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Oral Health Knowledge Practices and Dental Service Utilization among Adults in Rural and Urban Communities in Bayelsa State, Nigeria

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ABSTRACT

Background: *Oral diseases had remained a major public health concern in Sub-Saharan Africa, where limited oral health knowledge, inappropriate hygiene practices, sociocultural misconceptions and inadequate access to professional dental services had contributed to preventable oral morbidity. This study assessed and compared oral health information, practices and dental service utilization among adults in rural and urban communities in Bayelsa State, Nigeria.*

Method: *A community-based comparative cross-sectional study was conducted among 355 adults aged 18–65 years, comprising 177 urban and 178 rural respondents selected through a multistage sampling technique. Data were collected using a structured interviewer-administered questionnaire, while respondents demonstrated their toothbrushing techniques using a dental model. No clinical oral examination was conducted. The questionnaire demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.70. Data were managed using Microsoft Excel and analysed using IBM SPSS Statistics version 23 and STATA. Frequencies and percentages were calculated, while Pearson's chi-square test, Yates' continuity correction and Fisher's exact test were applied as appropriate. Statistical significance was determined at $p < 0.05$.*

Results: *Radio and television were the leading sources of oral health information in both settings. Only 38.6% of respondents identified bacteria as a cause of tooth decay, while 34.4% attributed it to worms and 7.3% attributed it to deities, witches or wizards. Knowledge of bacterial causation was significantly higher among urban respondents (53.7%) than rural respondents (23.6%; $p < 0.001$). Only 13.8% correctly stated that fluoride prevented tooth decay, while 76.6% did not know what dental plaque was. Toothbrush use was significantly higher among urban respondents than rural respondents (59.3% versus 14.0%; $p < 0.001$), whereas chewing-stick use was substantially higher among rural respondents (53.9% versus 6.8%; $p < 0.001$). Rural respondents more frequently brushed only in the morning and demonstrated the horizontal brushing technique. Among respondents who had experienced toothache, drug use was more common among rural respondents, whereas visiting a dentist was more common among urban respondents ($p < 0.001$). Only 13.0% of all respondents had ever visited a dentist, and attendance was significantly higher among urban respondents (19.8%) than rural respondents (6.2%; $p < 0.001$). Pain accounted for 63.0% of dental visits, while only 19.6% were for routine check-ups. Lack of nearby dental clinics and absence of pain were prominent barriers among rural respondents, whereas lack of time predominated among urban respondents.*

Conclusion: *The study concluded that considerable rural–urban inequalities had existed in oral health knowledge, hygiene practices, toothache management and dental service utilization. Dental attendance had remained low and predominantly symptom-driven. Culturally appropriate oral health education, practical toothbrushing instruction, correction of misconceptions, integration of basic oral healthcare into primary healthcare and expanded rural dental outreach had been required.*

Keywords
Oral health information, Oral hygiene practices, Dental service utilization, Toothache management, Rural–urban disparities, Dental caries, Sub-Saharan Africa, Nigeria.

Introduction
Oral health was an essential component of general health and well-being. It influenced individuals' ability to eat, speak, communicate, work, and participate confidently in social activities. Poor oral health was associated with pain, discomfort, impaired nutrition, loss of productivity, social isolation, and a reduced quality of life. Despite its importance, oral health had often received less attention than other noncommunicable diseases, particularly in low- and middle-income countries. Peres et al. [1], reported that oral diseases were among the most prevalent diseases globally and imposed considerable health, social, and economic burdens on affected individuals and health systems.

The global burden of oral diseases had remained substantial. The World Health Organization reported that approximately 3.5 billion people had been affected by oral diseases in 2019, representing about 45% of the world's population. Approximately three-quarters of affected individuals had lived in low- and middle-income countries, where access to preventive and curative oral healthcare had remained limited. Untreated dental caries in permanent teeth had affected approximately 2.5 billion people, while severe periodontal disease, complete tooth loss, and oral cancers had also contributed considerably to the global disease burden [2]. Dental caries and periodontal diseases had been among the most frequently experienced oral conditions. Although these diseases had largely been preventable, their occurrence had been influenced by frequent consumption of free sugars, inadequate exposure to fluoride, poor oral hygiene, tobacco use, harmful alcohol consumption, and limited access to professional dental care. Oral diseases had also shared several modifiable risk factors with other noncommunicable diseases, including cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases. Consequently, preventive oral health practices had represented an important component of the broader approach to preventing noncommunicable diseases [2].

Access to accurate oral health information had influenced individuals' knowledge, attitudes, preventive practices, and decisions to seek professional care. Information obtained through health workers, schools, community programmes, radio, television, social media, family members, and friends had the potential to improve awareness of the causes and prevention of oral diseases. However, inaccurate information and culturally established misconceptions had sometimes encouraged ineffective or harmful practices. Knowledge of dental plaque, the role of bacteria in dental caries, the benefits of fluoride toothpaste, the effects of sugar consumption, and the importance of regular dental examinations had therefore been necessary for effective disease prevention. Oral health literacy had also influenced people's ability to obtain, understand, evaluate, and apply information concerning oral disease prevention and treatment. Individuals with adequate oral health literacy had generally been better positioned to adopt appropriate self-care practices and make informed decisions about professional treatment. Baskaradoss [3] found that oral health literacy had been related to oral health status, indicating that limitations in understanding oral health information could contribute to poorer outcomes. Nevertheless, access to information alone had not always resulted in appropriate practices because behaviour had also been affected by income, education, cultural beliefs, the availability of dental products, and access to dental facilities. Regular tooth cleaning with an appropriate toothbrush and fluoride toothpaste had been a central component of personal oral hygiene. Other practices had included the use of dental floss, chewing sticks, mouth rinses, charcoal, salt, sand, alum, and locally available materials. Some traditional cleaning methods had remained common within African communities because they had been affordable, culturally familiar, and readily available. Research conducted in parts of Nigeria had demonstrated the continued use of both traditional and emerging oral hygiene practices, highlighting the need for interventions that considered existing cultural behaviour while promoting scientifically appropriate methods [4]. The effectiveness of tooth cleaning had depended not only on the material used but also on the frequency, timing, duration, and technique of brushing. Brushing twice daily with fluoride toothpaste and replacing a worn toothbrush regularly had been important preventive practices. Nevertheless, individuals had differed considerably in their brushing frequency, technique, choice of cleaning materials, and reasons for using or avoiding toothbrushes and toothpaste. Financial limitations, lack of time, forgetfulness, preference for chewing sticks, and limited knowledge of the benefits of fluoride had influenced these practices. Toothache had been one of the most recognisable consequences of untreated oral disease and had often motivated individuals to seek treatment. However, responses to toothache had varied widely. Some individuals had visited dental professionals, whereas others had relied on self-medication, pharmacies, traditional healers, herbal preparations, household substances, or other informal remedies. Delayed professional treatment had allowed disease progression and increased the likelihood of infection, tooth loss, more complicated treatment, and higher treatment costs. Such treatment choices had reflected differences in knowledge, beliefs, financial capacity, perceived severity, and access to dental facilities. Dental service utilization had remained low in many low- and middle-income settings. Dental visits had commonly occurred in response to pain or an established oral problem rather than for preventive examination. A Nigerian study showed that although many adults had rated their oral health positively, the majority had reported poor dental service utilization [5]. More recent qualitative evidence from Nigeria had similarly indicated that oral healthcare seeking had often been delayed and reactive and had been shaped by financial, sociocultural, and health-system factors [6]. Several barriers had limited the use of professional dental services. These had included the cost of care, fear of dental procedures, lack of time, absence of perceived need, unfavourable previous experiences, distance to dental facilities, and shortages of oral healthcare professionals.

Uguru et al. [7] found that the location and number of oral health facilities, treatment costs, human-resource availability, equipment, government funding, and public awareness had affected access to dental caries treatment in Nigeria. These barriers had been especially relevant in communities where dental services were concentrated in urban centres.

Rural–urban inequalities had represented an important dimension of oral health. Rural populations had often experienced lower health literacy, limited access to fluoridated dental products, fewer dental facilities, longer travel distances, lower income, and reduced health-insurance coverage. Ogunbodede et al. [8] observed that rural populations were more likely to experience socioeconomic disadvantage, lower oral health literacy, greater tooth loss, and reduced access to dental care than urban populations. Urban residents had generally experienced better physical access to dental facilities and oral health information, although treatment costs, time constraints, fear, and reliance on self-medication had continued to limit appropriate service utilization. In Nigeria, disparities in the distribution of dental professionals and facilities had affected equitable access to oral healthcare. These disparities had been particularly relevant in riverine and geographically difficult settings such as Bayelsa State, where some communities had experienced transportation challenges and limited availability of specialised health services. Rural and urban residents might therefore have differed in their exposure to oral health information, knowledge of oral disease prevention, choice of oral hygiene materials, management of toothache, and utilization of professional dental services. Although previous studies had examined individual aspects of oral health knowledge, behaviour, and service utilization, limited community-based comparative evidence had simultaneously assessed oral health information, hygiene practices, toothache management, and dental service utilization among rural and urban adults in the study setting. A clearer understanding of these patterns had been necessary for designing context-specific oral health education, community outreach, preventive programmes, and accessible dental services. Therefore, this study assessed oral health information, practices, and dental service utilization among adults in rural and urban communities in Bayelsa State, Nigeria.

Statement of the Problem

Oral diseases had remained a major public health problem despite being largely preventable. Dental caries, periodontal diseases, tooth loss, oral infections, and dental pain had affected people's ability to eat, speak, work, and interact socially. The World Health Organization estimated that oral diseases had affected approximately 3.5 billion people worldwide, with about three-quarters of affected individuals living in low- and middle-income countries [2]. Nevertheless, oral health had continued to receive limited attention within many health systems in Sub-Saharan Africa. Limited access to accurate oral health information had contributed to misconceptions about the causes and prevention of oral diseases. Some adults had attributed dental caries to worms or supernatural causes, while many had possessed inadequate knowledge of dental plaque, fluoride, sugar restriction, and routine dental examinations. Although oral health information had been available through health workers, mass media, schools, relatives, and community programmes, unequal exposure to these sources might have produced differences in oral health knowledge and behaviour between rural and urban residents. Oral hygiene practices had also varied considerably. While some adults had used toothbrushes and fluoride toothpaste, others had relied on chewing sticks, charcoal, sand, salt, alum, or broomsticks. Tooth-cleaning practices had further differed in frequency, timing, duration, technique, and toothbrush replacement. Some of these methods might not have provided adequate protection against oral diseases, particularly when they had been used incorrectly or without fluoride. Financial constraints, lack of time, forgetfulness, cultural preferences, and limited knowledge had influenced the selection of oral hygiene materials and practices. The management of toothache had presented an additional concern. Rather than seeking timely professional dental care, some affected individuals had used self-medication, herbal remedies, petroleum products, topical preparations, or other informal treatments. Such practices might have temporarily reduced symptoms without addressing the underlying disease. Delayed treatment had increased the likelihood of disease progression, infection, avoidable tooth loss, complicated dental procedures, and higher treatment costs. Dental service utilization had remained low and predominantly problem-driven. Many individuals had visited dental facilities only when they experienced severe pain, while routine preventive dental examinations had been uncommon. Treatment costs, fear of dental procedures, lack of time, absence of nearby dental clinics, low perceived need, and dissatisfaction with dental services had discouraged professional care. These barriers had been particularly important in rural and riverine communities, where geographical isolation, transportation difficulties, and the limited distribution of dental facilities had restricted access. Differences in infrastructure, education, exposure to health information, income, and availability of dental services might have produced distinct oral health experiences among rural and urban adults. However, there had been limited community-based comparative evidence that simultaneously examined oral health information, knowledge, hygiene practices, toothache management, and dental service utilization among rural and urban populations in the study setting. The absence of such evidence had limited the capacity of policymakers and programme managers to design targeted oral health education, community outreach, preventive interventions, and equitable dental services. Therefore, this study assessed and compared oral health information, practices, and dental service utilization among adults in rural and urban communities in Bayelsa, Nigeria. The findings were expected to identify knowledge gaps, inappropriate practices, barriers to professional care, and rural–urban inequalities requiring targeted public health interventions.

Justification for the Study

Oral diseases had constituted a substantial but often neglected public health problem, particularly in low- and middle-income countries. Although many oral conditions had been preventable

through appropriate information, effective oral hygiene practices, reduced sugar consumption, fluoride use, and timely professional care, considerable gaps had persisted in people's knowledge and behaviour. This study was therefore necessary to provide evidence on how adults obtained oral health information and how such information related to their oral hygiene practices and treatment-seeking behaviour. The study was justified by the continued use of inappropriate or potentially harmful methods for managing toothache. Self-medication, traditional remedies, petroleum products, and other informal treatments might temporarily relieve symptoms without treating the underlying oral disease. Identifying these practices was important for developing health-education interventions that encouraged safe self-care and timely presentation at dental facilities. The study was also necessary because dental service utilization had remained low and largely driven by pain rather than preventive care. Treatment costs, fear of dental procedures, lack of time, low perceived need, and the absence of nearby dental facilities had discouraged routine dental visits. Assessing these barriers would provide evidence for improving the accessibility, acceptability, and affordability of oral healthcare services. Comparing rural and urban adults was particularly important because their exposure to oral health information, availability of hygiene products, transportation conditions, socioeconomic circumstances, and access to dental facilities differed. Rural residents might experience greater geographical and service-related barriers, while urban residents might face financial and time-related constraints despite living closer to dental facilities. The comparison would help to identify inequalities that could be overlooked when rural and urban populations were analysed together. Furthermore, the study was on account of limited community-based evidence that had simultaneously examined oral health information, knowledge, hygiene practices, toothache management, and dental service utilization among adults in the study setting. The findings would therefore provide baseline information for oral health programme planning, community education, preventive outreach, resource allocation, and the appropriate distribution of dental services. The results would be useful to policymakers, public health authorities, dental professionals, primary healthcare managers, community leaders, and health educators. They would support the design of targeted interventions, including rural dental outreach, mass-media education, promotion of fluoride toothpaste, routine dental examinations, and integration of basic oral healthcare into primary healthcare services. The study would also contribute to the existing literature on rural–urban oral health inequalities and provide a foundation for further research in comparable Sub-Saharan African settings.

Research Questions

1. What were the major sources of oral health information among adults in rural and urban communities?
2. What was the level of respondents' knowledge of the causes and prevention of dental caries?
3. What oral hygiene materials and practices were used by adults in rural and urban communities?
4. What methods were used by respondents to manage toothache?
5. What were the patterns of dental service utilization among the respondents?
6. What factors influenced respondents' use or non-use of toothbrushes and toothpaste?
7. What barriers prevented respondents from utilizing professional dental services?
8. Were there significant differences in oral health information, practices, toothache management, and dental service utilization between rural and urban adults?

General Objective

To assess and compare oral health information, practices, and dental service utilization among adults in rural and urban communities in Bayelsa State, Nigeria.

Specific Objectives

1. To identify and compare the sources of oral health information among adults in rural and urban communities.
2. To assess respondents' knowledge of the causes and prevention of dental caries.
3. To determine respondents' knowledge of dental plaque and the preventive function of fluoride in toothpaste.
4. To examine and compare the oral hygiene materials and practices used by rural and urban adults.
5. To identify the reasons for the use or non-use of toothbrushes and toothpaste among respondents.
6. To determine and compare the methods used by rural and urban respondents to manage toothache.
7. To assess the pattern of dental service utilization among adults in rural and urban communities.
8. To identify the reasons for visiting or not visiting a dentist.
9. To determine whether significant rural–urban differences existed in oral health knowledge, hygiene practices, toothache management, and dental service utilization.

Research Hypotheses

The following null hypotheses were formulated and tested at the 5% level of statistical significance ($p < 0.05$):

H_0: There were no statistically significant differences in oral health information, knowledge, oral hygiene practices, toothache management, and dental service utilization between adults in rural and urban communities.

Scope and Limitation of the Study

Scope of the Study

1. **Subject scope**: The study assessed oral health information, oral hygiene practices, toothache management, and dental service utilization among adults in selected rural and urban communities.
2. **Study population**: The study included 355 adults aged 18–65 years, comprising 177 urban and 178 rural respondents.
3. **Geographical scope**: The study was conducted in selected rural and urban communities across the three senatorial districts of Bayelsa State, Nigeria. The specific names of the

communities were withheld to preserve the anonymity of the study locations.

4. **Oral health information**: The study examined respondents' exposure to oral health information and the sources through which such information was obtained.
5. **Oral health knowledge:** Respondents' knowledge of the causes and prevention of dental caries, the meaning and consequences of dental plaque, and the preventive function of fluoride in toothpaste was assessed.
6. **Oral hygiene materials**: The study assessed the materials used for cleaning the teeth, including toothbrushes, chewing sticks, dental floss, charcoal, sand, salt, alum, and other locally available materials.
7. **Oral hygiene practices**: The study examined tooth-cleaning frequency, time of brushing, duration of brushing, toothbrush replacement, and toothbrushing technique.
8. **Assessment of toothbrushing technique**: Respondents demonstrated their usual toothbrushing techniques using a dental model. The demonstrated techniques were observed and classified according to the predetermined categories in the study instrument.
9. **Use of toothbrushes and toothpaste**: The study examined respondents' reasons for using or not using toothbrushes and toothpaste.
10. **Toothache management**: It assessed the methods used by respondents to manage toothache, including professional care, medicines, self-treatment, and locally available remedies.
11. **Dental service utilization**: The study examined where respondents sought treatment for toothache, whether they had visited a dentist, their reasons for visiting, and the barriers that prevented dental attendance.
12. **Rural–urban comparison**: Oral health information, knowledge, hygiene practices, toothache management, and dental service utilization were compared between rural and urban respondents.
13. **Analytical scope**: Descriptive statistics were used to summarise the data, while Pearson's chi-square test, Yates' continuity correction and, where appropriate, Fisher's exact test was used to examine associations between place of residence and the selected variables. Statistical significance was determined at $p < 0.05$.

Limitations of the Study

1. **Cross-sectional design**: Data were collected at one point in time. Therefore, the study identified associations but could not establish causal relationships or determine changes in oral health behaviour over time.
2. **Self-reported information**: Most of the information was based on respondents' accounts and might have been affected by recall bias. Participants might not have accurately remembered their exposure to oral health information, toothache experiences, previous treatment methods, or dental visits.
3. **Social-desirability bias**: Respondents might have provided answers they considered socially acceptable, particularly regarding tooth-cleaning frequency, toothpaste use, and dental service utilization.
4. **Absence of clinical examination**: The study did not include clinical oral examinations using dental probes, mouth mirrors, pen torches, radiographs, or other diagnostic procedures. Consequently, the presence and severity of dental caries, periodontal disease, and other oral conditions could not be clinically established.
5. **Dental-model demonstration**: Respondents demonstrated their toothbrushing techniques using a dental model. Although this provided a practical assessment of brushing methods, the demonstration might not have fully reproduced their routine toothbrushing behaviour at home.
6. **Observation effect**: Some respondents might have modified their usual brushing techniques because they knew that the researchers were observing them. This could have resulted in a more careful or socially desirable demonstration than their normal practice.
7. **Limitations of the dental model**: A dental model did not completely reproduce the conditions of brushing inside the mouth. It could not adequately capture factors such as brushing pressure, access to difficult areas, duration, dexterity, gum sensitivity, toothpaste quantity, or rinsing practices.
8. **Multiple-response questions**: Some questions permitted more than one response. Therefore, percentages within these categories might not have totalled 100%.
9. **Small response categories**: Some response options contained relatively few respondents. This reduced the statistical power of certain comparisons and required continuity corrections (Yates's correction) or cautious interpretation of the findings.
10. **Geographical generalizability**: The study was limited to selected communities in Bayelsa State. Although the setting shared some characteristics with other Sub-Saharan African communities, the findings could not be generalised directly to the entire region.
11. **Unmeasured factors**: Household income, distance to dental facilities, transportation costs, health insurance coverage, service quality, and availability of dental professionals were not comprehensively measured. These factors might have influenced oral health practices and dental service utilization.
12. **Limited assessment of behaviour over time**: The study assessed reported current practices and previous service utilization but did not follow respondents prospectively to determine whether exposure to oral health information resulted in sustained behavioural change.

Literature Review

Theoretical Framework

This study was guided by the *Health Belief Model* and *Andersen's Behavioural Model of Health Service Use*. The two models provided complementary explanations of oral health behaviour. The *Health Belief Model* explained how individuals' knowledge, beliefs, perceived risks, expected benefits, and perceived barriers influenced preventive oral health practices. Andersen's model explained how personal characteristics, available resources, and

perceived or evaluated healthcare needs influenced the utilization of professional dental services.

Health Belief Model

The *Health Belief Model* was originally developed to explain why individuals accepted or rejected preventive health services. It proposed that health-related behaviour depended on individuals' perceptions of their susceptibility to a condition, its seriousness, the benefits of taking preventive action, and the barriers that could prevent such action. Cues to action and self-efficacy were subsequently incorporated into the model to explain what stimulated behaviour and whether individuals believed they could successfully perform the recommended action [9]. The principal constructs of the *Health Belief Model* included perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. Perceived susceptibility explains individual's belief about the likelihood of developing an oral disease. Adults who understood that inadequate tooth cleaning, frequent consumption of sugar, dental plaque, and failure to use fluoride toothpaste increased their risk of dental caries might have been more likely to practise appropriate oral hygiene. Conversely, respondents who attributed dental caries to worms, supernatural forces, or unrelated causes might not have considered themselves personally susceptible through modifiable behaviours. Perceived severity emphasizes an individual's assessment of the seriousness and possible consequences of an oral health condition. Toothache, gum inflammation, mouth odour, tooth mobility, infection, difficulty eating, and eventual tooth loss might have increased the perceived seriousness of oral diseases. Individuals who regarded dental pain as temporary or believed that treatment was unnecessary in the absence of pain might have underestimated the severity of untreated oral disease and delayed professional care. Perceived benefits represented beliefs about the effectiveness of recommended actions in preventing or controlling oral diseases. In this study, such actions included cleaning the teeth regularly, using a toothbrush and fluoride toothpaste, restricting sugar consumption, replacing toothbrushes at appropriate intervals, employing suitable brushing techniques, attending routine dental examinations, and seeking professional treatment for toothache. Adults who believed that these practices prevented dental caries or maintained clean and healthy teeth were expected to adopt them more consistently. Perceived barriers explain the practical, psychological, financial, cultural, or structural difficulties that discouraged preventive behaviour or treatment seeking. The barriers examined in this study included lack of money, lack of time, forgetfulness, preference for chewing sticks, high treatment costs, fear of dental procedures, absence of nearby dental clinics, and dislike of dental facilities. These barriers might have discouraged the use of toothbrushes and toothpaste or prevented individuals from visiting dental professionals even when they experienced an oral health problem. The cues to action represented internal or external events that stimulated individuals to take action. Internal cues might have included toothache, dental discomfort, mouth odour, tooth mobility, or visible dental problems. External cues included oral health information received from health workers, radio, television, schools, community programmes, family members, friends, and other communication channels. Exposure to reliable oral health information might have encouraged improved hygiene practices or dental visits, while pain might have triggered curative rather than preventive service use. Self-efficacy reinforced the individuals' confidence in their ability to perform a recommended behaviour successfully. It included confidence in brushing correctly, brushing at the recommended frequency, using fluoride toothpaste, replacing a toothbrush regularly, obtaining professional care, and maintaining appropriate oral hygiene despite financial or environmental constraints. Rosenstock et al. [9] identified self-efficacy as an important element in achieving sustained behavioural change. The *Health Belief Model* suggested that adults were more likely to practise appropriate oral hygiene and seek dental care when they believed that they were susceptible to oral diseases, considered the consequences serious, recognised the benefits of preventive action, encountered manageable barriers, received appropriate cues to action, and felt capable of undertaking the required behaviour. Health messages were therefore more likely to promote behavioural change when they addressed benefits, barriers, risks, and self-efficacy [10]. In this study, the model was used to explain respondents' knowledge of dental caries, dental plaque and fluoride; their reasons for using or not using toothbrushes and toothpaste; their choice of tooth-cleaning materials; the frequency and technique of toothbrushing; the methods used to manage toothache; and their decisions to seek professional dental care.

Andersen's Behavioural Model of Health Service Use

Andersen's Behavioural Model was developed to explain variations in the use of health services and to assess whether access to healthcare was equitable. The model proposed that healthcare utilization was determined by three principal groups of factors: predisposing characteristics, enabling resources, and need factors [11]. The model was subsequently applied extensively in health-service research, including studies of dental service utilization [12,13]. Predisposing characteristics were individual attributes that existed before the occurrence of illness and influenced the tendency to use health services. These included age, sex, marital status, ethnicity, education, employment, health knowledge, attitudes, cultural beliefs, and previous health practices. In this study, adults' sociodemographic characteristics and their knowledge of the causes and prevention of dental caries might have influenced whether they regarded dental services as necessary and acceptable. Education might also have affected their ability to understand oral health information and navigate available services. Enabling resources explains the personal, household, community, and health-system resources that facilitated or restricted access to services. Relevant enabling factors included income or employment, affordability of treatment, availability of dental facilities, proximity and transportation to clinics, time available to seek care, and exposure to oral health information. Place of residence was particularly important because rural and urban communities might have differed in the availability of dental clinics, transportation, oral health personnel, health

information, and dental hygiene products. In rural and riverine settings, long travel distances, transportation difficulties and the limited distribution of dental facilities might have discouraged professional dental visits. In urban settings, services might have been geographically closer, but high costs, work commitments, waiting time, or reliance on pharmacies and self-medication might still have limited utilization. Enabling resources therefore helped to explain why individuals with similar oral healthcare needs might have displayed different patterns of service use. The need factors represented the most immediate reasons for seeking healthcare. Andersen [11] distinguished between perceived need and evaluated need. Perceived need referred to how individuals interpreted their symptoms and considered whether professional treatment was necessary. Evaluated need referred to a health professional's clinical assessment of the presence and severity of disease. The present study principally considered perceived need because respondents reported their own experiences and reasons for seeking or avoiding dental care. Toothache, pain, mouth odour, tooth mobility, and other perceived oral problems could create a need for treatment. However, individuals who did not experience pain might believe that a dental visit was unnecessary, even when an asymptomatic condition was present. The model therefore explained why dental visits were often symptom-driven rather than preventive. Previous applications of Andersen's model to oral healthcare demonstrated that predisposing characteristics, enabling resources, and perceived or evaluated need influenced dental service utilization [13,14]. Within the present study, the outcome component of Andersen's model was represented by whether respondents had visited a dentist, where they sought treatment for toothache, their reasons for visiting a dentist, and their reasons for not using dental services. The model also supported the comparison of rural and urban populations by recognising that contextual and enabling conditions could produce inequalities in dental service utilization.

Integration of the Two Models

The integration of the *Health Belief Model* and *Andersen's Behavioural Model* provided a broader explanation of the study outcomes than either model could provide independently. The *Health Belief Model* focused primarily on individuals' knowledge, perceptions, motivation, and preventive behaviour, whereas *Andersen's model* addressed the personal, economic, contextual, and need-related conditions that shaped service utilization. The integrated framework proposed that exposure to oral health information could shape knowledge and beliefs about oral disease. These beliefs could influence oral hygiene practices and how individuals responded to toothache. However, the decision to use professional dental services could also depend on sociodemographic characteristics, financial resources, availability of facilities, place of residence, and perceived treatment needs. Accordingly, an individual might understand the benefits of professional dental treatment but fail to use dental services because treatment was unaffordable or no dental clinic was available nearby. Conversely, an individual might have access to a dental facility but avoid it because of fear, low perceived susceptibility, absence of pain, or limited appreciation of preventive dental care. The combined framework therefore recognised that oral health behaviour resulted from interactions among personal beliefs, health information, social circumstances, enabling resources, perceived need, and healthcare accessibility. The framework guided the selection and interpretation of the study variables. It supported the assessment of rural–urban differences in oral health information, knowledge, hygiene practices, toothache management, and dental service utilization. It also provided a basis for recommending interventions that addressed both individual behaviour and structural barriers, including targeted oral health education, improved self-efficacy, affordable dental care, community outreach, and equitable distribution of oral health services.

Conceptual Framework of the Study

The conceptual framework explained how oral health information, sociocultural beliefs, place of residence, oral hygiene practices, toothache experience, and access-related factors interacted to influence dental service utilization among adults in rural and urban communities. The framework proposed that the respondents' oral health information and knowledge shaped their understanding of the causes, prevention, and appropriate treatment of dental caries and toothache. Accurate information obtained from health professionals, the media, schools, community programmes, relatives, or friends could improve knowledge of the relationship between diet, dental plaque, bacteria, poor oral hygiene, and dental caries. Conversely, limited or inaccurate information could encourage misconceptions, including beliefs that toothache was caused by worms or punishment for offences committed against deities. These beliefs could influence respondents' oral hygiene practices. The study population used different materials to clean their teeth, including toothbrushes and toothpaste, chewing sticks, charcoal, sand, salt, alum, and dental floss. Chewing-stick use was particularly common and appeared to be more prevalent among rural residents. The choice of cleaning material could be influenced by cultural familiarity, affordability, availability, education, knowledge of fluoride, and access to modern oral hygiene products. Oral health outcomes could also be affected by the frequency, timing, duration, and technique of tooth cleaning. Inadequate oral hygiene practices and limited knowledge of disease prevention could contribute to oral health problems, including dental caries and toothache. However, the occurrence of toothache did not necessarily lead directly to professional treatment. Respondents interpreted dental pain according to their knowledge, cultural beliefs, perceived seriousness of the condition, previous experiences, and available resources. Consequently, people adopted different toothache-management practices. Some sought professional dental care, whereas others used self-medication or informal remedies such as petroleum products, locally prepared "Touch & Go," Bonjela, aloe vera gel, herbal preparations, and other household substances. The selected treatment approach could provide temporary relief without addressing the underlying cause of the pain [15]. Reliance on informal remedies could therefore delay diagnosis and appropriate treatment. The framework further proposed that dental service utilization was influenced

by perceived need. Pain served as a major trigger for visiting a dental clinic, while the absence of pain reduced the perceived need for professional care. Consequently, dental attendance was predominantly curative and symptom-driven, and only a small proportion of respondents attended dental facilities for routine check-ups or preventive services. The decision to use dental services was also shaped by predisposing, enabling, and access-related factors. Predisposing factors included age, sex, education, employment, ethnicity, knowledge, and cultural beliefs. Enabling factors included income, treatment costs, availability of dental facilities, transportation, time, exposure to oral health information, and access to toothbrushes and fluoride toothpaste. Need factors included toothache, perceived severity, tooth mobility, mouth odour, and other oral symptoms. Place of residence operated as an important contextual factor. Rural residents might have had less exposure to professional oral health information, fewer dental facilities, longer travel distances, limited availability of modern oral hygiene products, and stronger reliance on traditional beliefs and remedies. Urban residents might have had better physical access to dental facilities and oral health products, although high treatment costs, lack of time, fear of treatment, and preference for pharmacies or self-medication could still limit their use of professional services.

Materials and Methods

Study Design

The study adopted a community-based comparative cross-sectional design. Quantitative data were collected from adults residing in selected rural and urban communities at a defined period. The design enabled the assessment and comparison of oral health information, knowledge, oral hygiene practices, toothache management, clinical oral conditions, and dental service utilization among rural and urban respondents. Data were collected using a structured interviewer-administered questionnaire, clinical oral examination, and practical demonstration of toothbrushing techniques. Clinical oral examinations were conducted using dental probes, mouth mirrors, and pen torches, while respondents demonstrated their usual brushing techniques using a dental model. The comparative design also enabled the researchers to examine associations between place of residence and the selected oral health variables.

Study Area

The study was conducted in selected rural and urban communities in Bayelsa State, located in the Niger Delta region of southern Nigeria. The state consisted of eight local government areas distributed across three senatorial districts: Bayelsa Central, Bayelsa East, and Bayelsa West. Bayelsa State had predominantly riverine terrain, with several communities surrounded by rivers, creeks, wetlands, and other water bodies. Transportation in many rural areas depended substantially on boats and other forms of water transport. These geographical conditions affected access to healthcare services, particularly in remote and hard-to-reach communities. Healthcare services in the state were provided through primary, secondary, tertiary, and private health facilities. However, dental personnel and specialised oral healthcare services were more concentrated in urban centres. Residents of some rural communities travelled considerable distances to access professional dental care. Rural and urban communities were included to permit comparison of oral health information, hygiene practices, clinical oral conditions, toothache management, and dental service utilization across different residential settings. The selected communities were drawn from the three senatorial districts to enhance geographical representation. However, their specific names were withheld to maintain the anonymity of the study locations.

Study Population

The study population comprised adults aged 18–65 years who resided in the selected rural and urban communities across the three senatorial districts of Bayelsa State. Eligible participants included men and women who had lived in their respective communities for the minimum residential period specified in the study protocol and who provided informed consent. A total of 355 respondents participated in the study. Of these, 177 were selected from urban communities and 178 from rural communities. The participants represented different sociodemographic groups based on sex, age, marital status, ethnicity, educational attainment, and employment status. The study population was appropriate because adults were responsible for making decisions concerning their oral hygiene, management of toothache, and use of dental services. Information was obtained on their exposure to oral health messages, knowledge of dental caries and dental plaque, use of oral hygiene materials, toothbrushing practices, approaches to toothache management, and dental service utilization. Participants also underwent clinical oral examination and demonstrated their toothbrushing techniques using a dental model.

Sampling Technique

A multistage sampling technique was used to select respondents from rural and urban communities across the three senatorial districts of Bayelsa State. In the first stage, the state was stratified into its three senatorial districts: Bayelsa Central, Bayelsa East, and Bayelsa West. This ensured that the major geographical divisions of the state were represented. In the second stage, rural and urban areas within the senatorial districts were identified based on the official administrative classification of the communities. The communities were subsequently grouped into rural and urban strata to permit comparison between the two residential populations. In the third stage, eligible rural and urban communities were selected from the respective strata using simple random sampling. The names of the selected communities were withheld to maintain the anonymity of the study locations. In the fourth stage, households within the selected communities were identified and selected using a systematic sampling procedure. The sampling interval was determined by dividing the estimated number of households in each selected community by the number of households required from that community. A random starting household was selected, after which subsequent households were approached according to the calculated interval. In each selected household, adults aged 18–65

years were screened for eligibility. Where more than one eligible adult was present, one respondent was selected through simple balloting to prevent overrepresentation of larger households. When an eligible respondent declined participation or was unavailable after the prescribed follow-up visits, the non-response was recorded and managed according to the study protocol. The final sample was allocated almost equally between the two residential strata to support rural–urban comparison. Consequently, 177 respondents were selected from urban communities and 178 from rural communities, giving a total sample of 355 participants.

Sample Size Determination

In a study [16] carried out in Nigeria, showed the prevalence of dental caries to be 30%. Here in Bayelsa State, there was no documented study of the prevalence of dental caries, thus 30% prevalence is assumed for the statistical calculation of the sample size.

The sample size of my research work is as follows:

$$\text{Formula, } n_o = \frac{Z^2 P (1-P)}{d^2}$$

Where:
n_o = minimum required sample size
Z = corresponding table value for confidence interval
P = estimated proportion of the characteristic in the population, which was 1.96
1-p = 0.70

d = desired margin of error, which was 0.05

Substituting the values:

$$n_o = \frac{(1.96)^2 (0.30) (0.70)}{(0.05)^2}$$

$$n = \frac{3.8416 \times 0.21}{0.0025}$$

$$n_o = \frac{0.806736}{0.0025} = 322.69 \approx 323$$

The initial minimum sample size was therefore approximately 323 respondents.

To compensate for possible non-response, incomplete questionnaires, or withdrawal, a non-response adjustment factor of 1.10 was applied.

$n_f = n_o \times 1{,}10$
$n_f = 323 \times 1.10 = 355.3$

The final sample size was approximated to 355 respondents. This was distributed almost equally between the study groups, comprising 177 urban respondents and 178 rural respondents.

Selection Criteria

Inclusion Criteria

Participants were included in the study if they met the following criteria:

1. Adults aged 18–65 years.
2. Permanent residents of the selected rural or urban communities in Bayelsa State.
3. Individuals who had resided in the selected community for at least six months before data collection.
4. Men and women who were available during the period of data collection.
5. Individuals who were able to understand and respond to the questionnaire in English or the local language.
6. Individuals who voluntarily provided written or verbal informed consent to participate.
7. Individuals who agreed to complete the interviewer-administered questionnaire.
8. Individuals who consented to the clinical oral examination using dental probes, mouth mirrors, and pen torches.
9. Individuals who agreed to demonstrate their usual toothbrushing technique using a dental model.

Exclusion Criteria

The following individuals were excluded from the study:

1. Persons younger than 18 years or older than 65 years.
2. Visitors, temporary residents, and individuals who had lived in the selected community for less than six months.
3. Individuals who declined or were unable to provide informed consent.
4. Individuals who were seriously ill or medically unstable at the time of data collection.
5. Individuals with cognitive, communication, or mental health conditions that prevented them from understanding the questions or providing reliable responses.
6. Individuals who declined the questionnaire, clinical oral examination, or toothbrushing demonstration.
7. Eligible residents who were unavailable after the specified follow-up visits.
8. Individuals who had already participated in the study in another selected household or community.
9. Questionnaires with substantial missing information that could not be resolved during data checking.

Method of Data Collection

Data were collected using a structured interviewer-administered questionnaire and a practical demonstration of toothbrushing techniques using a dental model. No clinical oral examination was conducted, and dental probes, mouth mirrors or pen torches were not used. The questionnaire was developed in accordance with the research questions, objectives, theoretical framework and conceptual framework of the study. It was organised into sections

that assessed respondents' sociodemographic characteristics, sources of oral health information, knowledge of dental caries and dental plaque, oral hygiene materials and practices, methods of managing toothache, and dental service utilization. Trained research assistants administered the questionnaire through face-to-face interviews. Questions were presented in English and explained in the respondents preferred local language where necessary to ensure adequate understanding. Interviews were conducted privately to maintain confidentiality and reduce the influence of other household or community members on the responses. Respondents were asked to demonstrate their usual toothbrushing techniques using a dental model. The demonstrated techniques were observed and classified according to the predetermined categories in the study instrument. This procedure enabled the researchers to assess toothbrushing methods through practical demonstration rather than relying solely on self-reported responses. Completed questionnaires were reviewed daily by the principal investigator for completeness, consistency, accuracy and legibility. Identified omissions or inconsistencies were resolved promptly where possible. Each respondent was assigned a unique identification number, while names and other direct personal identifiers were excluded from the questionnaires and analytical dataset.

Data Management and Analysis

Completed questionnaires were coded using a data-coding guide developed from the study variables. The data were initially entered into Microsoft Excel, where they were organised, cleaned and checked for missing values, duplicate records, coding errors, out-of-range values and internal inconsistencies. Microsoft Excel was also used to organise summary tables and prepare selected figures and charts. Following data cleaning, the dataset was exported to IBM SPSS Statistics version 23 and STATA for statistical analysis. SPSS version 23 was used for variable definition, data labelling, descriptive analysis, cross-tabulations and the principal inferential analyses. STATA was used to verify the statistical estimates and confirm the chi-square statistics, degrees of freedom and corresponding p-values. Categorical variables were summarised using frequencies and percentages. The analyses covered respondents' sociodemographic characteristics, sources of oral health information, knowledge of dental caries, dental plaque and fluoride, reasons for using or not using toothbrushes and toothpaste, materials used for cleaning the teeth, brushing frequency, timing, duration and technique, methods of managing toothache, and patterns of dental service utilization. Results were presented for the entire study population and separately for rural and urban respondents. For questions that allowed multiple responses, each response option was coded and analysed as a separate dichotomous variable. Consequently, the percentages for such questions were not expected to total 100%. Subgroup percentages were calculated using the appropriate number of eligible respondents as the denominator. Pearson's chi-square test was used to examine associations between respondents' place of residence and categorical study variables. Yates' continuity correction was applied to relevant two-by-two contingency tables when expected cell frequencies were small. Fisher's exact test was used where the assumptions of Pearson's chi-square test were not satisfied. The chi-square statistic, degrees of freedom and corresponding p-value were reported. Statistical significance was determined at the 5% level, and results with $p<0.05$ were considered statistically significant. Mendeley Reference Manager was used to organise the scholarly literature, store and retrieve relevant publications, insert in-text citations, remove duplicate references and generate the reference list in the required citation style. The anonymised electronic dataset and supporting research documents were stored on password-protected devices and were accessible only to authorised members of the research team.

Reliability and Validity Test

Reliability Test: The reliability of the questionnaire was assessed using Cronbach's alpha coefficient. The instrument was pretested among adults with characteristics similar to those of the main study population but who were not included in the final study. Responses from the pretest were coded and analysed to determine the internal consistency of the related questionnaire items. The instrument produced a Cronbach's alpha coefficient of 0.70, indicating an acceptable level of internal consistency. This showed that the items used to assess related aspects of oral health information, knowledge, practices, and dental service utilization demonstrated sufficient consistency for use in the study. The questionnaire was therefore considered reliable for collecting the required data.

Construct Validity: Construct validity was established by aligning the questionnaire items with the study objectives and the constructs of the *Health Belief Model* and *Andersen's Behavioural Model of Health Service Use*. Items relating to perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy were incorporated into the assessment of oral health knowledge and practices. Andersen's predisposing, enabling, and need-related factors guided the selection of items concerning sociodemographic characteristics, place of residence, access to oral health information, barriers to dental care, toothache experience, and dental service utilization. The questionnaire was organised into distinct domains covering oral health information, knowledge, oral hygiene practices, toothache management, and dental service utilization. This alignment ensured that the instrument adequately represented the theoretical concepts underlying the study.

Content Validity: Content validity was established through expert assessment of the questionnaire. The draft instrument was reviewed by professionals with expertise in dentistry, public health, epidemiology, behavioural science, and research methodology. The reviewers evaluated the relevance, clarity, adequacy, comprehensiveness, and appropriateness of the questions in relation to the research questions and specific objectives. Their comments were used to revise ambiguous expressions, remove repetitive items, improve the response options, and ensure adequate coverage of the study domains. The questionnaire was subsequently pretested in a population with characteristics similar to those of the main study population. Feedback obtained during

the pretest further supported the refinement of the questions before the instrument was used for the main data collection.

Criterion Validity: Criterion validity was assessed, where applicable, by comparing selected self-reported responses with directly observable behaviour. In particular, respondents reported toothbrushing techniques were compared with the techniques they demonstrated using a dental model. Agreement between the reported and demonstrated methods provided evidence of concurrent criterion validity for the assessment of toothbrushing technique. For the remaining domains, including previous toothache-management practices and dental service utilization, no independent clinical records or universally accepted gold-standard measures were available for direct comparison. Their validity was therefore supported mainly through expert review, pretesting, theoretical alignment, and the use of questions adapted from relevant oral health literature. Criterion validity should consequently be interpreted as applying principally to the toothbrushing-technique component of the instrument.

Ethical Consideration

1. **Institutional Consent:** Ethical clearance and institutional approval were obtained from the Ethics Committee of the Bayelsa State Primary Health Care Board before the commencement of the study. The approval was granted with reference number PHCB/AD/171/Vol.1/p.62. The research protocol, data-collection instrument, consent procedure, study objectives, sampling method, and measures for protecting participants were reviewed and approved. All study activities were conducted in accordance with the approved protocol and established ethical principles for research involving human participants.

2. **Community Consent**: Permission to conduct the study was obtained from the relevant community leaders and other authorised representatives of the selected rural and urban communities. The purpose, procedures, expected benefits, possible inconveniences, and duration of the study were explained to them. Community consent facilitated access to the selected communities and supported the orderly conduct of data collection. However, permission from community leaders did not replace the voluntary informed consent required from each participant.

3. **Individual Consent**: Individual informed consent was obtained from each eligible respondent before participation. The objectives and procedures of the study were explained in English or the preferred local language. Participants were informed that participation was voluntary and that they could decline to answer any question or withdraw from the study at any time without penalty or loss of any benefit. Respondents were also informed about the questionnaire and the demonstration of toothbrushing techniques using a dental model. Only individuals who understood the information provided and freely agreed to participate were enrolled. Privacy was maintained during data collection, while names and other direct personal identifiers were excluded from the analytical dataset. Completed questionnaires and electronic data were securely stored and accessed only by authorised members of the research team.

Timeline of the Study

1. **Research Planning and Proposal Development – May 2026**: Research planning and proposal development were undertaken in May 2026. During this period, the research problem was identified, relevant literature was reviewed, and the study objectives, research questions, design and methodology were developed. The data-collection instrument and implementation plan were also prepared.

2. **Institutional Consent – June 2026**: Ethical clearance and institutional approval were obtained from the Ethics Committee of the Bayelsa State Primary Health Care Board in June 2026. The approval was granted with reference number PHCB/AD/171/Vol.1/p.62. Permission to conduct the study was subsequently obtained from the appropriate authorities.

3. **Data-Collection Preparedness – July 2026**: Preparations for data collection were completed in July 2026. The questionnaire was reviewed and pretested, research assistants were selected and trained, and necessary revisions were made to the instrument. The sampling arrangements, community-entry procedures, logistics, field schedules and materials required for toothbrushing demonstrations were also finalised.

4. **Data Collection – August–September 2026**: Data were collected between August and September 2026 in the selected rural and urban communities. Eligible respondents were recruited after informed consent had been obtained. Trained research assistants administered the questionnaires and observed respondents' toothbrushing techniques using a dental model. Completed instruments were checked daily for completeness, accuracy and consistency.

5. **Report Writing and Dissemination – October 2026**: Data cleaning, analysis, interpretation and report writing were completed in October 2026. The findings were organised into tables and figures and compared with evidence from relevant literature. The final report was prepared for dissemination to relevant stakeholders and submission for scientific publication.

Results

Table 1 showed that 355 respondents participated in the study, comprising 177 urban and 178 rural residents. The sex distribution was nearly equal, with males representing 50.4% and females 49.6% of the total sample. There was no statistically significant difference in sex between the urban and rural groups ($\chi^2 = 0.003$, $p = 0.958$).

Table 1: Sociodemographic characteristics of respondents.

Variable	Category	Urban n = 177 Frequency (%)	Rural n = 178 Frequency (%)	Total =355 Frequency (%)	χ^2	df	p-value
Gender	Male	89 (50.3)	90 (50.6)	179 (50.4)	0.003	1	0.958
	Female	88 (49.7)	88 (49.4)	176 (49.6)			
Age	18-35 years	85 (48.0)	84 (47.2)	169 (47.6)	0.025	1	0.875
	36-65 years	92 (52.0)	94 (52.8)	186 (52.4)			
Marital status	Single	68 (38.4)	60 (33.7)	128 (36.1)	1.895	4	0.755
	Married	88 (49.7)	94 (52.8)	182 (51.3)			
	Divorced	5 (2.8)	8 (4.5)	13 (3.7)			
	Separated	8 (4.5)	10 (5.6)	18 (5.1)			
	Widowed	8 (4.5)	6 (3.4)	14 (3.9)			
Ethnic group	Izon	132 (74.6)	135 (75.8)	267 (75.2)	5.092	3	0.165
	Igbo	27 (15.3)	25 (14.0)	52 (14.6)			
	Yoruba	8 (4.5)	2 (1.1)	10 (2.8)			
	Others	10 (5.6)	16 (9.0)	26 (7.3)			
Employment	Self-Employment	57 (32.2)	70 (39.3)	127 (35.8)	3.421	2	0.181
	Gainfully employed	47 (26.6)	34 (19.1)	81 (22.8)			
	Unemployed	73 (41.2)	74 (41.6)	147 (41.4)			
Education level	Primary	44 (24.9)	49 (27.5)	93 (26.2)	32.714	2	<0.001
	Secondary	45 (25.4)	89 (50.0)	134 (37.7)			
	Tertiary	88 (49.7)	40 (22.5)	128 (36.1)			

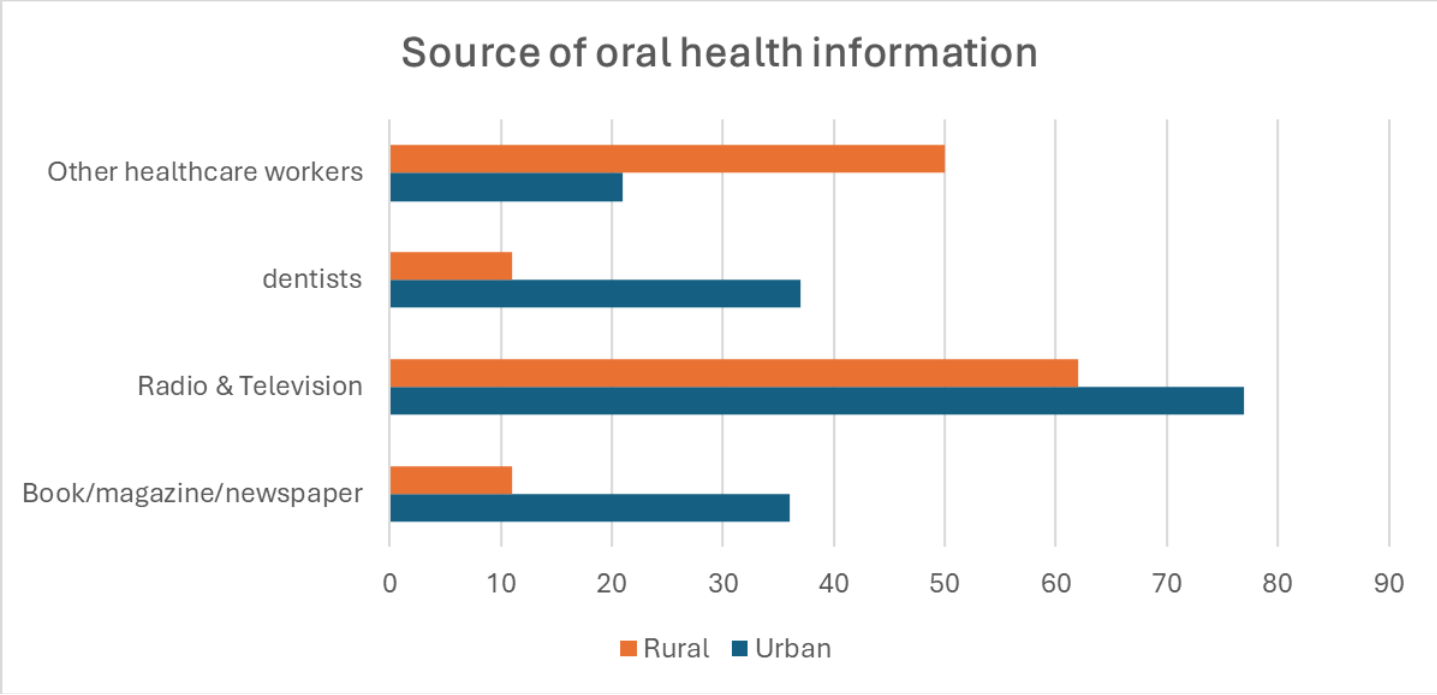


Figure 1: Source of oral health information among respondents.

Respondents aged 36–65 years constituted 52.4% of the sample, while those aged 18–35 years accounted for 47.6%. Age distribution was similar in both settings and did not differ significantly (χ^2 = 0.025, p = 0.875). More than half of the respondents were married (51.3%), while 36.1% were single. Divorced, separated and widowed respondents constituted relatively small proportions. Marital status did not differ significantly between urban and rural respondents (χ^2 = 1.895, p = 0.755). Most participants were Izon (75.2%), followed by Igbo (14.6%), other ethnic groups (7.3%) and Yoruba (2.8%). There was no significant rural–urban difference in ethnicity (χ^2 = 5.092, p = 0.165). Unemployed respondents constituted 41.4% of the sample, while 35.8% were self-employed and 22.8% were gainfully employed. Although self-employment was more frequent among rural respondents and gainful employment was more common among urban respondents, the overall difference was not statistically significant (χ^2 = 3.421, p = 0.181). Secondary education was reported by 37.7% of respondents, tertiary education by 36.1% and primary education by 26.2%. Tertiary education was more common among urban respondents, whereas secondary education was more frequent among rural respondents. The difference in educational attainment was statistically significant (χ^2 = 32.714, p < 0.001).

Figure 1 showed that radio and television were the leading sources of oral health information in both residential groups, reported by 77 urban and 62 rural respondents. Dentists provided information to 37 urban respondents but only 11 rural respondents. Books, magazines and newspapers followed a similar pattern, with 37 urban respondents compared with 11 rural respondents. Other health workers were a more important source of information among rural respondents, reported by 50 rural respondents compared with 21 urban respondents. Figure 1 therefore indicated that urban respondents had greater exposure to dentists and printed media, while rural respondents depended more heavily on other health workers. Radio and television offered the broadest communication channel across both settings.

Table 2 showed the methods used by 173 respondents to manage toothache, comprising 65 urban and 108 rural respondents. Drug use was the most common method overall, reported by 44.5% of affected respondents. It was substantially more common among rural respondents (60.2%) than urban respondents (18.5%), and the difference was statistically significant (χ^2 = 28.601, p < 0.001). Visiting a dentist was reported by 27.7% of respondents. This method was substantially more common among urban respondents (61.5%) than rural respondents (7.4%), and the difference was statistically significant (χ^2 = 59.310, p < 0.001). The use of locally prepared Touch & Go was reported by 10.4% of respondents, while petrol was used by 8.1%. Both practices were more common among rural respondents, although their rural–urban differences were not statistically significant. Petrol use approached statistical significance (p = 0.061), but it remained above the 0.05 threshold. Kerosene and Bonjela or aloe vera gel were each used by 4.6% of respondents. Their use did not differ significantly by residence. Overall, Table 2 indicated that rural respondents relied more heavily on medicines and informal remedies, whereas urban respondents were more likely to seek professional dental care.

Table 3 showed that 47.9% of respondents believed that food contributed to tooth decay. This knowledge was significantly more common among urban respondents (55.4%) than rural respondents (40.4%; χ^2 = 7.914, p = 0.005). Regarding the perceived cause of tooth decay, 38.6% correctly identified bacteria, while 34.4% attributed it to worms. The bacterial explanation was more common among urban respondents (53.7%) than rural respondents (23.6%; χ^2 = 33.877, p < 0.001). Conversely, belief in worms was substantially more common among rural respondents (46.6%) than urban respondents (22.0%; χ^2 = 23.802, p < 0.001). A further 7.3% attributed tooth decay to deities, witches or wizards. This belief was significantly more common among rural respondents (10.7%) than urban respondents (4.0%; p = 0.015). Approximately 19.7% had no idea of its cause, with no significant residential difference (p = 0.769). Table 3 therefore revealed substantial misconceptions about the causes of dental caries, particularly among rural respondents. Sugar restriction was the most frequently identified preventive measure, reported by 38.9% of respondents, followed by the use of fluoride toothpaste and toothbrushes at 35.2%. Sugar restriction was more commonly reported by rural respondents (50.0%), whereas fluoride toothpaste and toothbrush use was more commonly recognised by urban respondents (46.3%). Both differences were statistically significant (p < 0.001). Rinsing the mouth with water was more commonly identified by rural respondents, while regular dental visits were more commonly identified by urban respondents. These rural–urban differences were also statistically significant (p < 0.001). Only 3.1% had no idea how tooth decay could be prevented, and this response did not differ significantly between the two settings (p = 0.363). Knowledge of dental plaque was generally poor. Table 3 showed that 76.6%

Table 2: Methods used by respondents to manage toothache.

Variables	Category	Urban Frequency (%)	Rural Frequency (%)	Frequency (%)	χ^2	df	p-value
		n = 65	n = 108	n = 173			
Management of toothache	Used kerosene	2 (3.1)	6 (5.6)	8 (4.6)	0.143*	1	0.705
	Used petrol	2 (3.1)	12 (11.1)	14 (8.1)	3.522	1	0.061
	Used Touch & Go	4 (6.2)	14 (13.0)	18 (10.4)	2.018	1	0.155
	Used drugs	12 (18.5)	65 (60.2)	77 (44.5)	28.601	1	<0.001
	Visited dentist	40 (61.5)	8 (7.4)	48 (27.7)	59.310	1	<0.001
	Used Bonjela & aloe vera gel	5 (7.7)	3 (2.8)	8 (4.6)	1.248*	1	0.264

Table 3: Respondents' knowledge of dental caries causes and prevention.

Variables	Category	Urban frequency (%)	Rural Frequency (%)	Frequency (%)	χ^2	df	p-value
		n=177	n=178	N=355			
Food contributes to tooth decay	Yes	98 (55.4)	72 (40.4)	170 (47.9)	7.914	1	0.005
	No	79 (44.6)	106 (59.6)	185 (52.1)	7.914	1	0.005
Respondents understanding of causes of tooth decay	Caused by worm	39 (22.0)	83 (46.6)	122 (34.4)	23.802	1	<0.001
	Caused by bacteria	95 (53.7)	42 (23.6)	137 (38.6)	33.877	1	<0.001
	Caused by deities, witches & wizards	7 (4.0)	19 (10.7)	26 (7.3)	5.903	1	0.015
	No idea	36 (20.3)	34 (19.1)	70 (19.7)	0.086	1	0.769
Respondents understanding of prevention of tooth decay	Used fluoride toothpaste/toothbrush	82 (46.3)	43 (24.2)	125 (35.2)	19.122	1	<0.001
	Restriction of sugar	49 (27.7)	89 (50.0)	138 (38.9)	18.601	1	<0.001
	Rinsing of mouth with water	7 (4.0)	28 (15.7)	35 (9.9)	13.847	1	<0.001
	By regular visit to the dentist	35 (19.8)	11 (6.2)	46 (13.0)	14.542	1	<0.001
	No idea	4 (2.3)	7 (3.9)	11 (3.1)	0.827	1	0.363
Respondents understanding of dental plague	Known as soft debris on the teeth	18 (10.2)	28 (15.7)	46 (13.0)	2.433	1	0.119
	Known as a stain on the teeth	5 (2.8)	16 (9.0)	21 (5.9)	6.059	1	0.014
	Known as hard debris on the teeth	5 (2.8)	11 (6.2)	16 (4.5)	2.321	1	0.128
	No idea	149 (84.2)	123 (69.1)	272 (76.6)	11.266	1	<0.001
Respondents' knowledge of what dental plague leads to	Inflammation of the gum	17 (9.6)	9 (5.1)	26 (7.3)	2.705	1	0.100
	Staining of the teeth	4 (2.3)	8 (4.5)	12 (3.4)	1.357	1	0.244
	Causes dental caries	51 (28.8)	25 (14.0)	76 (21.4)	11.505	1	<0.001
	No idea	103 (58.2)	128 (71.9)	231 (65.1)	7.348	1	0.007
	Mouth odour, tooth mobility	2 (1.1)	8 (4.5)	10 (2.8)	2.544*	1	0.111
Respondent knowledge of the function of fluoride in toothpaste	It brings about foaming during brushing	39 (22.0)	22 (12.4)	61 (17.2)	5.837	1	0.016
	It is responsible for the flavour of the toothpaste	16 (9.0)	28 (15.7)	44 (12.4)	3.659	1	0.056
	It prevents tooth decay	28 (15.8)	21 (11.8)	49 (13.8)	1.206	1	0.272
	It is responsible for the colouring of the toothpaste	30 (16.9)	23 (12.9)	53 (14.9)	1.134	1	0.287
	I do not have an idea	64 (36.2)	84 (47.2)	148 (41.7)	4.444	1	0.035

*Note: *Yates' continuity correction was applied when an expected cell count was below 5.*

of respondents had no idea what dental plaque was. Lack of knowledge was more common among urban respondents (84.2%) than rural respondents (69.1%), and the difference was statistically significant ($\chi^2 = 11.266$, $p < 0.001$). Only 13.0% correctly described plaque as soft debris on the teeth, and this response did not differ significantly between the groups ($p = 0.119$). Approximately 65.1% of respondents had no idea of the consequences of dental plaque. Only 21.4% stated that plaque caused dental caries, with this knowledge being significantly more common among urban respondents (28.8%) than rural respondents (14.0%; $\chi^2 = 11.505$, $p < 0.001$). Knowledge that plaque could cause gum inflammation, staining, mouth odour or tooth mobility remained low and generally did not differ significantly by residence. Knowledge of fluoride was also limited. Only 13.8% correctly stated that fluoride prevented tooth decay, and there was no significant rural–urban difference in this response ($p = 0.272$). Overall, 41.7% had no idea about the function of fluoride, with lack of knowledge being significantly more common among rural respondents (47.2%) than urban respondents (36.2%; $p = 0.035$). A considerable proportion incorrectly associated fluoride with foaming, flavour or toothpaste colour. Overall, Table 3 demonstrated better urban knowledge of the bacterial cause of caries, fluoride-based prevention, regular dental attendance and the relationship between plaque and caries. Rural respondents showed greater reliance on misconceptions and non-specific preventive measures.

Table 4 showed the reasons given by 305 respondents who used toothbrushes and toothpaste. Prevention of tooth decay was the most common reason, reported by 44.9%, followed by removal of foul odour (37.0%) and maintenance of clean, bright teeth (36.1%). Sweet aroma or flavour was reported by 9.5%. Preventing tooth decay was reported by 64.5% of urban users compared with 24.7% of rural users. This difference was statistically significant ($\chi^2 = 48.926$, $p < 0.001$). The remaining reasons did not differ significantly between the two groups. Table 4 therefore indicated that urban respondents were more likely to use toothbrushes and toothpaste specifically for disease prevention. Among the 50 respondents who did not use toothbrushes and toothpaste, preference for chewing sticks was the most common reason, reported by 44.0%. Lack of money was reported by 30.0%, forgetfulness by 20.0%, lack of time by 16.0%, and preference for charcoal or sand by 10.0%. None of these reasons differed

Table 4: Reasons for using or not using toothbrush and toothpaste.

Variables	Category	Urban Frequency (%)	Rural Frequency (%)	Frequency (%)	χ^2	df	p-value
		n=155	**n=150**	N=305			
Reasons for using toothpaste and toothbrush	For clean, bright teeth	51 (32.9)	59 (39.3)	110 (36.1)	1.367	1	0.242
	To prevent tooth decay	100 (64.5)	37 (24.7)	137 (44.9)	48.926	1	<0.001
	To get rid of foul odour	59 (38.1)	54 (36.0)	113 (37.0)	0.139	1	0.709
	For sweet aroma, flavour	13 (8.4)	16 (10.7)	29 (9.5)	0.460	1	0.497
		n=22	**n=28**	*N=50	χ^2	**df**	**p-value**
Reasons why respondents do not use toothpaste and toothbrush	I have no money	7 (31.8)	8 (28.6)	15 (30.0)	0.062	1	0.804
	I have no time	3 (13.6)	5 (17.9)	8 (16.0)	0.000*	1	0.988
	I always forget	3 (13.6)	7 (25.0)	10 (20.0)	0.411*	1	0.522
	I prefer chewing stick to toothpaste & toothbrush	11 (50.0)	11 (39.3)	22 (44.0)	0.574	1	0.449
	Used charcoal, sand	3 (13.6)	2 (7.1)	5 (10.0)	0.081*	1	0.776

*Note: *Yates' continuity correction was applied when an expected cell count was below 5.*

Table 5: Oral hygiene attitudes and practices among respondents.

Variable	Category	Urban Frequency (%)	Rural Frequency (%)	Frequency (%)	χ^2	df	p-value
		n=177	**n=178**	N=355			
Materials used for cleaning teeth	Chewing stick	12 (6.8)	96 (53.9)	108 (30.4)	93.222	1	<0.001
	Toothbrush	105 (59.3)	25 (14.0)	130 (36.6)	78.389	1	<0.001
	Charcoal	20 (11.3)	25 (14.0)	45 (12.7)	0.604	1	0.437
	Sand	12 (6.8)	17 (9.6)	29 (8.2)	0.908	1	0.341
	Dental floss	21 (11.9)	5 (2.8)	26 (7.3)	10.722	1	0.001
	Salt, alum, or broomstick	7 (4.0)	10 (5.6)	17 (4.8)	0.538	1	0.463
Number of times respondents brushed teeth per day	Once	29 (16.4)	60 (33.7)	89 (25.1)	14.179	1	<0.001
	Twice	98 (55.4)	85 (47.8)	183 (51.5)	2.060	1	0.151
	Thrice	30 (16.9)	20 (11.2)	50 (14.1)	2.394	1	0.122
	Four times and above	20 (11.3)	13 (7.3)	33 (9.3)	1.681	1	0.195
Time of day respondents brushed their teeth	Morning only	49 (27.7)	113 (63.5)	162 (45.6)	45.846	1	<0.001
	Afternoon only	8 (4.5)	2 (1.1)	10 (2.8)	2.602*	1	0.107
	Evening only	3 (1.7)	5 (2.8)	8 (2.3)	0.122*	1	0.727
	Morning and evening	85 (48.0)	49 (27.5)	134 (37.7)	15.864	1	<0.001
	Morning, afternoon and evening	32 (18.1)	9 (5.1)	41 (11.5)	14.734	1	<0.001
Minutes spent on brushing teeth	One minute	21 (11.9)	33 (18.5)	54 (15.2)	3.066	1	0.080
	Two minutes	53 (29.9)	51 (28.7)	104 (29.3)	0.072	1	0.789
	Three minutes	44 (24.9)	42 (23.6)	86 (24.2)	0.077	1	0.781
	Four minutes	16 (9.0)	17 (9.6)	33 (9.3)	0.027	1	0.868
	Five minutes and above	43 (24.3)	35 (19.7)	78 (22.0)	1.110	1	0.292
Frequency of toothbrush replacement	1-3 months	61 (34.5)	30 (16.9)	91 (25.6)	14.437	1	<0.001
	4-6 months	76 (42.9)	89 (50.0)	165 (46.5)	1.779	1	0.182
	7-12 months	33 (18.6)	38 (21.3)	71 (20.0)	0.406	1	0.524
	More than 1 year	7 (4.0)	21 (11.8)	28 (7.9)	7.514	1	0.006
Respondents toothbrushing technique	Horizontal method	99 (55.9)	127 (71.3)	226 (63.7)	9.117	1	0.003
	Vertical method	78 (44.1)	51 (28.7)	129 (36.3)	9.117	1	0.003

significantly between urban and rural respondents. Thus, Table 4 suggested that cultural preference for chewing sticks and financial constraints were the leading barriers to toothbrush and toothpaste use in both settings.

Table 5 showed marked rural–urban differences in materials used for cleaning the teeth. Toothbrushes were used by 59.3% of urban respondents compared with 14.0% of rural respondents (χ^2 = 78.389, $p < 0.001$). In contrast, chewing sticks were used by 53.9% of rural respondents compared with 6.8% of urban respondents (χ^2 = 93.222, $p < 0.001$). Dental floss was more commonly used by urban respondents (11.9%) than rural respondents (2.8%), and the difference was statistically significant ($p = 0.001$). The use of charcoal, sand, salt, alum or broomsticks did not differ significantly between the residential groups. Brushing twice daily was the most common frequency, reported by 51.5% of respondents. However, brushing once daily was significantly more common among rural respondents (33.7%) than urban respondents (16.4%; $\chi^2 = 14.179$, $p < 0.001$). The proportions brushing twice, three times, or four or more times daily did not differ significantly between the groups. Morning-only brushing was reported by 45.6% of respondents and was significantly more common among rural residents (63.5%) than urban residents (27.7%; $\chi^2 = 45.846$, $p < 0.001$). Brushing in both the morning and evening was significantly more common among urban respondents (48.0%) than rural respondents (27.5%; $\chi^2 = 15.864$, $p < 0.001$). Brushing in the morning, afternoon and evening was also more common among urban respondents (18.1%) than rural respondents (5.1%; $\chi^2 = 14.734$, $p < 0.001$). The most frequently reported brushing duration was two minutes, accounting for 29.3%, followed by three minutes at 24.2% and five minutes or more at 22.0%. None of the brushing-duration categories differed significantly between urban and rural respondents. Table 5 therefore showed that residential differences related more to the frequency and timing of brushing than to the reported duration. Replacing toothbrushes every four to six months was the most common practice, reported by 46.5% of respondents. Replacement every one to three months was more common among urban respondents (34.5%) than rural respondents (16.9%; $\chi^2 = 14.437$, $p < 0.001$). Keeping a toothbrush for more than one year was more common among rural respondents (11.8%) than urban respondents (4.0%; $\chi^2 = 7.514$, $p = 0.006$). The horizontal toothbrushing method was demonstrated by 63.7% of respondents, while 36.3% demonstrated the vertical method. Horizontal brushing was more frequent among rural respondents (71.3%) than urban respondents (55.9%), whereas vertical brushing was more frequent among urban respondents (44.1%) than rural respondents (28.7%). The difference was statistically significant ($\chi^2 = 9.117$, $p = 0.003$). Overall, Table 5 indicated that urban respondents demonstrated more favourable oral hygiene practices through greater toothbrush and floss use, more frequent morning-and-evening brushing, earlier toothbrush replacement and greater use of the vertical technique. Rural respondents depended more heavily on chewing sticks, morning-only cleaning, prolonged toothbrush use and the horizontal brushing method.

Table 6 showed that pharmacy stores were the most frequently reported source of treatment for toothache, accounting for 26.8%, followed by self-medication at 23.7%, herbal homes at 22.3%, dental clinics at 15.8% and health centres at 11.5%. Use of herbal homes was significantly more common among rural respondents (39.3%) than urban respondents (5.1%; $\chi^2 = 60.142$, $p < 0.001$). Self-medication was significantly more common among urban respondents (33.3%) than rural respondents (14.0%; $\chi^2 = 18.280$, $p < 0.001$). Pharmacy-store use was also more common among urban respondents (37.9%) than rural respondents (15.7%; χ^2 = 22.162, $p < 0.001$). The use of dental clinics and health centres did not differ significantly between the two residential groups. Only 13.0% of all respondents had ever visited a dentist, while 87.0% had never done so. Dental attendance was significantly higher among urban respondents (19.8%) than rural respondents (6.2%; $\chi^2 = 14.542$, $p < 0.001$). Table 6 therefore demonstrated generally low utilization of professional dental services, particularly among ruralcc residents. Among the 46 respondents who had visited a dentist, pain was the leading reason, accounting for 63.0%. Only 19.6% attended for routine check-ups, 10.9% went for free treatment and 6.5% attended to determine treatment costs. None of these reasons differed significantly between urban and rural respondents. These findings indicated that dental attendance was predominantly symptom-driven rather than preventive. Among the 309 respondents who had never visited a dentist, absence of pain was the leading reason, reported by 27.2%. This reason was significantly more common among rural non-attendees (38.3%) than urban non-attendees (14.1%; $\chi^2 = 22.779$, $p < 0.001$). Lack of a nearby dental clinic was reported by 21.7% and was significantly more common among rural respondents (32.9%) than urban respondents (8.5%; $\chi^2 = 27.091$, $p < 0.001$). Lack of time was reported by 21.4% and was significantly more common among urban respondents (40.8%) than rural respondents (4.8%; χ^2 = 59.393, $p < 0.001$). High treatment cost was reported by 16.8%, but the rural–urban difference did not reach statistical significance ($p = 0.063$). Fear of treatment and dislike of dental clinics were less frequently reported and did not differ significantly by residence. Overall, Table 6 showed that rural respondents were constrained mainly by lack of nearby dental facilities and low perceived need in the absence of pain, whereas lack of time was the dominant barrier among urban respondents.

Figure 2 showed that 132 urban respondents and 126 rural respondents had received oral health information. In contrast, 45 urban respondents and 52 rural respondents had not received such information. Exposure was therefore relatively high and broadly similar in both groups, although it was slightly greater among urban respondents. Overall, Figure 2 indicated that most respondents had been exposed to oral health information. Nevertheless, the remaining information gap was somewhat greater among rural residents.

Figure 3 showed that 155 urban respondents and 150 rural respondents used toothbrushes and toothpaste. Conversely, 22 urban respondents and 28 rural respondents did not use them. Use was therefore high in both residential groups, although it was

Table 6: Pattern of dental service utilization among respondents.

Variable	Category	Urban Frequency (%)	Rural Frequency (%)	Frequency (%)	χ^2	df	p-value
		n=177	**n=178**	**N=355**			
Where respondents sought treatment for toothache	Herbal home	9 (5.1)	70 (39.3)	79 (22.3)	60.142	1	<0.001
	Dental clinic	26 (14.7)	30 (16.9)	56 (15.8)	0.313	1	0.576
	Self-medication	59 (33.3)	25 (14.0)	84 (23.7)	18.280	1	<0.001
	Health centres	16 (9.0)	25 (14.0)	41 (11.5)	2.177	1	0.140
	Pharmacy store	67 (37.9)	28 (15.7)	95 (26.8)	22.162	1	<0.001
Respondents who had visited the dentist	Yes	35 (19.8)	11 (6.2)	46 (13.0)	14.542	1	<0.001
	No	142 (80.2)	167 (93.8)	309 (87.0)			
		n=35	**n=11**	**N=46**	χ^2	***df***	***p-value***
Reasons why respondents visited the dentist	For routine check-up	5 (14.3)	4 (36.4)	9 (19.6)	1.379*	1	0.240
	Because of pain	24 (68.6)	5 (45.5)	29 (63.0)	1.056*	1	0.304
	For free treatment	4 (11.4)	1 (9.1)	5 (10.9)	0.000*	1	1.000
	To know the cost of treatment	2 (5.7)	1 (9.1)	3 (6.5)	0.000*	1	1.000
		n=142	**n=167**	**N=309**	χ^2	***df***	***p-value***
Reasons why respondents did not visit the dentist	Treatment cost was high	30 (21.1)	22 (13.2)	52 (16.8)	3.468	1	0.063
	There was no pain	20 (14.1)	64 (38.3)	84 (27.2)	22.779	1	<0.001
	No dental clinics around	12 (8.5)	55 (32.9)	67 (21.7)	27.091	1	<0.001
	Afraid of treatment	13 (9.2)	14 (8.4)	27 (8.7)	0.057	1	0.811
	There was no time	58 (40.8)	8 (4.8)	66 (21.4)	59.393	1	<0.001
	Disliked the dental clinic	9 (6.3)	4 (2.4)	13 (4.2)	2.960	1	0.085

*Note: *Yates' continuity correction was applied when an expected cell count was below 5.*

slightly more common among urban respondents. Figure 3 also showed that non-use was somewhat more common among rural respondents. The relatively small difference suggested that access to toothbrushes and toothpaste was widespread, but a minority—particularly in rural communities—continued to depend on alternative cleaning materials.

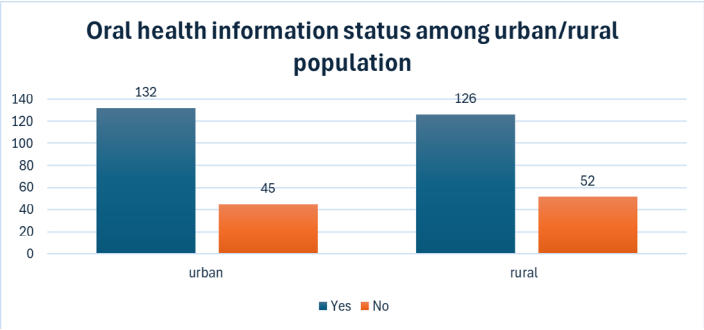


Figure 2: Exposure to oral health information among rural and urban respondents.

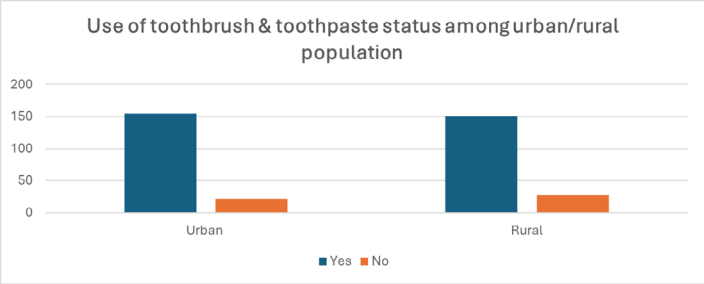


Figure 3: Use and urban respondents of toothbrush and toothpaste among rural.

Discussion

This study examined oral health information, knowledge, hygiene practices, toothache management and dental service utilization among adults in rural and urban communities. The findings generally supported the integrated theoretical framework based on the *Health Belief Model* and *Andersen's Behavioural Model of Health Service Use*. Although exposure to oral health information was relatively high, important gaps remained between receiving information, possessing accurate knowledge, adopting appropriate preventive practices and utilizing professional dental services. The observed pattern suggested that oral health behaviour had been influenced not only by information but also by perceived susceptibility, perceived severity, expected benefits, cultural beliefs, enabling resources and perceived need for professional care. The findings therefore supported the conceptual framework's proposition that oral health behaviour resulted from the interaction of individual knowledge, sociocultural influences, place of residence, available resources and accessibility of dental services.

The rural and urban groups were comparable in terms of sex, age, marital status, ethnicity and employment status. However, educational attainment differed significantly, with tertiary education being more common among urban respondents. This difference might partly have accounted for the observed rural–urban variations in oral health knowledge and practices. Within *Andersen's model*, education represented a predisposing characteristic that influenced health literacy, understanding of preventive information and the ability to navigate healthcare services. Previous evidence had indicated that oral health literacy was associated with health behaviour and oral health status [3,17]. Nevertheless, the findings also showed that education and information exposure alone had not

guaranteed comprehensive oral health knowledge, as considerable misconceptions and knowledge gaps occurred in both residential groups.

Oral health information and knowledge

Most respondents had received oral health information, although exposure was slightly higher among urban respondents. Radio and television were the leading sources in both settings, indicating that mass media had served as important cues to action within the *Health Belief Model*. Dentists and printed materials were more prominent sources among urban respondents, whereas rural respondents depended more heavily on other healthcare workers. This difference reflected the conceptual framework's assumption that place of residence influenced access to both oral health information and professional sources of knowledge. The greater reliance on other healthcare workers in rural communities might have resulted from the limited presence of dentists and dental facilities in those areas. Despite the relatively high exposure to information, knowledge of dental caries, dental plaque and fluoride remained inadequate. Fewer than half of the respondents recognised that food contributed to tooth decay, while only 38.6% correctly identified bacteria as a cause. Urban respondents demonstrated significantly better knowledge of the bacterial cause of caries, whereas rural respondents more frequently attributed tooth decay to worms, deities, witches or wizards. These findings were consistent with the conceptual framework, which proposed that inaccurate information and culturally established explanations could shape people's perceptions of oral disease. From the perspective of the *Health Belief Model*, misconceptions about disease causation might have weakened perceived susceptibility to preventable oral disease. Respondents who believed that tooth decay resulted from worms or supernatural forces might not have perceived sugar consumption, dental plaque or inadequate tooth cleaning as personal risk factors. Consequently, they might have been less likely to adopt evidence-based preventive behaviour. Traditional beliefs and locally established oral healthcare practices had previously been documented in Nigeria, alongside the continued use of chewing sticks and locally prepared products [4,18,19]. Knowledge of dental plaque was particularly poor. More than three-quarters of respondents did not know what dental plaque was, while approximately two-thirds did not know its consequences. Only 21.4% recognised that plaque could contribute to dental caries. Knowledge of fluoride was similarly limited: only 13.8% correctly identified its role in preventing tooth decay, whereas many respondents associated fluoride with foaming, flavour or toothpaste colour. These findings demonstrated that exposure to general oral health messages had not necessarily produced functional oral health literacy. The information received might have been insufficiently detailed, irregular or poorly adapted to local language and cultural understanding. Baskaradoss [3,17] similarly found that oral health literacy was related to oral health status and preventive behaviour, suggesting that the ability to understand and apply information was more important than exposure alone. Knowledge of preventive measures also differed between the two settings. Urban respondents more frequently identified fluoride toothpaste, toothbrush use and routine dental attendance as preventive measures, whereas rural respondents more frequently mentioned sugar restriction and mouth rinsing. The greater urban recognition of fluoride and dental attendance might have reflected increased access to dentists, printed information and tertiary education. Nevertheless, the limited recognition of routine dental attendance in both groups suggested that preventive dental care had not become an established social norm.

Oral hygiene practices

The findings showed substantial rural–urban differences in oral hygiene materials and practices. Toothbrush use and dental floss use were significantly more common among urban respondents, whereas chewing-stick use was considerably more common among rural respondents. These findings agreed with previous Nigerian evidence in which chewing sticks and locally prepared products had remained prominent, while toothbrush use had been more common in urban areas [4,19]. Earlier research had also identified chewing-stick use as particularly common among rural populations and lower socioeconomic groups. Within the conceptual framework, the choice of oral hygiene material had been shaped by cultural familiarity, affordability, availability and access to modern dental products. Chewing sticks might have remained attractive because they were locally available, inexpensive and culturally accepted. Therefore, their use should not automatically have been interpreted as evidence of neglect. However, dependence on chewing sticks without adequate knowledge of technique, fluoride exposure or complementary preventive measures might not have provided sufficient protection against dental caries. The *Health Belief Model* further helped to interpret respondents' reasons for using toothbrushes and toothpaste. Prevention of tooth decay was the leading reason overall, but it was substantially more common among urban users. Rural respondents more frequently used these products for clean or bright teeth and removal of mouth odour. Urban users therefore appeared to have perceived stronger disease-prevention benefits, whereas rural use appeared to have been influenced more by cleanliness and social acceptability. Among non-users, preference for chewing sticks was the most common reason, followed by lack of money, forgetfulness and lack of time. These represented cultural, financial and behavioural barriers within the *Health Belief Model*. Although general use of toothbrushes and toothpaste was reportedly high, specific cleaning-material responses showed that rural respondents still depended heavily on chewing sticks. This suggested that some respondents might have used more than one cleaning method or used toothbrushes inconsistently. The finding reinforced the conceptual framework's position that access to a preventive product did not necessarily ensure its regular or appropriate use. Brushing twice daily was the most frequently reported practice. This was in tandem with findings in Nigeria study [20]. However, once-daily and morning-only brushing were significantly more common among rural respondents, while morning-and-evening brushing was more common among urban respondents. Urban respondents also replaced their toothbrushes within one to three months more frequently, whereas keeping a

toothbrush for more than one year was more common among rural respondents. These practices might have reflected differences in oral health knowledge, purchasing power and access to dental products. The dental-model demonstrations also revealed that the horizontal brushing technique predominated, particularly among rural respondents, whereas the vertical technique was more common among urban respondents. This finding suggested that self-reported brushing frequency alone might have overstated the adequacy of oral hygiene practices. Although respondents might have believed that they were undertaking beneficial action, limited practical knowledge and self-efficacy might have affected their ability to clean their teeth effectively. Under the *Health Belief Model*, sustained preventive behaviour required not only recognition of benefits but also confidence and practical competence in performing the recommended action. Oral health education programmes therefore needed to include practical demonstrations rather than relying solely on verbal messages.

Toothache management

The methods used to manage toothache further demonstrated the influence of knowledge, beliefs, perceived severity and access to care. Drug use was the most common management method and was considerably more frequent among rural respondents. Urban respondents were substantially more likely to visit a dentist, while rural respondents relied more heavily on drugs and informal remedies such as petrol, kerosene, locally prepared "Touch & Go," Bonjela and aloe vera gel. These findings supported the conceptual framework's proposed pathway from oral health beliefs and toothache experience to treatment choice. Toothache had served as an internal cue to action, but the action taken was not always professional dental treatment. Respondents interpreted pain according to their beliefs, previous experiences, available resources and perceived effectiveness of alternative remedies. Petroleum products and locally prepared preparations might have been perceived as affordable and immediately accessible, even though they could only provide temporary relief and might pose additional health risks [21]. The findings were also consistent with evidence that Nigerian adults frequently delayed dental care and used pharmacies, self-medication and traditional remedies before seeking professional services. Dental care had often been considered a last resort when symptoms became severe. The *Health Belief Model* suggested that the perceived benefits of professional treatment might have been outweighed by perceived barriers such as cost, distance, lack of time and fear. The *Andersen's model* further indicated that perceived need alone was insufficient where enabling resources were limited.

Dental service utilization

Professional dental service utilization was generally low. Only 13.0% of respondents had ever visited a dentist, and dental attendance was significantly higher among urban than rural respondents. This finding was consistent with earlier Nigerian research reporting poor dental service utilization among adults and predominantly problem-driven attendance [5,22]. Rural outreach research in southern Nigeria had similarly reported low utilization and recommended regular screening, oral health awareness and community dental outreach. More broadly, rural residence, lower education and lower income had been associated with reduced dental service utilization [23]. Pain was the main reason for visiting a dentist, accounting for 63.0% of previous visits, while fewer than one-fifth of attendees had presented for routine check-ups. This pattern closely reflected the perceived-need component of *Andersen's model*. Pain had generated an immediate need for treatment, whereas asymptomatic disease had not been perceived as requiring professional attention. The finding also reflected the *Health Belief Model's* cue-to-action construct: dental pain had triggered attendance, but preventive information alone had rarely produced routine visits. A previous Nigerian hospital study similarly found that pain was the dominant reason for dental attendance, while very few patients attended without symptoms for routine examination or professional cleaning [24,25] . The absence of pain was the leading reason for not visiting a dentist and was especially prominent among rural respondents. This finding suggested low perceived susceptibility and severity when symptoms were absent. Respondents might have interpreted the absence of pain as the absence of disease, even though dental caries and periodontal disease could progress without severe early symptoms. The finding corresponded closely with recent qualitative evidence from Nigeria in which lack of pain reduced the perceived need to visit a dental clinic [24]. The barriers to dental attendance differed by residence. Rural respondents were more likely to report the absence of nearby dental clinics, whereas urban respondents more frequently reported lack of time. High treatment cost was also reported but did not differ significantly between the residential groups. These findings supported Andersen's distinction between predisposing, enabling and need factors. Rural respondents experienced a structural enabling barrier associated with the geographical availability of services, while urban respondents faced a time-related barrier despite relatively better physical access. Thus, proximity alone had not ensured utilization. The treatment pathways also differed significantly. Rural respondents frequently used herbal homes, while urban respondents more frequently used pharmacies and self-medication. These patterns indicated that informal or non-dental providers had filled gaps created by limited accessibility, affordability and perceived convenience. Previous research in Nigeria had shown that the location of dental facilities, treatment costs, availability of personnel and equipment, government funding and public awareness affected access to dental treatment [7]. The present findings therefore reinforced the conceptual framework's position that professional dental utilization depended on both personal beliefs and the health-system environment.

Integration of the findings with the frameworks

Taken together, the findings demonstrated how the *Health Belief Model* and *Andersen's Behavioural Model* complemented each other. Oral health information from radio, television, dentists and other healthcare workers provided external cues to action. However, inaccurate knowledge of caries, plaque and fluoride reduced perceived susceptibility and weakened appreciation of preventive benefits. Cultural preference for chewing sticks and

informal remedies, lack of money, forgetfulness, fear and lack of time functioned as perceived barriers. Toothache increased perceived severity and acted as an internal cue, but it usually produced curative rather than preventive behaviour. Andersen's model explained why individuals who might have recognised the benefits of dental care still failed to use professional services. Educational differences and cultural beliefs operated as predisposing characteristics; cost, time, availability of clinics and place of residence operated as enabling factors; and pain or other symptoms operated as perceived-need factors. The significantly lower dental attendance among rural respondents was therefore unlikely to have resulted solely from poor knowledge. It also reflected the limited availability of nearby services and greater reliance on informal treatment sources. The conceptual framework was consequently supported by the observed sequence of relationships: information exposure influenced knowledge and beliefs; knowledge and beliefs shaped oral hygiene and toothache-management practices; toothache created perceived need; and the eventual treatment choice was modified by affordability, cultural preference, time and service availability. However, because the study used a cross-sectional design, these relationships represented theoretically plausible interpretations rather than proven causal pathways.

Overall, the null hypothesis of no rural–urban differences were not supported for several important outcomes. Significant differences were observed in educational attainment, knowledge of caries causation and prevention, chewing-stick and toothbrush use, timing and technique of brushing, management of toothache, dental attendance and barriers to service utilization. Nevertheless, some outcomes—including brushing duration, certain reasons for toothpaste use, treatment cost, fear of treatment and selected informal remedies—did not differ significantly. The findings therefore indicated that rural–urban residence influenced many, but not all dimensions of oral health behaviour. The study showed that improving oral health required more than disseminating information. Communication interventions needed to correct misconceptions concerning worms and supernatural causes, clarify the roles of bacteria, dental plaque, dietary sugars and fluoride, and demonstrate effective toothbrushing techniques. Mass media could provide broad coverage, while healthcare workers and community outreach programmes could adapt messages to local languages and beliefs. Structural interventions were equally necessary, including rural dental outreach, integration of basic oral healthcare into primary healthcare, affordable preventive services and improved geographical distribution of dental personnel. These combined interventions would have addressed the individual behavioural determinants identified by the *Health Belief Model* and the enabling and access-related determinants identified by Andersen's model.

Conclusion

The study concluded that adults in both rural and urban communities had considerable exposure to oral health information, particularly through radio and television. However, important gaps remained in their knowledge of dental caries, dental plaque and the preventive function of fluoride. Misconceptions that attributed tooth decay to worms and supernatural causes were more common among rural respondents. Oral hygiene practices differed significantly between the two settings. Urban respondents reported greater use of toothbrushes and dental floss, more frequent morning-and-evening brushing, earlier toothbrush replacement and better toothbrushing techniques. Rural respondents relied more heavily on chewing sticks, morning-only cleaning and prolonged toothbrush use. Although toothbrush and toothpaste use was generally high, cultural preference and financial limitations continued to encourage the use of alternative cleaning materials. Dental service utilization was low and predominantly symptom-driven. Most respondents had never visited a dentist, while pain was the main reason for dental attendance among those who had done so. Rural respondents relied more on drugs, herbal homes and locally available remedies for managing toothache, whereas urban respondents were more likely to use pharmacies, practise self-medication or seek professional dental care. The absence of nearby dental clinics and low perceived need without pain were the major barriers among rural respondents, while lack of time was more prominent among urban respondents. The findings supported the *Health Belief Model* and *Andersen's Behavioural Model of Health Service Use* by demonstrating that oral health behaviour had been shaped by knowledge, cultural beliefs, perceived benefits and severity, financial and geographical barriers, available resources and perceived need for care. Improving oral health in these communities therefore required culturally appropriate education, practical toothbrushing demonstrations, correction of misconceptions, promotion of routine dental examinations, affordable services and expanded community-based dental outreach, particularly in rural areas.

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