KNOWLEDGE ON CAUSES, EFFECTS AND CONTROL OF DENTAL PLAQUE; A QUALITATIVE APPROACH.

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ABSTRACT

BACKGROUND: Understanding dental plaque, a diverse micro-organism population on the surface of teeth, is crucial for controlling dental caries and periodontitis in the Ghanaian population, thereby reducing the oral disease burden. This study sought the views and perspectives of Dentists and Traditional Dental Herbal Practitioners (TDHPs) on the causes, effects, and control mechanisms for dental plaque.

METHOD: This cross-sectional study employed a qualitative approach to understand the causes, effects, and control of dental plaque. Four dentists and two TDHPs were interviewed one-on-one using an interview guide and a digital recorder. The data was transcribed, coded, and analyzed using NVivo 14. Ethical approval was granted by the Committee on Human Research Publication and Ethics of KNUST

RESULTS: The Dentists attributed the causes of dental plaque to bacteria, food particles, and poor oral hygiene, whereas the TDHPs believed it developed from birth, eating raw meat, and poor oral hygiene. Dentists believed that dental plaque could be controlled by maintaining proper oral hygiene, whereas TDHPs recommended the use of special chewing sticks, minimizing the consumption of fresh meat, and applying herbs, tree bark, and roots to control dental plaque.

CONCLUSION: Dentists and TDHPs differ in their understanding of the causes and methods of dental plaque control but share similar knowledge regarding the effects of dental plaque. This study has confirmed the importance of good oral hygiene practices in controlling dental plaque, as endorsed by both dentists and dental hygienists and therapists (TDHPs). It highlights the role of intensifying oral health education in promoting good oral hygiene practices.

KEYWORDS: Dental plaque, causes, effects, control, qualitative, Dentists, and Traditional Dental Herbal Practitioners (TDHPs)

INTRODUCTION

Dental plaque is described as a diverse and organised community of tooth surface micro-organisms. Through an ordered sequence of events, a matrix of polymers of host and bacterial origin coalesce to form a microbial biofilm. This process begins just minutes after tooth cleaning, with the formation of a protective saliva pellicle on the tooth surface. When left undisturbed, the biofilm can develop into a more pathogenic composition, which can eventually lead to periodontal disease and dental caries.

According to Figuero and colleagues[5], it is feasible to prevent or limit the incidence of dental caries and periodontitis by putting in place effective methods to regulate dental plaque production and build-up. Dental plaque control is accomplished either mechanically or chemically; sometimes, the two procedures are combined[6]. Mechanical plaque control mainly involves brushing teeth using cleaning devices. Different cleaning devices have been used in different cultures over the centuries. Examples include toothbrushes (manual and electronic), tongue brushes, interdental brushes, dental floss (orthodox methods), chewing sticks, chewing sponges, tree twigs, strips of linen, bird feathers, animal bones, and porcupine quills (traditional methods). Several studies[7-9] have been conducted on the role of TDHPs in treating oral diseases. However, a comparison of their knowledge to that of dentists on the causes, effects, and control of the main risk factors for dental caries and periodontitis (dental plaque) is scarce. This study sought to understand the causes, effects, and control mechanisms for dental plaque from the perspectives of Dentists and TDHPs and forms part of a larger study to assess the effectiveness of orthodox and traditional methods of plaque control among adults in the Ejisu municipality of the Ashanti region in Ghana.

MATERIALS AND METHODS

The study employed a cross-sectional study with a qualitative research approach to capture the views, opinions, and perspectives of all relevant stakeholders (i.e., dentists and TDHPs). The philosophical paradigm underpinning this study was the epistemology concept, where the narratives and insights shared by practitioners about the subject matter were assumed to be pragmatic, denoting that the insights and narratives provided by practitioners focused on practical skills, flexible problem-solving knowledge, and experiences. The study setting was Ejisu Metropolis. This geographical setting was considered to accommodate Dentists and TDHPs, who were the primary targets for this study. The choice of this location resonates with the researcher's idea of movement, citing reasons of convenience, cost-effectiveness, adaptability, and proximity.

The study utilized a maximum variation-based purposive sampling technique to select six respondents, four (4) Dentists and two (2) TDHPs from a diverse range of dental practitioners, focusing on their experience, affiliation, familiarity with dental plaque issues, and availability or convenience. The key informant interview (KII) was used for data collection. The data was saturated for six informants because the information provided by the practitioners adequately supported the concept of the subject matter, which was repetitive; hence, no extra or fresh ideas were supplied by almost all the practitioners. This led to exhausting the sub-themes and general themes generated for the study.

The step-by-step procedure for data collection involved a reconnaissance visit (a formal visit to the target dental practitioners, during which we introduced ourselves and

the study and provided a detailed explanation of its purpose). This was followed by a key informant interview (KII).

Data were collected using a predefined interview guide and in-person interactions, with audio recordings made for documentation purposes. Participants were allowed to express their knowledge in the language best understood by practitioners, such as English for dentists and Twi language for TDHPs. The process was undertaken in a convenient location. The recording technique lasted approximately 45 to 60 minutes and was conducted exclusively by the researcher (male, PhD candidate) after consent was obtained from the respondents. The data processing stage began with transcribing the audio recordings. Thematic analysis was employed to examine the various aspects of the study thoroughly.[11,12] This analysis facilitated the identification and examination of recurring themes[11,13] found in all interview data and transcripts of audio interviews conducted with key informants, which were deemed to address aspects of the research objectives[14,15].

The interview data collected from key informants were analyzed using the NVivo software (version 14). During the analysis process, all audio interviews conducted with key informants were transcribed, and the wording sequence was modified to accurately convey the intended meaning of what the interviewees said. Second, these audio transcripts were fed into the software, and the following procedures were observed in the analysis: The transcripts were thoroughly reviewed to gain familiarity with the interview content. Key terms [statements] that emerged during the interviews were identified and assigned preliminary codes [nodes]. Similar codes were grouped to create potential themes, and a review of the existing themes was conducted to ensure that the identified themes accurately reflect the subject matter. At this stage, themes were clearly defined and named appropriately, and a narrative of the defined themes was obtained.

Ethical approval was obtained from the Committee on Human Research, Publications, and Ethics of Kwame Nkrumah University of Science and Technology (CHRPE/AP/124/23).

RESULTS

The four (4) dentists and two (2) TDHPs ages ranged between 30-60 years, with a minimum and maximum working experience of 4- 25 years, respectively. The dental surgeons consisted of three males and one female. All the traditional herbal practitioners were males and had only primary education. Two of the dentists were part-time lecturers at the KNUST School of Dentistry and Garden City University.

The results encompassed knowledge of the causes, effects, and various control mechanisms for dental plaque from the perspectives of Dentists and TDHPs.

Causal elements of dental plague

A dental practitioner was of the view that tooth plaque can be caused by leftover food particles that accumulate around the tooth. This build-up occurs due to the interaction between micro-organisms present in the saliva and food particles that are not correctly removed during teeth cleaning.

"We all have saliva in our mouth that contains micro-organisms, and these micro-organisms have what we call the glycoproteins that interact with leftover food particles that together get stuck on the teeth. If it is not cleaned properly, the first layer of plaque is formed, and the accumulation of these over a while, if not removed together with the saliva, produces plague" (Dentist 1).

During the interview with one of the dentists, it was further explained that plaque is a build-up of debris (dirt), mostly from leftover food particles that get stuck on the teeth and can turn into a discoloured solid state (e.g., green, black, etc.) around teeth. This build-up is often difficult to remove through regular brushing or cleaning but would require special [cleaning] treatment.

"Plague is a combination of debris that solidifies on the teeth that may or may not be easily removed by a toothbrush" (Dentist 2)

Another perspective from a dentist states that plaque is normally formed between 48-72 hours, especially due to the presence of uncleaned mineral contents in some foods and drinks that stain the surface of the teeth.

"Investigations have shown that it usually takes between 48-72 hours for plaque to form, particularly as a result of mineral deposits around the neck of the teeth" (Dentist 2)

Regarding the causes of dental plaque formation, one dentist said it is a result of poor oral hygiene due to improper tooth cleaning.

"In my view, dental plaque occurs because of poor oral hygiene. Some people do not take care of their mouth with respect to cleaning teeth" (Dentist 3).

Further information on the causes of tooth plaque from the dentist's perspective is related to the mineral content or components in some foods and drinks that people consume, which, when deposited on the teeth, remain uncleaned.

"Some foods and drinks that people consume contain some mineral content that stains the teeth, which, when uncleaned, causes tooth plaque" (Dentist 4).

The Indigenous knowledge from a traditional practitioner indicated the element of leftover food particles [particularly on fresh meat in-take] as a causal factor of dental plaque and emphasized that plaque formation may be caused by a combination of family hereditary factors [through birth],

"Some people are born with tooth plague from childbirth, and they grow with it; others also chew fresh meat from animals such as goats, etc., that they do not clean after eating, and pieces of this meat cause plaque" (TDHP 1)

Further traditional knowledge suggests that excessive chewing of kola nuts (locally known as bese in Ghana) can cause plaque formation due to their staining natural colours. According to the findings, this practice is common among elderly people.

"Some people [especially old people] chew more pieces of kola nuts, and they do not also clean teeth after chewing, which also causes plaque" (TDHP 2)

Effects of dental plaque

During the interview, a view was expressed that one of the effects of dental plaque is gum bleeding (gum disease), which occurs particularly during tooth brushing.

"The main effect [of plaque] on a person is that the person usually experiences gum bleeding when he/she brushes the teeth. When they spit, you see blood" (Dentist 1).

Another dentist expressed the effect of plaque as stated below:

"Gum bleeding that is detected during brushing of the teeth remains a typical effect contracted through dental plaque" (Dentist 3).

Additional findings reveal that tooth plaque, if left untreated, can result in bad breath due to the activities of micro-organisms present in saliva byproducts and food debris.

"There is a likelihood that untreated tooth plaque can result in producing bad mouth odour" (Dentist 4).

It was observed from the interviews that excessive gum bleeding, which is caused by untreated gum inflammation, can result in tooth mobility.

"When extreme gum bleeding is unattended to, it can lead to a possible tooth mobility, which would require extraction, and it becomes difficult to chew" (Dentist 2)

The effect of tooth mobility and extraction was also confirmed from the perspective of traditional dental practitioners.

"People experiencing a mobile tooth, as a result of plague formation, finally have to undergo extraction process before they would be free" (TDHP 1)

Control mechanism for tooth plaque

Proper and regular brushing of the teeth with an appropriate toothbrush and fluoride-containing toothpaste is an effective way to control tooth plaque.

"First and foremost, brushing the teeth is the most important thing to do twice daily, both morning and evening, with the kind of toothbrush that you use and the fluoride within the toothpaste, and I want to say that the more you brush, the more you get rid of most of the dirt in your mouth" (Dentist 2)

From the dentist's perspective, an additional control mechanism for dental plaque formation has been the advocacy for people to practice good oral hygiene, which includes comprehensive teeth examinations.

"I have always advocated for proper or good oral hygiene as a means to control dental plaque formation" (Dentist 3)

From the interviews, another control mechanism is the practice of mechanically removing dental plaque. This occurs when plaque is intentionally removed by strategically attending to each tooth during brushing or cleaning, a process that is time-consuming.

"To effectively control tooth plaque, there should be an intentional cleaning practice which requires taking time to clean each tooth well during teeth brushing" (Dentist 4)

Another recommendation from a dentist is to visit or consult an oral health professional every six months for a thorough checkup to detect and treat any potential tooth-related issues. This remains a key component of controlling dental plaque.

"That is why we advocate as dentists that everybody should at least get cleaning done every 6 months because, within that period, a lot might have happened to lead to plaque formation and other possible teeth issues" (Dentist 1)

In traditional (indigenous) treatment, views from a TDHP reveal that herbal medications are commonly used. However, further findings suggest that the effectiveness of these medications may vary depending on whether the condition is inherited (by birth) or acquired through environmental factors. Conditions acquired through heredity may require longer treatment time compared to those acquired from the environment.

"I treat (tooth) plaque with herbs (i.e., plants, roots, tree barks, etc.) because of my profession, but the medicine works faster for normal plaque than those who had it from birth." (TDHP 1)

From a traditional perspective, another method of controlling dental plaque is to avoid consuming fresh meat in one's diet. According to them, fresh meat takes longer to digest, and if it gets stuck between the teeth and is not removed (during cleaning), it can cause discolouration in the surrounding area.

"I normally recommend to people to stop eating fresh meat from goats, cows, sheep, etc., after coming for treatment because the meat is hard to digest, so if it stays in your teeth over a long period, it can result in plaque" (TDHP 2)

Another control mechanism, according to a TDHP, is the use of specific chewing sticks that effectively clean dirt around the teeth, and their continuous use helps fight plaque bacteria.

"So, in northern Ghana, we have some chewing sticks that, if you chew, clear all the dirt from the tooth, and when you continue to chew that stick, the bacteria do not get a chance to stay around the tooth" (TDHP 1)

DISCUSSION

In-depth interviews (one-on-one) were conducted with four dentists and two TDHP. Both Dentists and TDHPs believe that poor oral hygiene is the leading cause of dental plaque formation. According to dentists, tooth plaque can be caused by the build-up of leftover food particles that are not properly removed during teeth cleaning, which interact with micro-organisms present in saliva. This assertion is supported by Radini et al.[16] and Rowińska et al.[17]. Additionally, the traditional practitioner's knowledge confirmed the element of leftover food particles (particularly on fresh meat intake) that could not be supported in the literature as a causal factor of dental plaque. The TDHPs emphasized that plaque formation may be caused by a combination of family hereditary factors [through birth], and studies by Shuler[18] and Bernadi[19] confirm the role of hereditary factors in the formation of dental plaque. Another study by Rostami et al. [20] confirmed the presence and role of extracellular DNA (eDNA) in the early stages of biofilm formation. Additional information from the literature indicates the role genes play in the development of saliva. [21]

Views from traditional practitioners suggest that excessive chewing of kola nuts (locally known as bese in Ghana) can stain plaque due to their natural staining colour. This practice is common among elderly people. Staining plaque has also been attributed to synthetic food dyes. [22] Moreover, studies conducted by Van Swaaij et al.[23] and Benahmed et al. [24] are consistent with the interview findings that an effect of plaque occurs when leftover food particles in tooth plaque interact with microbes, causing teeth discoloration.

During the interview, dentists and TDHP view the effects of dental plaque as bleeding gums, pain, tooth mobility, and mouth odour. Bleeding of the gums (gum disease) occurs particularly during tooth brushing due to the formation of plaque in the affected area. Reviews by De Geest et al. [25] and Murakami et al.[26] are consistent with these findings. This happens because of inflammation of the gums caused by the toxins released by the micro-organisms in dental plaque[27].

Dental plaque can cause tooth pain due to inflammation in the affected area, which worsens as the bleeding increases if left untreated. This can result in tooth mobility, as expressed by both Dentists and TDHPs. This is due to the weakening of the gum region by bacteria in dental plaque. Furthermore, findings from the interviews suggest

that if left untreated, tooth mobility can ultimately lead to tooth extraction and loss, resulting in difficulties with chewing and a negative impact on quality of life. These findings are consistent with studies by De Geest et al. [25]

One of the effects of dental plaque, as indicated by both Dentists and TDHPs in the interview, was mouth odour. Oral malodour is often observed in patients with gingivitis and chronic periodontitis, which are all caused by dental plaque. Tongue microbiota is also thought to play a major role in malodorous gas production, including volatile sulphur compounds (VSCs) such as hydrogen sulphide (H2S) and methanethiol (CH3SH)[28].

Study findings from Hayasaki et al.[29] and Iba and Adamu[30] are consistent with the findings drawn from the interview results, indicating that proper and regular brushing with an appropriate toothbrush and fluoride-containing toothpaste is an effective way to control dental plaque. Experts recommend brushing your teeth twice a day, preferably in the morning and at night before bed.[31] Regular teeth brushing helps to remove hidden dirt and keep teeth clean.

In addition, it is recommended that one visit or consult the dentist every six months for a thorough checkup to detect and treat any potential tooth-related issues, as this remains a key component of treating tooth plaque, as supported by Ng and Fida [32] as well as Fenning et al. [33] In traditional (Indigenous) treatment, findings from Cruz Martinez et al[34], Motallaei et al[35] and Ilic et al[8] reveal that herbal medications are commonly used in treating tooth plaque as indicated by TDHPs in this study. However, the results of our study suggest that the effectiveness of these herbal medications may vary depending on whether the condition is acquired through heredity (by birth) or environmental factors. The key finding in this study is that Dentists recommend orthodox methods for oral hygiene, while TDHPs recommend the use of traditional implements, such as sticks, leaves, tree barks, and plant roots, for oral hygiene. Further studies could be conducted on the oral health status of clients of these two practitioners to see the effective method of dental plaque control.

CONCLUSIONS

Dentists and TDHPs differ in their views on the causes and methods of controlling dental plaque but share similar opinions on the effects of dental plaque. The findings from this study confirmed the importance of good oral hygiene practices in controlling dental plaque, as endorsed by both Dentists and TDHPs and highlighted the clear role of intensifying oral health education in promoting good oral hygiene practices.

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