

**Periodontal Status and Associated Factors in Adults with Hearing
Impairment**



**UNIVERSITY of the
WESTERN CAPE**

**A Master's full thesis submitted in fulfilment of the requirements
for the degree of Magister Scientiae in the Faculty of Dentistry,**

University of the Western Cape

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Abstract:

Hearing impairment contributes significantly to the global burden of disabilities and has reported to be a prevalent disability in South Africa. The hearing impaired population has been associated with low levels of oral health due to numerous factors concomitant with reduced oral health care and knowledge. This predisposes these persons to oral disease including periodontal disease.

Aim: To determine the prevalence of periodontal disease and the associated factors in adults with hearing impairment in designated facilities in the Western Cape, South Africa.

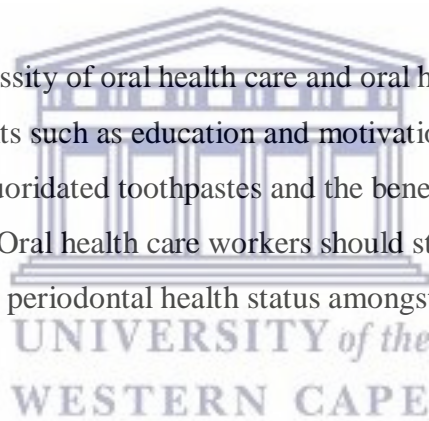
Objectives:

1. To determine the oral health care practices in adults with hearing impairment.
2. To determine oral health knowledge of adults with hearing impairment.
3. To determine the frequency of dental visits of adults with hearing impairment and identify any associated barriers.
4. To determine the prevalence of periodontal disease in adults with hearing impairment in designated facilities in the Western Cape, South Africa.
5. To determine the relationship between the prevalence of periodontal disease and associated factors including; sociodemographic factors, oral health care practices, oral health knowledge and frequency of dental visits in adults with hearing impairment.

Methodology: A quantitative, analytical cross-sectional study design was employed. A research questionnaire was used to evaluate oral health care practices, oral health knowledge, frequency of dental visits and related barriers to access oral health care. An intra-oral examination was conducted to determine the plaque index (PI), gingival index (GI) and clinical attachment loss (CAL) using the Ramjford six teeth. Data was analysed in Microsoft Excel and StataCorp using frequencies, means, standard deviations, confidence intervals, Chi-square and Fishers exact tests.

Results: The prevalence of gingivitis was 100% and the prevalence of periodontitis was 26.09% amongst hearing impaired adults. The mean gingival index score (GI) was 1.24 (STD±0.49; 95% CI: 1.14-1.35) and the mean plaque index score (PI) was 1.3 (STD±0.5; 95% CI: 1.2-1.4). Periodontitis prevalence was established for those participants presenting with an average clinical attachment loss (CAL) of >3mm and the mean clinical attachment loss was 4.47mm (STD ±1.41; 95% CI: 4.18-4.76mm) for those presenting with evidence of periodontitis. Age was statistically significant ($p<0.05$). Prevalence of periodontitis was evident amongst participants over the age of 35 years with a mean age of 48years (STD±13). Oral health care showed a lack of the use of dental floss and regular dental visits. Access to dental care was compromised primarily due to communication barriers, dental fear and a low priority of oral health.

Conclusion: The necessity of oral health care and oral health knowledge in hearing impaired adults such as education and motivation for the need of dental flossing, the use of fluoridated toothpastes and the benefits of regular dental visits, must be emphasized. Oral health care workers should strive to intensify efforts to facilitate a favourable periodontal health status amongst hearing impaired adults.



Declaration:

I declare that “Periodontal Status and Associated Factors in Adults with Hearing Impairment” is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Name: Qaanita Isaacs

Date: 6 May 2019

Signed:



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ABBREVIATIONS

CAL: Clinical Attachment Loss

CEJ: Cemento-Enamel Junction

dB HL: decibels Hearing Level

ICC: Intraclass Correlation Coefficient

SASL: South African Sign Language

VRS: Video Relay Services

DEFINITIONS

Adults – a person who is fully grown or developed

Barrier – obstacle that prevents access

Clinical Attachment Loss (CAL) - the extent of periodontal support that has been destroyed around a tooth

Deaf - partially or fully unable to detect sound frequencies but frequently associated with very little or no hearing ability

Gestures - a movement of part of the body, especially a hand or the head, to express an idea or meaning

Hearing Impairment - a condition where individuals are either partially or fully unable to detect sound frequencies normally heard by other people

Incidence - the number of new cases that develop in a given period of time

Interpreter - one who translates speech orally or into sign language

Mute – not capable of giving out sound or speech

Non-verbal Communication – communication without the use of spoken language

Participant - a person who takes part in or becomes involved in a particular activity

Prevalence - the number of cases of a disease that are present in a particular population at a given time

Ramjford Teeth – specific index teeth used to for epidemiologic studies of periodontal disease (Teeth no's: 16, 21, 24, 36, 41 and 44)

Regular Dental Visits – routine dental attendance where visits are associated with preventative care

Vulnerable - in need of special care, support, or protection because of age, disability, or risk of abuse or neglect



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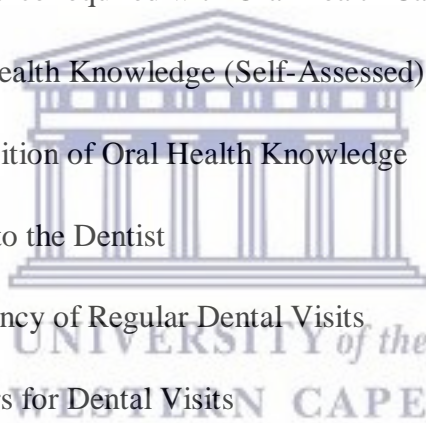
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CHAPTER 1

Introduction

Hearing impairment (HI) is one of the largest contributors to the global burden of disabilities (Ramma and Sebothoma, 2016). Hearing impairment influences the communication process and ultimately psychosocial wellbeing and quality of life (Peer, 2015). It is well documented that individuals with disabilities have an increased risk of poor oral health as dental care is often neglected (Yadav, *et al*, 2017).

This negligence of dental care in the hearing impaired may be attributed to various factors including problems with communication, with a consequent reduction in the acquisition of oral health information, socio-economic status, insufficient access, an underestimation of treatment needs and attitudes of parents and/or members of the dental team (Yani, 2010; Samnieng, 2014; Sandeep, *et al*, 2014; Hamad, *et al*, 2015; Khokhar, *et al*, 2016; Yadav, *et al*, 2017).

It has been reported that 40% of hearing impaired individuals have poor oral health and only 64% have regular dental visits (Hamad, *et al*, 2015). This predisposes them to oral diseases especially caries and periodontal disease (Al-Qahtani, *et al*, 2017).

Periodontal disease is prevalent worldwide. Periodontal disease includes both gingivitis and periodontitis and its prevalence appears to increase with age (Madiba and Bhayat, 2017). It is a multifactorial oral disease with risk factors that most commonly include inadequate oral hygiene as well as smoking and diabetes. (Lertpimonchai, *et al*, 2017). A lack of oral hygiene practices results in dental plaque accumulation and has a direct correlation to the occurrence of gingivitis (Nisha, *et al*, 2017). Persistent gingivitis is a key risk factor for periodontitis affecting the supporting structures of teeth and may progressively lead to tooth loss (Peterson and Ogawa, 2012).

Chapter 2

Literature Review

Hearing Impairment

Hearing impairment is a condition where individuals are either partially or fully unable to detect sound frequencies normally heard by other people (Khokhar, *et al*, 2016). The term “deaf” is the general term commonly used to denote the above but frequently associated with very little or no hearing ability or a profound hearing impairment (Naidoo, 2014; Al-Qahtani, *et al*, 2017). Severity of hearing impairment may be categorized into unilateral (<20 dB HL in the better ear; ≥35 dB HL in the worst ear), mild (24-34 dB HL), moderate (35-49 dB HL), moderately severe (50-64 dB HL), severe (65-79 dB HL) and profound (80-94 dB HL). A moderate hearing impairment may be associated with difficulty in hearing a normal voice in a quiet environment whereas a profound hearing impairment is associated with great difficulty of hearing in a quiet to no hearing ability in a noisy environment (Stevens, 2011).

Approximately 360 million people worldwide live with disabling hearing impairment. Of this, about 32 million are children below the age of 15 years and prevalence rates are eminent in developing countries that include sub-Saharan Africa, South Asia and Asia Pacific (Olusanya, *et al*, 2014).

The aetiology for developing hearing impairment can be congenital or acquired. Congenital hearing impairment may be due to genetic influences which include congenital anomalies or deformities and persons with a familial history with or without syndromes related to impaired hearing (Singh, *et al*, 2012; Khokhar, *et al*, 2016). It may furthermore be due to both prenatal and perinatal factors which may be preventable or treatable. Prenatal maternal factors include rubella, influenza, syphilis, hypertension, human immune virus (HIV) and the use of ototoxic drugs. Perinatal factors may include preterm birth, low birth weight, birth trauma, severe viral infections such as herpes simplex or cytomegalovirus, severe jaundice, the use of ototoxic drugs and toxemia late in pregnancy (Olusanya, *et al*, 2014; Khokhar, *et al*, 2016).

Acquired hearing impairment may be as a result of various sources including injury, infections and drug toxicity. Other conditions related to hearing impairment acquired in adulthood may include the exposure to excessive and /or prolonged noise, otosclerosis and presbycusis (gradual hearing loss as one gets older) (Singh, *et al*, 2012; Olusanya, *et al*, 2014).

There is an upward trend in prevalence and this can be ascribed to several factors including longer life expectancy rates that expose more people to gradual hearing loss as they get older, the increased use of ototoxic medications used to treat infections and viruses; and the lack of regulations on environmental and occupational noise (Olusanya, *et al*, 2014).

Hearing impairment influences the communication process and ultimately psychosocial wellbeing and quality of life. If the onset is early in life, it has an impact on speech and language development and this limits participation in society and educational achievement that modifies overall development and maturation. In adulthood, social isolation, stigmatisation and economic disadvantage are apparent factors (Olusanya, *et al*, 2014; Peer, 2015).

The age of onset plays a major role in the acceptance of the disability and children with hearing impairment are often neglected, leading to the development of negative attitudes. Hence, parents significantly influence the psychological adjustment of the hearing impaired child. There has, however, also been an association with an increased risk of physical, social, emotional and even sexual abuse amongst hearing impaired children (Olusanya, *et al*, 2014).

The Nunavik Inuit Health survey 2004 revealed that hearing loss had a great effect on educational achievement in Quebec, Canada and indicated that only 31% of adults aged 21-44 years had completed a secondary school education (Ayukawa, *et al*, 2007). Psychological disadvantages have also been recognised leading to depression, anxiety, occupational stress and an increased risk of dementia in adults (Olusanya, *et al*, 2014; Ramma and Sebothoma, 2016).

Disability and Hearing Impairment in South Africa

The WHO defines disability as “a term, covering impairments, activity limitations, and participation restrictions, referring to the negative aspects of the interaction between an individual (with a health condition) and that individual’s contextual factors (environmental and personal factors)” (WHO, 2011).

In South Africa, disability prevalence in 2011 was an estimate of 7.5% of the population with a higher prevalence amongst females as well as an increased prevalence associated with an increase in age (Statistics, South Africa, 2011). Sight impairment followed by physical impairment and thirdly hearing impairment are the most frequent disabilities in the country. The Western Cape is associated with lower total disability prevalence rates when compared to other provinces, though a high prevalence rate of physical disability amongst men (27%) has been reported (Phillips and Noubissi, 2004; Susuman, *et al*, 2014).

People with disabilities in South Africa face challenges in education and employment opportunities. In addition, the disabled have also been recognised as a vulnerable group who are likely to have problems in accessing health care. Access to health care has been restrained due to costs, a lack of services available, a lack of transport and problems encountered with quality services relating to inadequate equipment and being badly treated at facilities (Eide, *et al*, 2015).

As mentioned previously, hearing impairment is third most prevalent disability in South Africa yet limited data is available with regard to this disability. The prevalence of hearing impairment in sub-Saharan Africa for adults 15 years and older is estimated to be 11.5% to 20.3% (Louw, *et al*, 2018). This prevalence is thought to be underestimated which may be attributed to babies not been screened for hearing impairment since only 7.5% of public hospitals offer some form of infant hearing screening due to a lack of staff and equipment (Peer, 2015). When prevalence rates of hearing impairment were determined in primary health care clinics in Tshwane, South Africa, a prevalence of 17.5% was reported of which most were bilateral and were of a sensorineural nature (Louw, *et al*, 2018). In the Cape Town Metropolitan area, prevalence of hearing impairment was 12.35% and

was confirmed to have a much higher estimate than those received through the national population census (Ramma and Sebothoma, 2016).

An estimated incidence of six per 1000 live births are born with permanent hearing loss in Sub-Saharan Africa. The average diagnosis of hearing loss in South Africa has reported to be between 23 and 44.5 months. This contradicts the recommended diagnostic age of 3 months but is likely related to the lack of hearing screening in the country. Irrespective, early diagnosis is essential for early intervention. In sub-Saharan Africa, intervention strategies such as hearing aid fitting, enrolment in early intervention services and eventual cochlear implantation are often delayed further due to financial and other resource limitations (Le Roux, *et al*, 2015).

Research by Le Roux, *et al*, related to profound childhood hearing loss in South Africa revealed that risk factors for permanent childhood hearing loss was neonatal intensive care unit admittance, a family history of childhood hearing loss and premature birth (Le Roux, *et al*, 2015). Ramma and Sebothoma also found a strong relationship to a family history of hearing impairment when prevalence rates was determined in the Cape Metropolitan area, as well as a history of hypertension and head and neck trauma (Ramma and Sebothoma, 2016).

Deaf education in South Africa has largely been influenced by apartheid, which was based on discrimination due to race and culture, impacting language development and access to education for hearing impaired individuals (Storbeck and Martin, 2010). This resulted in few individuals trained in sign language and a shortage of educators for deaf schools leaving the hearing impaired with restrictions to a formal education. Consequently, those with no education or a poor education are excluded from tertiary education and professional employment opportunities. Although an improvement has been noted over time, challenges with access to education still persist. Numerous appeals for the recognition and development of South African Sign Language (SASL) have been put forth aiming to eliminate linguistic discrimination against the hearing impaired in South Africa. This is intended to decrease the barriers associated with education attainment

whilst creating equal employment opportunities and participation in society (Storbeck and Martin, 2010).

Hearing Impairment and Oral Health Care and Knowledge

Oral health is: “the standard of health of the oral and related tissues which enables one to eat, speak and socialize without active disease, discomfort and embarrassment and which contributes to general wellbeing” (Hamad, *et al*, 2015). Oral health is vital for adequate mastication, speech and an aesthetically acceptable appearance. Poor oral health can therefore lead to inadequate function and an unacceptable appearance which may lead to psychological and social consequences affecting self-esteem, confidence and socialization (Hamad, *et al*, 2015).

It is well documented that individuals with disabilities have an increased risk to poor oral health as they are often neglected with regard to dental care. This can be attributed to the fact that medical health and/or their disability takes priority as well as financial and/or social constraints (Yadav, *et al*, 2017; Patil, *et al*, 2017).

Dental care negligence in the hearing impaired is often related to the attitudes of parents and health care providers, the lack of cleaning ability as a result of less acquired information on oral health, socio-economic status, insufficient access and underestimation of treatment needs as well as communication and co-operation problems (Yani, 2010; Samnieng, 2014; Sandeep, *et al*, 2014; Hamad, *et al*, 2015; Khokhar, *et al*, 2016; Yadav, *et al*, 2017).

In a study by Hamad, *et al*, evaluating the oral health status of hearing impaired individuals aged 6-22yrs; 40% of participants had poor oral hygiene where 50% were not brushing more than once a day and 70% were not using any dental floss. The majority of participants did brush their own teeth (78%) and education on this seemed to be influenced mainly by family, followed by schools and television indicating that additional care by the parents and/ or the oral health care providers could improve oral health status (Hamad, *et al*, 2015).

Hearing Impairment and Frequency of Dental Visits

Hearing impaired individuals are reported to have extra barriers in accessing health and oral health care. This is linked to communication problems as the disability is not initially obvious and often associated with a lack of speech. Alternate methods of communication such as lip reading, sign language, finger spelling and interpreters are often relied upon. Hence, communication in the dental setting is compromised and dental staff should include non-verbal communication, remove masks when communicating, reduce background noise when possible and learn simple signing to improve the communication process (Samnieng, 2014; Singh, *et al*, 2017).

Siddiqi (2016) scrutinized the barriers related to dental care in the hearing impaired in Canada. The most common barriers were related to communication, financial barriers and negative attitudes of dentists. A hearing impaired person communicates generally with the dentist through interpreters, lip reading, writing or gestures. Frustration of a hearing impaired individual is often exhibited from the time the dental appointment is made as most dentists schedule appointments telephonically which creates dependence on family members relaying the information for the dental appointment. It was recommended that dentists communicate this information via text or email although this may increase the barriers for some not being literate or having a low level of education. Video Relay Services (VRS) was also recommended as the hearing impaired individual would then be allowed to communicate in their own language however, difficulties may be encountered as the dentists would be required to have knowledge of sign language and the hearing impaired individual and dentist would require access and be familiar with technological aspects of this method.

The most common forms of communication at the dental facility was writing and gestures as dentists are often not familiar with sign language. Hearing impaired individuals found this time consuming and that it limited explanations about treatment procedures. The alternative use of an interpreter was accepted but it was highlighted that communication using interpreters may also be limited if they

were not familiar with dental terms creating inadequate explanations (Siddiqi, 2016). The use of interpreters was also accentuated with regard to financial implications along with the high costs of dental treatment. It was queried whether the cost associated with employment of interpreters was the responsibility of the hearing impaired patient or the dentist.

Negative attitudes of the dentist were usually associated with the lack of training and awareness. It was presumed that this contributed to the unacceptance by dentists to having persons with disabilities as patients (Siddiqi, 2016).

Recent studies indicate that there is hence a lack of or absence of the hearing impaired in visiting the dentist. A study by Al-Qahtani, *et al*, disclosed that 40% of hearing impaired individuals that participated in the study had never visited a dentist before (Al-Qahtani, *et al*, 2017). Similarly, the study by Hamad, *et al*, revealed that only 64% visited the dentist regularly (Hamad, *et al*, 2015). This is likely attributed to the barriers relating to communication with a subsequent decrease awareness of oral health education and care (Doichinova and Peneva, 2015).



Oral Health in South Africa

South Africa is the second largest country in Africa and is currently ranked as having an upper-middle income economy with a population estimate of 55.6 million (Statistics, South Africa, 2016). Despite this, the country has numerous socio-economic challenges related to poverty, high unemployment rates, low income levels, poor living conditions, the lack of basic services and high levels of crime and violence (Nel and Grosser, 2016). This is linked to the inequalities of service access and interrelated to barriers encountered with access. Though, education was found to have a positive impact on reduction of these barriers particularly in South Africa as it was associated with the will to reduce poverty and an increase in income (Eide, *et al*, 2015). Socio-economic position also has an effect on oral health quality of life in South Africa. Ayo-Yusuf, *et al*, found that South Africans in a lower socio-economic position were more likely to utilize

public dental facilities which are often affiliated with a dissatisfaction with dental services related to long waiting times, painful procedures and rude staff (Ayo-Yusuf, *et al*, 2016). Another study by Ayo-Yusuf, *et al*, reported that area-level deprivation had a negative impact on oral health (Ayo-Yusuf, *et al*, 2016).

Above and beyond this, the lack of oral health service provision is well reported in the country. This is coupled with only 18% of the population being insured by private medical aids with the rest being dependant on public health services. Most South Africans are therefore forced to rely on the public sector for oral health care. Moreover, most public dental facilities in the country have limited availability of treatment services and emergency pain and sepsis relief is the most commonly performed clinical procedure (Niranjan and Knight, 2017). In the Western Cape, South Africa, an estimated 4.5 million of the estimated 5.8 million population are uninsured and are dependent on public dental clinics in the province for oral health care. Of the approximated 130 public dental clinics in the Western Cape, 65% only offer dental extractions as patients often present with pain and sepsis which becomes the priority of the dentist. A mere 31.5% of the clinics offer a basic oral health package which includes oral health promotion and examinations, bitewing radiographs, restorations of hard tissue and dental extractions. Less than half (43%) offer a scale and polish and along with low levels of oral health care, these circumstances are expected to influence the prevalence of oral disease in the province (Smit and Osman, 2017).

In a study by Africa and Reddy, that investigated tooth loss in South Africa in the Western Cape, it was found that tooth loss was associated with age (Africa and Reddy, 2013). The majority of public dental clinics providing dental extractions as the only form of treatment may also contribute to the high edentulous rates observed in the country. Edentulism is a prevalent phenomenon in South Africa and a prevalence of 33% in those over the age of 15years has been reported in the Western Cape (Adam, *et al*, 2007). Essentially, in the Western Cape tooth removal is elevated and often intentional as a result of certain behaviours and social pressures (Friedling and Morris, 2007).

Periodontal Disease

Periodontal disease is an oral disease that significantly contributes to the global burden of chronic disease as it is highly prevalent worldwide (Petersen and Ogawa, 2012). In South Africa, prevalence rates of periodontal disease are scarce with a paucity of data for comparison.

Periodontal disease includes both gingivitis and periodontitis and result in an inflammatory response and chronic destruction of the supporting tissues of the teeth. Gingivitis is associated with an inflammatory response in the gingivae only whilst periodontitis includes the destruction of the supporting tissues of teeth (Madiba and Bhayat, 2018).

Clinical signs of gingivitis include the presence of gingival inflammation and reddened, swollen gingiva which may bleed easily exclusive of connective tissue loss. Periodontitis includes deepening of periodontal pockets and loss of attachment which may lead to tooth loss. Periodontal disease prevalence increases with age, is more prevalent in males and is associated with poor oral health as a result of a low socioeconomic status (Petersen and Ogawa, 2012).

Risk factors associated with periodontal disease are multifactorial and its presence implies a direct probability of the disease occurring (Madiba and Bhayat, 2018). Dental plaque is the primary etiological factor for periodontal disease in addition to the host response. Dental plaque accumulation is directly related to oral hygiene practices which is key to prevention of periodontal disease. Additional risk factors, amongst others, include; age, gender, socioeconomic factors, smoking and systemic diseases including diabetes. The relationship associated with smoking and diabetes with the prevalence of periodontal disease is well-established (Petersen and Ogawa, 2012; Madiba and Bhayat, 2018). Africa and Reddy reported that females had better oral health than males as a result of lower plaque and gingival index scores, and less loss of gingival attachment in a sample of individuals just outside Cape Town, South Africa. Males were found to have inferior oral health due to unreliable cleansing and smoking habits (Africa and Reddy, 2013).

Risk Factors for Periodontal Disease

Dental Plaque:

The accumulation of dental plaque may be due to substandard oral hygiene associated with irregular oral hygiene practices. Inadequate oral health care is common in middle and low income countries and is linked to level of education (Petersen and Ogawa, 2012). Dental plaque accumulation may be a result of improper brushing techniques, inadequate interdental cleaning and irregular dental visits (Lertpimonchai, *et al*, 2017).

Dental plaque is a microbial biofilm and has a direct correlation to the occurrence of gingivitis. Periodontitis results from complex interactions of micro-organisms and the immune system (Nisha, *et al*, 2017).

Over 400 microbial species are found in subgingival plaque but only a small number is relevant in the etiology and progression of periodontal disease. Bacterial species implicated in the etiology include *Porphyromonas gingivalis* and *Actinobacillus actinomycetemcomitans*, and in addition, *Bacteriodes forsythus*, *Prevotella intermedia*, *Peptostreptococcus micros* and *Fusobacterium nucleatum* play a role in the progression of periodontitis (AlJehani, 2014).

Regular tooth brushing is said to reduce periodontitis by 34%. Twice daily brushing with a fluoridated toothpaste for the proper duration and using an efficient technique is endorsed along with interdental plaque removal (Lertpimonchai, *et al*, 2017).

Age:

The prevalence and severity of periodontal disease has been substantiated in several studies to increase with age. This may be related to the duration of time the periodontium is exposed to bacterial plaque and is a result of the cumulative effect of a chronic infection. Studies report that bone loss and advanced periodontal disease is infrequently observed in individuals under the age of 40 years and those with advanced forms tend to progress with an increase in age (AlJehani, 2014).

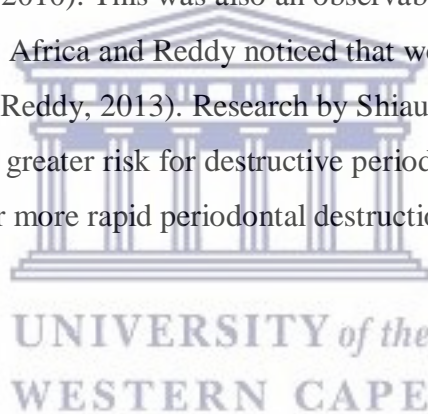
Gender:

The relationship between gender and prevalence of periodontal disease is inconsistent as other factors related to genetic predispositions and socio-behavioural factors need to be considered (Kazem, *et al*, 2017). However, establishing gender differences in the development and progression of periodontal disease is imperative for understanding the pathogenesis of periodontitis (Shiau and Reynolds, 2010).

Males have been characterized as having higher prevalence rates of attachment loss, gingival bleeding and probing depths than females. The higher probability may also be relevant to behavioural factors related to a higher smoking prevalence and excessive dental plaque detected amongst males when compared to females (Shiau and Reynolds, 2010). This was also an observable fact in the Western Cape, South Africa as Africa and Reddy noticed that women had better oral health than men (Africa and Reddy, 2013). Research by Shiau and Reynolds concluded that males appear at a greater risk for destructive periodontal disease but evidently not at a higher risk for more rapid periodontal destruction (Shiau and Reynolds, 2010).

Education:

Gingival health is dominant amongst individuals with higher education levels and a dependable income. AlJehani states that periodontal disease has a reciprocal relationship with education level and the higher the education level, the lower the occurrence of periodontal diseases (AlJehani, 2014). Low income and rural residence has also been associated with a significant risk for attachment loss. The increased risk of periodontal disease with a low income and/or education level also seems to be ascribed to several behavioural and environmental factors (Mehta, 2015).



Diabetes:

Diabetes is a known risk factor for periodontal disease and both type 1 and type 2 diabetes increases the prevalence of periodontal disease. An increase in blood glucose level has a strong relation to periodontal disease and poorly controlled diabetics are generally predisposed to periodontal infection and exaggerated bone loss (Mehta, 2015). An early age of onset and more severe forms of periodontal disease is also evident amongst diabetics specifically when it is poorly controlled. A well-controlled diabetic has seen to have a favourable response to periodontal therapy and can often maintain their periodontal health (AlJehani, 2014).

Smoking:

Second to bacterial plaque, smoking is a strong modifiable risk factor for periodontal disease. Smoking increases the risk for periodontal attachment loss which is usually dose dependant. An increased rate of periodontal disease progression and tooth loss is also evident in smokers when compared to non-smokers (Johnson and Guthmiller, 2007).

Tobacco smoking modifies the host response to bacteria in microbial plaque and therefore favours colonization of pathogens. Smokers with periodontal disease often present with less clinical gingival inflammation and bleeding than non-smokers. This may be attributable to the vasoconstrictive properties of nicotine which reduces blood flow to the gingival tissues (AlJehani, 2014).

Hearing Impairment and Periodontal Disease

The hearing impaired has a greater risk for oral disease due to neglect, poor oral hygiene and limited access to routine dental care (Samnieng, 2014). In fact, the majority of studies indicate that hearing impaired individuals display higher levels of the main oral diseases such as caries and periodontal disease, than their unaffected counterparts (Al-Qahtani, *et al*, 2017).

A limitation in oral health care leads to an increase in plaque biofilm accumulation and ultimately the acquisition of gingival disease with no

intervention. Plaque scores are particularly high in the hearing impaired as well as bleeding of the gingiva (Yadav, *et al*, 2017).

A recent study by Sandeep, *et al*, uncovered plaque scores indicating that up to 81% of the hearing impaired individuals in the study had moderate to abundant deposits of plaque and 78% exhibited a moderate to severe gingivitis (Sandeep, *et al*, 2016). Similarly, whilst evaluating the periodontal status of hearing impaired individuals, Yadav, *et al*, observed that more than 45% had bleeding on probing, 30% presented with calculus deposits and loss of periodontal attachment was detected in individuals over the age of 15 years, indicating poor periodontal conditions (Yadav, *et al*, 2017). A 55% prevalence of periodontal disease amongst hearing impaired students in Thailand was evident in a national oral health survey affirming an elevated prevalence when compared to normal hearing individuals (Sandeep, *et al*, 2016; Yadav, *et al*, 2017).



Chapter 3

Aim:

To determine the prevalence of periodontal disease and the associated factors in adults with hearing impairment in designated facilities in the Western Cape, South Africa.

Objectives:

1. To determine the oral health care practices in adults with hearing impairment
2. To determine oral health knowledge of adults with hearing impairment
3. To determine the frequency of dental visits of adults with hearing impairment and identify any associated barriers
4. To determine the prevalence of periodontal disease in adults with hearing impairment in designated facilities in the Western Cape, South Africa.
5. To determine the relationship between the prevalence of periodontal disease and associated factors including; sociodemographic factors, oral health care practices, oral health knowledge and frequency of dental visits in adults with hearing impairment

Research Question:

Is there periodontal disease in patients with hearing impairment in the Western Cape, South Africa? What are the associated factors?

Statement of the Problem:

Most available studies indicate high levels of oral disease and limited oral health care in the hearing impaired (Samnieng, 2014). Currently, there are few published reports related to oral health and hearing impairment in South Africa.

Prevalence rates of hearing impairment are believed to be greater in developing countries which include Sub-Saharan Africa. A literature search revealed that there are no published studies that investigated the prevalence of periodontal

disease and the associated factors in adults with hearing impairment in South Africa.

Null Hypothesis:

There is no periodontal disease and no associated factors in adults with hearing impairment in the Western Cape, South Africa.



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Chapter 4

Research Methodology:

Objectives 1, 2, 3

A research questionnaire with close-ended questions evaluated (1) oral health care practices, (2) oral health knowledge and the (3) frequency of dental visits. See Appendix 1 (page 72)

Objectives 4, 5

Examination of the participant was completed independently by the principal researcher and two independent assistant examiners. Assistant examiners were experienced oral hygienists. The attached form was used as a guide (See Appendix 2 (page 74)) to review and assess the following:

- Participant age and gender
- Medical history
- Severity of hearing impairment
- Social history with regard to smoking and alcohol consumption status
- ***The Plaque Index (Silness & Loe, 1964) and Gingival Index (Loe & Silness, 1963) scores were calculated and pocket depths, gingival recession, clinical attachment loss (CAL) and tooth mobility was evaluated and recorded using the Ramfjord six teeth. This was performed using a Michigan design periodontal probe and dental mirror.

***Intra-oral examinations, indices and recordings were performed with adequate dental light and optimal access as a mobile dental unit was utilised for these procedures. Periodontal probes were inspected to ensure that all are identical in order to produce accurate results and ensure inter-rater reliability. When any of the Ramfjord index teeth were missing, the adjacent tooth was examined. When multiple Ramfjord teeth were missing, the total plaque and gingival index scores was calculated based on the number of surfaces examined. Clinical attachment loss (CAL) was calculated using the average score obtained from available Ramfjord teeth

recordings. Periodontal pocket depths were recorded with a measurement from the gingival margin to the base of the pocket. Gingival recession was then measured from the cemento-enamel junction (CEJ) to the gingival margin. These measurements were added for each tooth to determine clinical attachment loss (CAL). It was established that an average clinical attachment loss (CAL) of >3mm exhibited evidence of periodontitis. All procedures were done adhering to standard infection control procedures.

Currently, there is no universal method for the measurement of periodontal disease making it difficult to authenticate patterns of periodontal disease over time. Indices are methods which may be used to classify periodontal status of a patient or a population. In order to obtain a relatively fast representation of periodontal status, plaque and bleeding levels are central for determining periodontal health and disease. It has been established that bacterial plaque is a determining factor for periodontal bleeding and inflammation and that plaque scores are in direct correlation with bleeding on probing severity (Feier, *et al*, 2009).

The plaque index (PI) was developed by Silness and Loë in 1964 and allows a quantitative estimate of the amount of plaque on a tooth surface (Feier, *et al*, 2009). It is one of the most commonly used indices used to evaluate plaque and has good reliability and validity (Joshi, *et al*, 2012). Each examined tooth surface is marked with a score from 0 to 3 as follows:

Score	Criteria
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth which may be seen by using the sample on the tooth surface.
2	Moderate accumulation of soft deposits within the gingival pocket, or the tooth and gingival margin which may be seen with naked eye.
3	Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

(Feier, *et al*, 2009)

The plaque index is obtained by adding the tooth scores together and dividing it by the number of teeth examined. A score of 0.1 to 1.0 indicates a small amount of plaque, a score of 1.1 to 2.0 is indicative of a moderate amount of plaque and a score of 2.1 to 3.0 indicates a considerable amount of plaque detected (Feier, *et al*, 2009).

The gingival index (GI) was developed by Loë and Silness in 1963 aimed at assessing the gingival condition by recording qualitative changes in the gingiva. It may be used for assessment of prevalence and severity of gingivitis. Advantages include a good sensitivity and reproducibility which is reliant on examiner knowledge of periodontal biology and pathology (Rebelo and de Queiroz, 2011). Each examined tooth surface is also marked with a score from 0 to 3 as follows:

Score	Criteria
0	Normal gingiva
1	Mild inflammation: Slight change in colour and slight oedema. No bleeding on probing.
2	Moderate inflammation: Redness, oedema and glazing. Bleeding on probing.
3	Severe inflammation. Marked redness and oedema, ulceration with a tendency to spontaneous bleeding.

(Rebelo and de Queiroz, 2011)

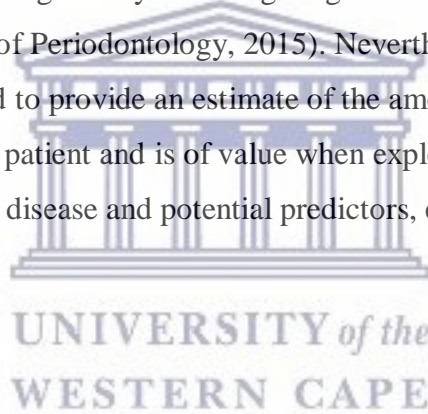
The gingival index score is calculated similar to the plaque index score. It is obtained by adding the tooth scores together and dividing by the amount of teeth examined. A score of 0.1 to 1 indicates mild inflammation, a score of 1.1 to 2 indicates moderate inflammation and a score of 2.1 to 3 is indicative of severe inflammation of the gingiva. Scores may be calculated using all surfaces or selected surfaces on all or selected teeth (Rebelo and de Queiroz, 2011).

The identification of periodontitis is based on clinical findings of periodontal pockets, clinical attachment loss and radiographic bone loss; and often a combination of these factors (Shaju, 2011). In 1997, the WHO suggested including loss of periodontal attachment in oral health surveys (Petersen and

Ogawa, 2015). Clinical attachment loss still remains the “gold standard” for diagnosing periodontitis and has been documented as an important feature for the advancement of knowledge of periodontitis. The Extent and Severity index approach was found to be appropriate in some instances, where the extent was the number of teeth in the mouth with a clinical attachment loss of >1mm and the severity was based on mean clinical attachment loss for those teeth (Hatem, 2012). Correlations for assessing pocket depth and clinical attachment loss using Ramjford teeth and using a full mouth assessment are both positive and significant (Vettore, *et al*, 2007). The American Academy of Periodontology categorized the severity of clinical attachment loss as: Slight=1-2mm; Moderate=3-4mm and Severe= >5mm. Though it was made mention of the challenges associated with determining clinical attachment loss; which included the location of the cemento-enamel junction not being readily evident giving rise to inaccurate measurements (American Academy of Periodontology, 2015). Nevertheless, mean attachment loss has been affirmed to provide an estimate of the amount of periodontal destruction in a given patient and is of value when exploring trends and relationships between disease and potential predictors, e.g. smoking status (Shaju, 2011).

Study Design

A quantitative, analytical cross-sectional design was employed. Cross sectional studies are conducted to estimate the prevalence of the outcome in a population of interest. It also allows opportunity for the investigation of risk factors associated with the outcome providing countless information related to the outcome (Levin, *et al*, 2006). A major limitation is that these studies may determine an association between an exposure and outcome though it cannot be assumed that the exposure caused the outcome. Moreover, prevalence rather than incidence of the outcome is evaluated which may result in under-representation of the outcome due to previous mortality (Carlson and Morrison, 2009).



Study Population

Participants with hearing impairment or referred to as “deaf” enrolled at the following three hearing institutions in the Western Cape, South Africa: National Institute for the Deaf (NID), Alwaagah Institute for the Deaf and The Deaf Community of Cape Town (DCCT).

National Institute for the Deaf (NID)-Adult Care Division

Adult Care at NID was established in 1978 as Lewensruimte (living space) for the Deaf in Worcester in the Western Cape, South Africa. It is a community that renders services and training to develop the full potential of Deaf persons. Though situated in Worcester, it accommodates beneficiaries from all over South Africa.

Alwaagah Institute for the Deaf

Al-Waagah is the only Deaf Islamic institution in Cape Town, South Africa. It is a non-profit organization which was established in 1995 with the objective of educating and empowering the Deaf Muslim community to take up their rightful place in society and in doing so, eliminate the trail of stigmatism.

The Deaf Community of Cape Town (DCCT)

DCCT is a non-governmental welfare organization that was established in 1987 whose aim is to address the needs of Deaf people in the Western Cape. DCCT has been involved in a number of awareness campaigns and have been focused on positively changing the education system for Deaf. The organization provides a number of self-help projects designed to empower Deaf people vocationally and socially.

Inclusion Criteria:

All hearing impaired or “deaf” participants at the institutions

Ages 16 years and older

Exclusion Criteria:

Participants not willing to participate

Edentulous participants

Sample Size

Statistical analysis with regard to sample size has been completed. The final sample accounting for withdrawal and loss was an estimate of 150 participants. However, the final sample size was 92 participants. Main reasons for this reduction included the fact that this was a convenience sample and dependant on participant presence on the day. A low participation was stumbled on at all three institutions. The other justification is based on the high edentulous rate in the Western Cape and even though present, these participants had to be excluded as edentulism was irrelevant to the aim of this study.

Sample Procedure:

A convenience sample was included where participants from the three institutions were approached to take part in the study. Enquiries for their participation and arrangements to accommodate the participants in attending the sessions were made for completing the questionnaire and the intra-oral evaluation. Participation was voluntary.

Data Collection

The principal researcher and two assistant examiners interviewed the participants with the aid of an interpreter from The Deaf Federation of South Africa (DEAFSA) or residing at the institute. The principal researcher and two assistant examiners evaluated the periodontium for evidence of periodontal disease. Both assistant examiners are experienced qualified oral hygienists. An accompanying dentist confirmed any uncertainties that arose with regard to diagnosis on all visits. All appendices (1-4) were completed for each participant at one visit on scheduled dates.

Data Analysis

Data analysis was in consultation with a statistician. Data was captured and analysed in Microsoft Excel and StataCorp.2017 (Stata Statistical Software: Release 15). Frequencies, means, standard deviations and confidence intervals

were determined. Statistical significance was set as $p < 0.05$ for Chi-square (a) or Fisher's Exact tests (b) to determine statistical significant difference between variables.

Validity

Validated indices (PI (Silness & Loë 1964) and GI (Loë & Silness, 1963)) and recordings to determine clinical attachment loss, used with similar research, was used which both the principal researcher and the assistant examiners are familiar with. The study had no control group and outcomes were compared to similar studies. Due to a lack of published research on the research topic, all related research was considered and not discerned exclusively for developing countries and therefore outcomes may not be specific in this context. Further studies are required on the topic to support the findings of this study due to the small sample size obtained in this study. Due to sample size constraints, all participants willing to participate were included in the study regardless of those who had additional factors (i.e. other disabilities) that may have impacted on the outcome. Though, it can be confirmed that none of the participants were blind and none had a physical impairment affecting the upper extremities.

Reliability

An interpreter at the institution or outsourced by DEAFSA was utilised when completing the questionnaires to eliminate any miscommunication and ensure understanding by the participant. Three examiners independently performed all clinical tasks (examinations) and mutually confirmed the results and diagnosis to exclude any concern about inter-examiner variability. Calibration between the principal researcher and assistant examiners for determining clinical attachment loss (CAL) was done prior to the commencement of this study. Reliability scores were hence not assessed on the actual sample. The intraclass correlation coefficient (ICC) was used as the reliability index to determine inter-rater reliability. The obtained ICC value for examiner 1 and examiner 2 for average CAL scores was 0.95 (95% CI: 0.818-0.988) indicating excellent reliability. The ICC value for examiner 2 and examiner 3 for average CAL scores was 0.793 (95% CI: 0.37-0.944) indicating good reliability.

Ethics:

Ethical clearance for this study was applied for from the University of the Western Cape's Research and Ethics Committee (Ethics Reference Number: BM18/1/12). Permission documents from the involved facilities for this study were obtained prior to commencement of the study and were forwarded with the application. Participants were provided with an information sheet indicating what the study was about (Appendix 3 (page 76)). According to the Declaration of Helsinki of the World Medical Association, informed consent was obtained from all participants (BMJ, 1996) (Appendix 4 (page 77)). An interpreter at the institution or outsourced from DEAFSA was used when relaying information about the study, completing the questionnaires and completing consent forms; and as an aid to answer any questions from participants pertaining to this research project. Interpreters were briefed beforehand on the requirements to meet the objectives of the study and guided by an oral health care worker whilst interviewing participants to promote clarity during the interview process.

All participants were assured that all information provided would be strictly confidential and anonymous as they will be allocated numbers. All of the data was kept secure in a locked cabinet and will be kept for a duration of 3 years and subsequently destroyed by incineration. Only the principal researcher had access to the documents.

Standard infection control procedures were adhered to for all clinical procedures. Participants was advised and referred if any dental treatment was required but no dental treatment was provided as part of this study due to time constraints. Oral health education was provided with the use of audio-visual aids and an interpreter. Participants was referred to the oral health clinics at the Tygerberg Oral Health Centre, Mitchell's Plain Oral Health Centre or public dental clinics that were more easily accessible.

Dental professionals are guided by a professional ethical code of conduct. Informed consent is an ethical and legal principle and valid consent should be obtained for any physical investigation or treatment in patient care or when conducting research on human participants. For research purposes it can be

defined as “ the process of agreeing to take part in a study based on access to all relevant and easily digestible information about what participation means, in particular, in terms of harms and benefits” (Kakar, *et al*, 2014). Regulations governing research with human participants specify that the information provided to participants should be accessible and graspable in their own language. This will allow participants to make an informed decision and by having an understanding of the information that is delivered, voluntary participation may be assured (Mckee, *et al*, 2013).

According to the guiding principles pertaining to ethics for research in South Africa, values of beneficence, non-maleficence, justice and respect for persons should be adhered to. Respect for persons includes treating participants with respect for their individual autonomy which is linked to informed consent (Health Professions Council of South Africa, 2008). It also involves respect for human rights and the South African Constitution (Bill of Rights, Section 9) stipulates that “Everyone has the right to equal protection and the full enjoyment of all rights and freedoms. One cannot be discriminated against on the basis of race, gender, sex, pregnancy, disability, sexual orientation, age, culture or language” (South African Human Rights Commission).

Beneficence embraces that researchers must always act in the best interest of the participant and efforts should be made to secure their well-being. The hearing impaired has been reported to be neglected by dental care practitioners by not being appropriately informed about their disease condition, treatment and prognosis (Suhani, *et al*, 2015). Suhani, *et al*, revealed that 16.8% of dental practitioners had refused to treat hearing impaired individuals at least once in their career, and 26.05% indicated that on occasion, confidentiality was not respected. This may be attributable to almost all dental practitioners in their study acknowledging having difficulties in communicating with hearing impaired individuals (Suhani, *et al*, 2015). It is advised that dental practitioners must have or develop skills to empower an ethical and empathetic interaction with patients presenting with special needs and by the same token inculcating confidence in the dental profession (Naidoo, 2014).

Justice in terms of research implies that researchers must attempt to address past inequities in the wider community and aim to restore these inequalities particularly for vulnerable populations by promoting equitable access to resources (Health Professions Council of South Africa, 2008). This aim of this study is intended to highlight the prevalence of periodontal disease and identify barriers with the intent of targeting inequalities of oral health care experienced by hearing impaired individuals in the Western Cape. The recommendations of this study are coherent with this intention.

Funding:

Interpreters were required for the study which was funded by the University of the Western Cape's research fund. The primary researcher carried all other administrative cost incurred during the research.

Conflict of Interest: No conflict of interest is declared.



CHAPTER 5

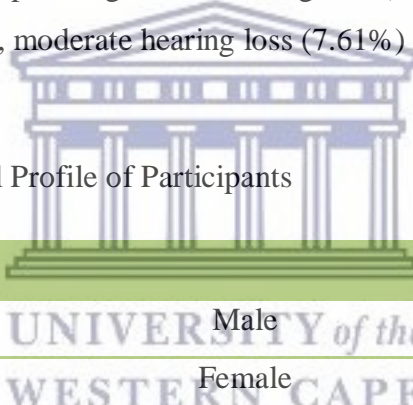
Results:

A total of 92 adults participated in the study that was available and willing to participate on the day visits were scheduled.

Participant Demographics

A fair proportion of males (46.74%) to females (53.26%) and a fair distribution of the various age groups were examined. 16.3% were in the 16-24 year age group, 21.74% were in the 25-34 year age group, 29.35% were in the 35-44 year age group, 18.48% were in the 45-54 year age group and 14.13% were 55 years and older. Most of the participants were profoundly deaf (64.13%) with smaller proportions of the group having severe hearing loss (3.26%), moderate to severe hearing loss (18.48%), moderate hearing loss (7.61%) and mild hearing loss (6.52%).

Table 1: Overall Profile of Participants

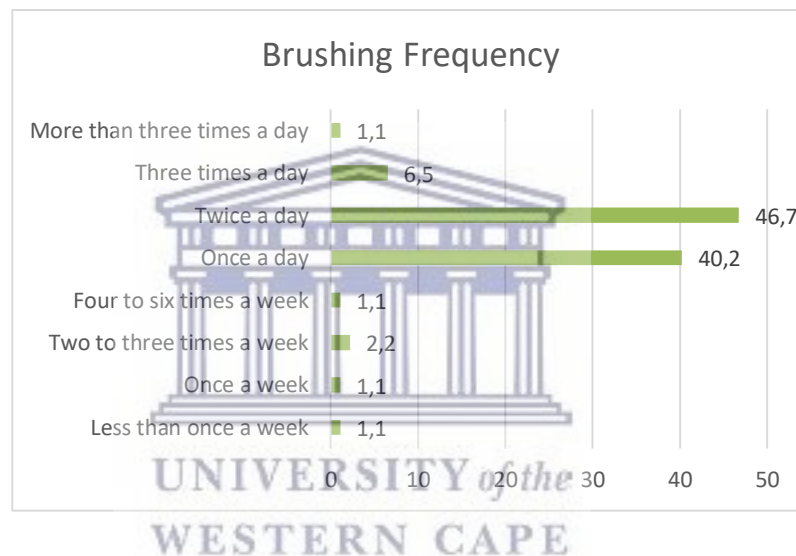


		N	%
Gender	Male	43	46.74
	Female	49	53.26
Age	16-24years	15	16.30
	25-34 years	20	21.74
	35-44 years	27	29.35
	45-54 years	17	18.48
	55+ years	13	14.13
Severity of Hearing Loss	Mild (20-34 dB HL)	6	6.52
	Moderate (35-49 dB HL)	7	7.61
	Moderate to Severe (50-64 dB HL)	17	18.48
	Severe (65-79 dB HL)	3	3.26
	Profound (80-94 dB HL)	59	64.13

Oral Health Care Practices

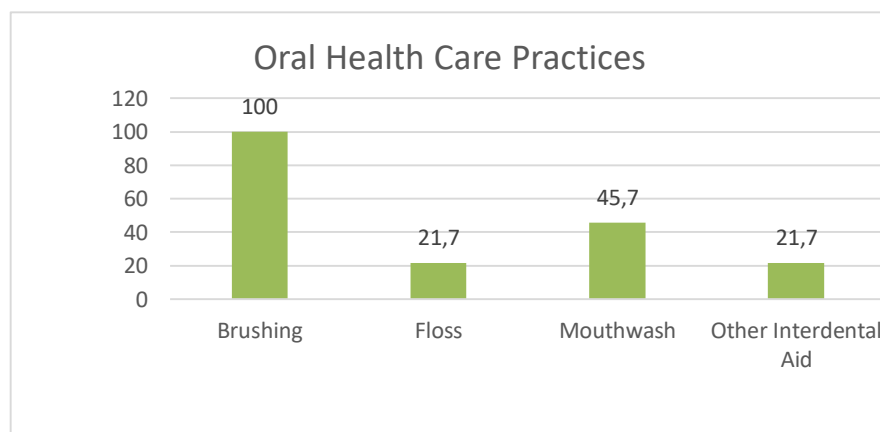
Of the 92 participants, all indicated that they brushed their teeth. 40.2% brushed their teeth once a day, 46.7% indicated that they brushed twice a day, 7.6% brushed three or more times a day and the remaining 5.5% brushed one to six times a week or less. The use of toothpaste whilst brushing was indicated by 99% of which 54.5% used a fluoridated toothpaste, 2.7% did not use a fluoridated toothpaste and the remaining 42.8% was unsure whether the toothpaste they were using was fluoridated or not.

Figure 1: Brushing Frequency



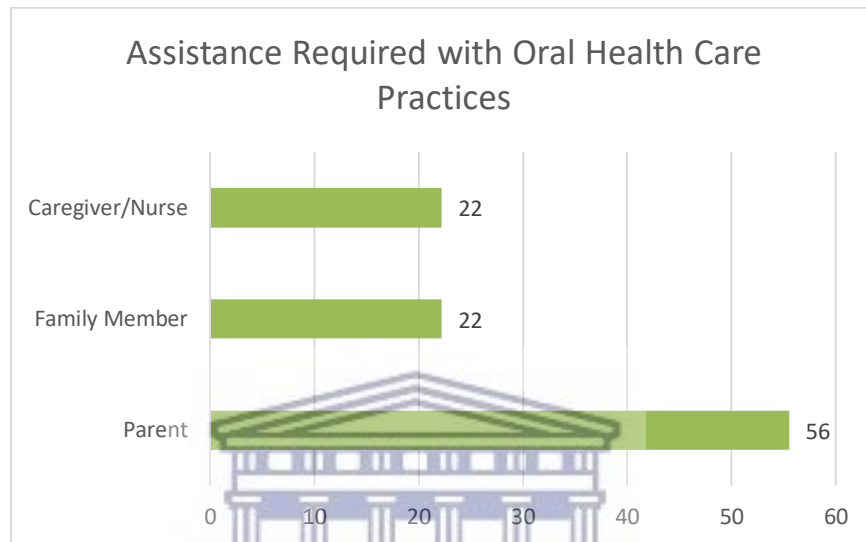
Only 21.7% indicated that they made use dental floss. Of this 21.7% (n=20), 25% flossed once a day, 5% flossed twice a day and the remaining 70% flossed one to six times a week or less. 21.7% indicated the use of an alternative interdental aid and 45.7% indicated that they used mouthwash as an oral health aid.

Figure 2: Oral Health Care Practices



Only 9.8% of the sample indicated that they required assistance to take care of their mouth, of which was usually from the parent/s (56%), another family member other than the parent/s (22%) and/or equally the caregiver or nurse (22%).

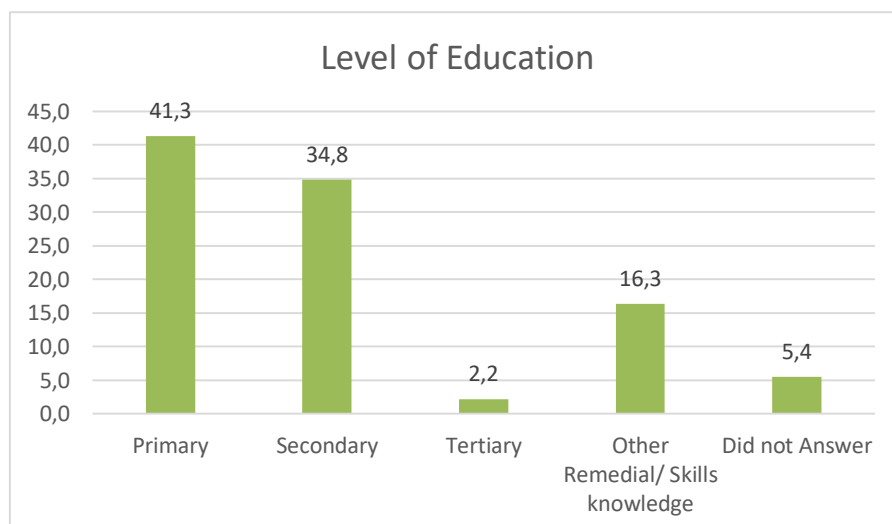
Figure 3: Assistance required with Oral Health Care Practices



Oral Health Care Knowledge

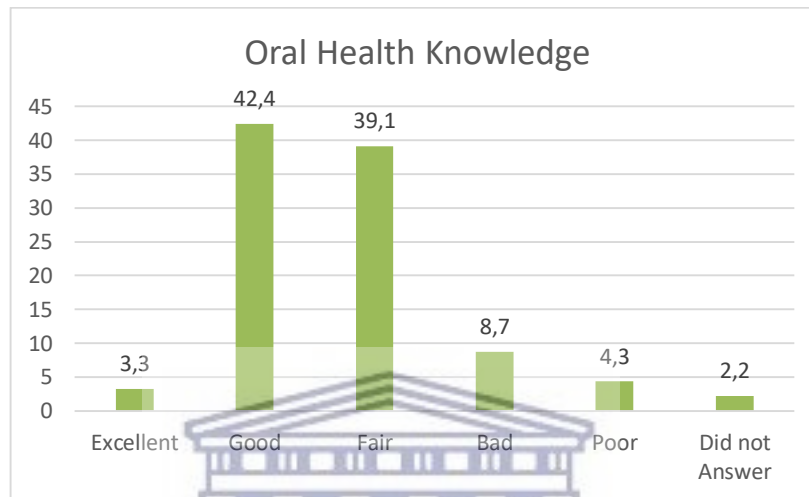
41.3% indicated that their level of education was at a primary school level and 34.8% indicated that they completed a secondary level of school education. Only 2.2% of the participants had a tertiary diploma/degree and the remaining 16.3% had completed a remedial or skills based education programme. 5.4% did not answer the question.

Figure 3: Highest Level of Education



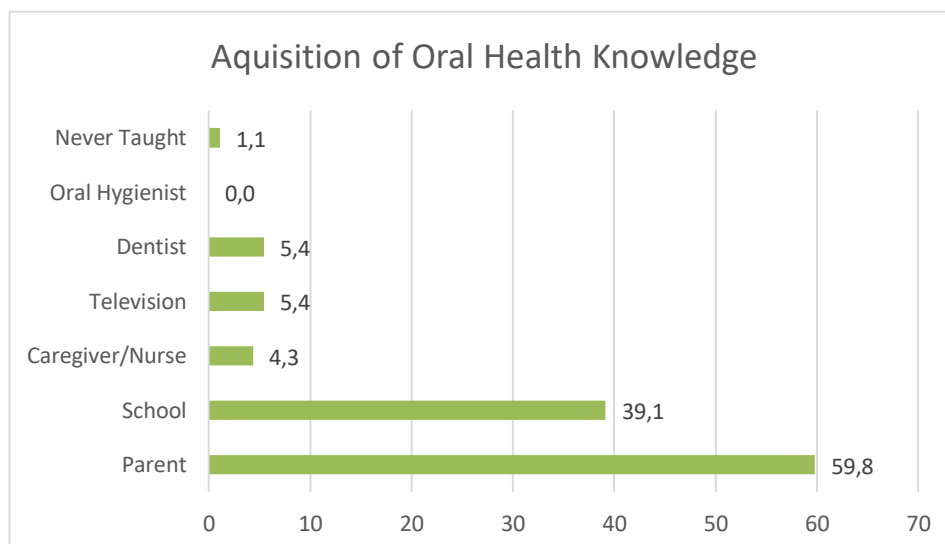
When the participants did a self-assessment of their oral health knowledge, 3.3% rated their oral health knowledge as excellent, 42.4% as good, 39.1% as fair, 8.7% as bad and 4.3% as poor. The remaining 2.2% was unable to do a self-assessment of their oral health knowledge.

Figure 4: Oral Health Knowledge (Self-Assessed)



Oral health knowledge was provided and influenced predominantly by the parents of the participant (59.8%), followed by the school the participant attended (39.1%), and to a lesser extent by a caregiver or nurse (4.3%) and equally from television (5.4%) and their dentist (5.4%). 1.1% revealed that they were never educated about oral health and there was no indication of receiving oral health education by an oral hygienist.

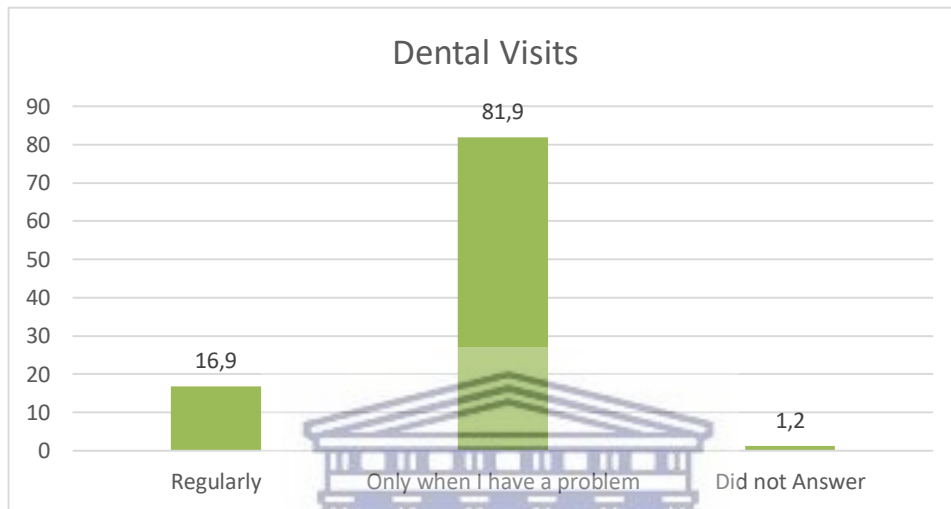
Figure 5: Acquisition of Oral Health Knowledge



Frequency of dental visits and associated barriers

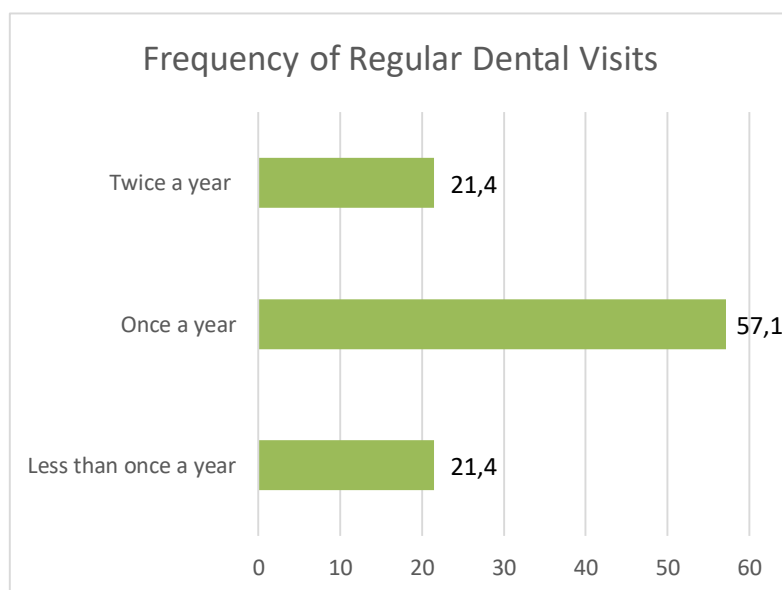
The majority of participants had previously visited a dentist (90.2%). Of this, 81.9% only visited the dentist when they had a problem and 16.9% visited the dentist on a regular basis.

Figure 6: Visits to the Dentist



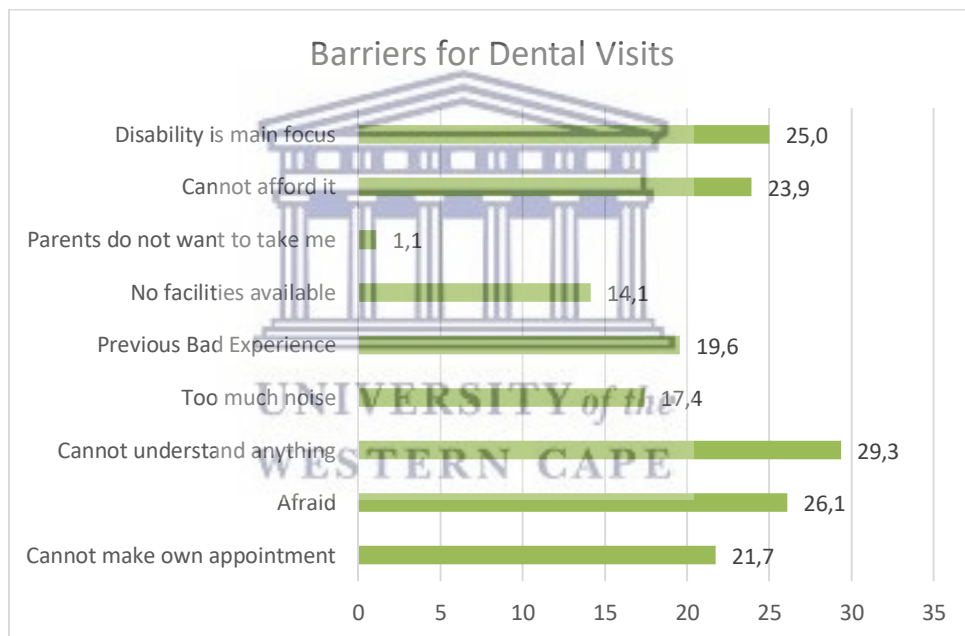
Those who visited the dentist regularly usually had annual visits (57.1%). Only 21.4% visited the dentist bi-annually and for the remainder (21.4%) of participants, visits were less than once a year or seldom.

Figure 7: Frequency of Regular Dental Visits



More than half of the participants (52.2%) found it difficult to visit a dentist. Various factors were highlighted that inhibited regular dental visits. These factors were related to the fact that they cannot understand anything when visiting the dentist (29.3%), they could not make their own appointments for a dental visit (21.7%), excessive noise at the dental facility (17.4%), financial constraints (23.9%), no dental facilities readily available (14.1%), being afraid of visiting the dentist (26.1%), having a previous bad experience (19.6%) and/ or the fact that their disability was their main focus and not dental treatment (25%).

Figure 8: Barriers for Dental Visits



Periodontal Disease

Plaque Index and Gingival Index

The prevalence of gingivitis was 100% among the participants. The mean gingival index score was 1.24 (STD \pm 049; 95% CI: 1.14-1.35) indicating moderate gingival inflammation overall for the group. The mean plaque index score for

participants was 1.3 (STD \pm 0.5; 95% CI: 1.2-1.4) which indicates that the participants' oral hygiene was generally fair.

Periodontitis

26.09% (n=24) of participants presented with evidence of periodontitis. This was identified in participants with an average clinical attachment loss (CAL) of >3mm. The mean clinical attachment loss (CAL) observed for those with evidence of periodontitis was 4.47mm (STD \pm 1.41; 95% CI: 4.18-4.76mm).

Table 2: Variables associated with Periodontitis (CAL >3mm)

	Variable	n	%	p-value
Gender	Male	14	58.33	<i>0.185^(a)</i>
	Female	10	41.67	
Age	16-24years	2	8.33	<i>0.01^(b)</i> <i>Statistically Significant</i>
	25-34 years	2	8.33	
	35-44 years	5	20.83	
	45-54 years	8	33.33	
	55+ years	7	29.17	
Severity of Hearing Loss	Mild (20-34 dB HL)	2	8.33	<i>0.515^(b)</i>
	Moderate (35-49 dB HL)	0	0	
	Moderate to Severe (50-64 dB HL)	4	16.67	
	Severe (65-79 dB HL)	1	4.17	
	Profound (80-94 dB HL)	17	70.83	
Level of Education	Primary	8	33.33	<i>0.764^(b)</i>
	Secondary	10	41.67	
	Tertiary	1	4.17	
	Remedial/Skills	4	16.67	
	Did not Answer	1	4.17	

Diabetes	Yes	3	12.5	<i>0.18^(b)</i>
	No	21	87.5	
Smoking	Yes	1	4.17	<i>0.06^(b)</i>
	No	23	95.83	
Brushing Frequency	Once a day	9	37.5	<i>0.764^(b)</i>
	Twice a day	13	54.17	
	Three times a day	1	4.17	
	More than three times a day	1	4.17	
Oral Health Knowledge (Self-Assessed)	Excellent	1	4.17	<i>0.845^(b)</i>
	Good	10	41.67	
	Fair	10	41.67	
	Bad	2	8.33	
	Poor	0	0	
	Did not Answer	1	4.17	
Difficulty in Visiting the Dentist	Yes	13	54.17	<i>0.820^(a)</i>
	No	11	45.83	
When do you visit the Dentist	Regularly	1	4.17	<i>0.185^(b)</i>
	Only when I have a problem	21	87.5	
	Did not answer	2	8.33	

Statistical Significance (set at $p < 0.05$); (a) = Chi-square; (b) = Fishers Exact

The percentage of males (58.33%) that presented with CAL>3mm was slightly more elevated than that of females (41.67%). Most of the participants presenting with CAL of >3mm were over the age of 35 years (83.3%). This was statistically significant. The mean age of the sample presenting with CAL>3mm was 48years (STD±13 years).

Participants presenting with CAL>3mm were mainly profoundly deaf (70.83%). When the prevalence of diabetes and smoking was investigated to influence the

periodontal status, it revealed that only 12.5% had diabetes and 4.17% were smokers.

The majority of participants with $CAL > 3mm$ brushed their teeth twice a day (54.17%) or at least once a day (37.5%). Oral health knowledge according to a self-assessment by participants displayed that 41.67% indicated that their oral health knowledge was good and 41.67% indicated that it was fair.

Marginally over half the participants that presented with $CAL > 3mm$ indicated that they had difficulty in visiting the dentist (54.17%) and 87.5% only visited the dentist when they had a problem.

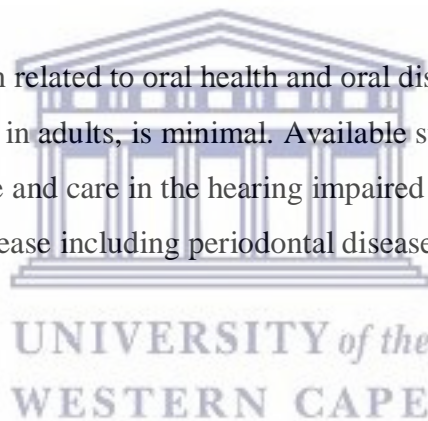


CHAPTER 6

Discussion:

A high prevalence of hearing impairment is evident amongst adults in low income regions particularly in Sub-Saharan Africa (Stevens, 2011). Hearing impairment was rated the third most prevalent disability in South Africa in 2007 with approximately 14 604 people living with hearing impairment in the Western Cape (Statistics South Africa, 2007). Ramma and Sebothoma argues that prevalence rates in the Cape Metropolitan area is underestimated as it is based on census data which is typically centred on self-report (Ramma and Sebothoma, 2016). Globally, it has been established that data pertaining to the hearing impaired is rather limited and that hearing impairment deserves considerable attention (Stevens, 2011).

Similarly, information related to oral health and oral disease in the hearing impaired, particularly in adults, is minimal. Available studies indicate inadequate oral health knowledge and care in the hearing impaired and an elevated prevalence of oral disease including periodontal disease (Al-Qahtani, *et al*, 2017; Mustafa, *et al*, 2018).



Oral Health Care Practices

Oral hygiene maintenance plays a key role in prevention of gingivitis and periodontitis (Pradhan, *et al*, 2015). Oral hygiene practices are less frequent in middle and low income countries and linked to education (Petersen and Ogawa, 2012). In the hearing impaired, insufficient oral health knowledge and care might impair oral hygiene practices along with a low priority of oral health (Ameer, *et al*, 2012; Tugeman, *et al*, 2016).

In this study, 100% of the participants brushed their teeth and 99% used toothpaste whilst brushing. The frequency of brushing indicated that 46.7% brushed twice daily and 40.2% brushed once daily. This is in line with a study done by Hamad, *et al*, where 50% of deaf persons indicated that they brushed

twice daily and 34% brushed once a day (Hamad, *et al*, 2015). Similarly, Pradhan, *et al*, found that 56.8% of hearing impaired individuals brushed once a day and 34.6% brushed twice daily or more (Pradhan, *et al*, 2015). In contrast to this, Ameer, *et al*, found a 100% once a day brushing frequency (Ameer, *et al*, 2012).

The majority of participants in this study did not make use of dental floss as an interdental aid (78.3%). A high percentage of hearing impaired individuals omits this oral hygiene practice as Pradhan, *et al*, and Hamad, *et al*, found that 98.8% and 70% respectively, of hearing impaired individuals did not make use of dental floss (Hamad, *et al*, 2015; Pradhan, *et al*, 2015). Though, it should be considered that the infrequent use of dental floss observed may be as a consequence of low socio-economic status in this study.

When questioned whether assistance was required with oral health care practices, 9.8% indicated that they need assistance. Hamad, *et al*, concurred with this as only 14% according to their research required assistance with brushing (Hamad, *et al*, 2015). This assistance was provided primarily by the mother and Tugeman, *et al*, was in agreement with this where a large proportion of hearing impaired individuals relied upon the mother for observation whilst brushing (Tugeman, *et al*, 2016). Similarly, this research depicts the same situation as 56% of participants that required assistance in this study, relied on a parent for assistance. Caregivers and/or nurses also played a role in assistance with brushing (22%) as well as family members other than the parent/s. It should be kept in mind that this study sample included adults as opposed to the studies by Hamad, *et al*, (2015) and Tugeman, *et al*, (2016) where the sample included adolescents and children, respectively. This may account for the low number of participants in this study that required assistance with oral health care.

Oral Health Knowledge

As previously mentioned, a lack of oral health knowledge may impair oral health practices and affect oral health status. Oral health status has also been linked to level of education and lack of awareness. Generally most people are aware of the

importance of preventing periodontal disease but to a lesser extent than to that of dental caries (Petersen and Ogawa, 2012).

Hearing impaired individuals are at risk of having problems due to the inability to be educated ordinarily and the effect the disability has on communication (Samnieng, 2014). Hearing impairment has an impact on level of education and when the Nunavik Inuit Health Survey investigated hearing loss and dental health, they concluded nearly a third of hearing impaired individuals completed secondary school and it was made mention of the fact that educational attainment has a positive impact on income level (Ayukawa, *et al*, 2004). This should be considered and is likely to impact oral health status. Similarly in this study, only 34.8% of participants completed secondary school and the majority (41.3%) obtained primary schooling as their highest level of education. In South Africa, education for the learner with deafness has been limited to a few learners with access to a few schools (Smith, 2013). Most available studies on hearing impairment individuals consider the level of education of the parent/s however, as mentioned previously, this may be more applicable as the sample was that of children and adolescents. Al-Qahtani, *et al*, concluded that a high prevalence rate of dental caries in hearing impaired adolescents was related to a low education level and low awareness of dental hygiene (Al-Qahtani, *et al*, 2017).

Most participants in this study indicated that their oral health knowledge was good (42.4%) or fair (39.1%). This oral health knowledge was provided and predominantly influenced by the parent (59.8%) followed by the school the participant attended (39.1%). Correspondingly, Hamad, *et al*, found that family had a great impact on education (50%) followed by the school (28%) (Hamad, *et al*, 2015). Overall, parents play a pivotal role and the preventative oral health behaviour of the parent influences the child's adoption of oral health practices (Khalaf, *et al*, 2015). Television influence was slightly lower for this study (5.4%) than for that of Hamad's, *et al*, (8%) (Hamad, *et al*, 2015). However, Vichayanrat and Kositpumivate found that hearing impaired students were less likely to receive oral education from their parents and media when compared to normal hearing students in Thailand. Oral health education sources were mainly from schools (93.8%) and dentists (71.6%). In this study the dentists' contribution

(5.4%) and the nurse/caregiver contribution (4.3%) to oral health education was minimal compared to the findings by Vichayanrat and Kositpumivate (Vichayanrat and Kositpumivate, 2014). These authors recommended that dental practitioners and health organizations increase efforts for oral health promotion and intervention that is accessible for hearing impaired individuals (Vichayanrat and Kositpumivate, 2014). Health and oral health professionals' are also known to have a lack of training in non-verbal communication with the result of the hearing impaired failing to obtain the needed care and knowledge (Samnieng, 2014).

A further deduction related to oral health knowledge can be attained in this study, in that almost half of the participants (42.8%) that used toothpaste as a dentrifice had no knowledge of whether the toothpaste contained fluoride or not. Pradhan, *et al*, also noted this as 34.6% were unaware of whether the toothpaste used contained fluoride (Pradhan, *et al*, 2015). Hence, emphasis with regard to the benefits of fluoridated toothpastes should be included in oral health education programmes for the hearing impaired.

Frequency of dental visits and barriers associated

Hearing impaired individuals are at high risk to oral disease due to various factors. With this, they may also have restricted visits to dentists. The majority of participants in this study have had previous visits to the dentist (90.2%). However, these visits were mainly only when they had a problem (81.9%). This could be directly related to the fact that 52.2% of the participants found it difficult to visit the dentist. This is in contrast to Mustafa, *et al* and Khalaf, *et al*, where 81% of hearing impaired individuals and 79% of children, respectively, have never been to a dentist (Khalaf, *et al*, 2015; Mustafa *et al*, 2018). Though, it is in agreement with Vichayanrat and Kositpumivate that only few visits to the dentist are regular and most often associated with a dental problem (Vichayanrat and Kositpumivate, 2014). Similarly, Pradhan, *et al*, reported a low number of hearing impaired individuals visiting the dentist on a regular basis (15.9%) (Pradhan, *et al*, 2015).

Difficulty in visiting the dentist may be attributed to additional reasons and struggles. In this study the main setback was that the participants did not understand anything (29.3%) which is likely to be related to communication problems experienced with the dental team not being familiar with sign language. Hearing impairment constrains communication and the lack of knowledge and training of the dental team widens the communication gap (Alshehri, *et al*, 2018). An interpreter is often relied upon to enhance the communication process and for the hearing impaired child, the parent/s often take this role. This study involved hearing impaired adults and hence the parent/s involvement is possibly minimal. A proportion of the participants alluded to the fact that they cannot even make their own appointment to visit the dentist (21.7%). Khalaf, *et al*, also recorded the communication barrier as being one of the most common reasons for the hearing impaired not receiving dental care (Khalaf, *et al*, 2015). Recommendation for dental staff to familiarize themselves with strategies to remove the communication barrier with hearing impaired individuals are numerous and implementation of such strategies also proves to be effective in relieving anxiety associated with dental visits experienced by the hearing impaired (Pradhan, *et al*, 2015; Chadrsekhar, *et al*, 2017).

Dental fear is ranked fourth among common fears (Chandrsekhar, *et al*, 2017). In this study, 26.1% was afraid of visiting the dentist and 19.6% had a previous bad experience. Alshehri, *et al*, found that 46.1% of respondents in their study had unpleasant dental experiences primarily due to communication problems and not understanding the treatment (Alshehri, *et al*, 2018). Hearing impaired patients have the same rights to full information of treatment and often complain that they are not properly informed of the disease and treatment. Amongst others, related issues include a lack of deaf awareness, the need to use basic sign language and even a lack of positive attitude of the dentist in handling a hearing impaired patient. It is recommended that to overcome this, simple dental sign language should be learnt by dentists and the dental team. This has proven to both relieve anxiety amongst the hearing impaired and instil a positive attitude of the dentist making dental visits more pleasant (Chandrsekhar, *et al*, 2017). It may also allow

participation of the hearing impaired patient in the form of feedback on dental care and treatment (Alshehri, *et al*, 2017).

Patients also require quiet surroundings to maximise understanding and often complain of background noise in the dental setting (Samnieng, 2014). In this study, 17.4% made reference to too much noise at dental visits and highlighted this as a barrier for visiting the dentist. Samnieng found that for as many as 55% of patients receiving dental treatment, there was always background noise. He concluded by advocating to reduce noise by means of turning off background music and closing windows to facilitate communication and understanding for hearing impaired individuals visiting the dentist (Samnieng, 2014).

A lack of dental insurance and dental care costs are also common reasons for not receiving dental care (Khalaf, *et al*, 2015). Participants in this study are generally of low socio-economic status and 23.9% indicated that they cannot afford dental treatment. Along with the reported 25% of participants that declared that their disability is their main focus, and not dental treatment, this may also contribute to the majority only visiting the dentist when they have a problem. Dental care treatment needs are highly unmet amongst the hearing impaired population as a result of poor socioeconomic status (Tariq, *et al*, 2017). In South Africa, 84-90% of people are dependent on public oral health services in spite of the general lack of oral health facilities and unequal distribution of dental services provided throughout the country (Ramphoma, 2016). A small portion (14.1%) of the sample made reference to the fact that there were no facilities available for dental care. Hence, it is likely that socioeconomic status (and having no medical aid/insurance), education achievement (linked to income level) as well as the lack of public oral health facilities are contributors to the financial constraints associated with visiting the dentist amongst the hearing impaired.

Disabling conditions when combined with pressures of associated illness, socioeconomic status and the stresses of daily living for the individual, family and caregivers can brand oral health as having a low priority (Jnaneswar, *et al*, 2017). A quarter of participants (25%) mentioned that as a result of their disability being their main focus, it hindered regular dental visits. This may be dependent on

parenteral and social support as well as the cost of medical treatment or interventions being very expensive for the hearing impaired individual in South Africa (Ameer, *et al*, 2012; Smith, 2013).

Periodontal disease

Several studies report high levels of periodontal problems in the disabled (Petersen and Ogawa, 2012). Available studies investigating periodontal disease in the hearing impaired corroborates with an increased prevalence specifically in this population. A thorough search of the relevant literature yielded no research on prevalence of periodontal disease in South Africa amongst the hearing impaired population. In fact, there is no evidence of any research pertaining to oral health and periodontal disease prevalence in hearing impaired adults in the country.

Plaque index

Dental plaque biofilm is the leading cause of periodontal disease. Improper tooth brushing techniques, failure of interdental cleaning and irregular dental visits result in accumulation, stimulating periodontal disease (Lertpimonchai, *et al*, 2017). The mean plaque index (according to Loë and Sillness, 1964) for participants in this study was 1.3 (STD±0.49, 95% CI: 1.2-1.4). This reveals that the participants generally had a film of plaque adhered to the tooth and oral health is defined as fair (Lertpimonchai, *et al*, 2017). This is in accordance with Hamad, *et al*, that found a mean plaque index of 1.33 (± 0.67) that was statistically significant in participants 16 years and older (Hamad, *et al*, 2015). This was however in contrast to Sandeep, *et al* and Tugeman, *et al*, who found a higher mean plaque index score of 1.7 (±0.61) and 1.8 (±0.57) associated with hearing impaired children respectively, and a lower mean plaque index of 0.79 (±1.32) found by Shivakumar, *et al*, amongst deaf and mute children aged 5-18 years (Sandeep, *et al*, 2016; Tugeman, *et al*, 2016; Shivakumar, *et al*, 2017). Plaque scores may be influenced by various factors including oral hygiene knowledge

and practice pertaining particularly to brushing method and frequency, and the priority of oral health amongst participants.

Gingival Index

Gingivitis affects 50-90% of adults worldwide and is characterized by gingival inflammation and bleeding (Madiba and Bhayat, 2018). The gingivitis prevalence in this sample was 100% amongst hearing impaired adults. The mean gingival index score was 1.24 (STD±0.5; 95% CI: 1.14-1.35) indicating a moderate gingival inflammation representation for the sample group. A similar mean gingival index score of 1.59 (±0.58) was observed in hearing impaired children by Sandeep, *et al*, where 78% presented with moderate to severe inflammation (Sandeep, *et al*, 2016). However, Pradhan, *et al*, showed that only 24.7% had presented with gingival inflammation when investigating oral health status in adults with hearing impairment and shows a considerably lower prevalence rate of gingival inflammation when compared to this study (Pradhan, *et al*, 2015). Tariq *et al*, found a gingivitis prevalence of 61.11% in hearing impaired children on initial examination and after oral health education the prevalence decreased to 28.88% (Tariq, *et al*, 2017). Other research exploring periodontal status of hearing impaired children exhibited bleeding on probing rates of 23.9-45.53% (Jnaneswar, *et al*, 2017; Yadav, *et al*, 2017). As periodontal disease is associated with an increase in age, it should once more be noted that the sample in this study includes adults with hearing impairment which may explain the higher prevalence rate of gingivitis observed.

Periodontitis

In 1997, the WHO suggested including loss of periodontal attachment in oral health surveys (Petersen and Ogawa, 2015). Periodontitis was defined by an average clinical attachment loss (CAL) of >3mm and was prevalent in 26.09% of participants in this study. The mean CAL recorded for those presenting with periodontitis was 4.47mm (STD±1.41; 95% CI: 4.18-4.76mm).

Research by Pradhan, *et al*, discovered that 14.4% of participants presented with evidence of destructive periodontal disease and indicates a lower prevalence of periodontitis amongst hearing impaired adults than in this study (Pradhan, *et al*, 2015). Correspondingly, Yadav, *et al*, recorded that only 14.29% of participants presented with loss of attachment (>3mm) when determining the prevalence of periodontal disease in participants 15 years and older amongst deaf and mute participants (Yadav, *et al*, 2017). With a slight decrease in prevalence of periodontal disease (9.1%) recorded by Ameer, *et al*, where loss of attachment was >3mm amongst deaf and dumb participants, the prevalence of periodontitis/periodontal disease (>3mm CAL) in this study also appears elevated (Ameer, *et al*, 2012). An explanation of this increased prevalence may be attributable to the age range selected for this sample where only adults were recruited. Pradhan, *et al*, selected a similar age range though other research findings were conducted on adolescents.

Periodontitis Prevalence and Gender

More males (58.33%) than females (41.67%) in this study presented with evidence of periodontitis (CAL>3mm) amongst hearing impaired adults even though the participant sample included more females than males. In South Africa, the female population is merely above 51% (Statistics South Africa, 2016) of the general population which relatively corresponds to the distribution of gender in this study. Generally males present with more destructive forms of periodontitis than females due to lifestyle choices, such as higher prevalence rates of smoking and lower levels of oral health care, and these factors should be taken into account as it impacts on the prevalence of periodontal disease (Madiba and Bhayat, 2018). Shivakumar, *et al*, had a similar finding where loss of gingival attachment was higher in males when compared to females amongst deaf and mute participants' aged 5-22 years and this was statistically significant (Shivakumar, *et al*, 2017).

Periodontitis Prevalence and Age

Indicator age groups have been selected by WHO for inter-country comparisons of oral health status and oral health surveillance and those age-groups relevant to periodontal health are 15-19, 35-44 and 65-74 years (Petersen and Ogawa, 2012).

Prevalence of periodontal disease is said to increase with age and as life expectancy has increased in South Africa, Madiba and Bhayat assumes that this increases the geriatric population requiring treatment of periodontal disease (Madiba and Bhayat, 2018).

This study indicated that 83.33% of participants that presented with periodontitis (CAL>3mm) were 35 years and older and was statistically significant ($p=0.008$). The mean age for those participants presenting with periodontitis in this study was 48 years (STD±13years). This confirms that periodontitis has an aged standardized prevalence (Lertpimonchai, *et al*, 2017). According to research there are no other studies that report on periodontitis in the hearing impaired in relation to the selected adult age ranges in this study, and hence were not comparable. Although, Shivakumar, *et al*, states that dental health of disabled individuals is influenced by age, severity of impairment and living conditions (Shivakumar, *et al*, 2017). When investigating age-dependant distributions of periodontitis of those unaffected by hearing impairments, mean clinical attachment loss (CAL) linearly increased with age. Though, it was mentioned that gingival recession contributed increasingly to clinical attachment loss (CAL) with age especially after 45 years (Billings, *et al*, 2018).

Periodontitis Prevalence and Severity of Hearing Impairment

When evaluating oral hygiene amongst hearing impaired children, Khalaf, *et al*, reported that oral hygiene levels were worse in participants having severe to profound and profound hearing impairment as of those who had a mild to severe hearing impairment (Khalaf, *et al*, 2015). Al Qahtani, *et al*, also reported that dental caries was more frequent in deaf individuals than hearing impaired individuals (Al-Qahtani, *et al*, 2017). According to results in this study, 70.83% of participants that presented with periodontitis (CAL>3mm) had profound hearing impairment. This could be incidental as the total sample included 64.13% of participants that had profound hearing impairment or related to the fact that the profoundly hearing impaired would have acquired less information on oral health knowledge due to communication being further limited giving rise to lower oral hygiene levels. Nonetheless, Pradhan, *et al*, also observed that only deaf patients

and none of the hearing impaired patients in their study presented with destructive periodontal disease (Pradhan, *et al*, 2015).

Periodontitis Prevalence and Level of Education

Periodontal health has evidently been recognized as superior among those with higher education and income. Madiba and Bhayat predicts that with the high unemployment rate in South Africa, poor education and low levels of knowledge, periodontal disease prevalence rates will increase amongst the general population (Madiba and Bhayat, 2018). A hearing impaired patient's ability to learn may be delayed and diminished when compared to a normal hearing patient (Samnieng, 2014). Along with this, availability of schools in South Africa offering secondary education to hearing impaired individuals are minimal and could impact on educational achievement and income level.

The majority of participants in this study that presented with periodontitis (CAL>3mm) had however completed a secondary education (41.67%). This is contrary to the total sample where the majority of participants had a primary education as their highest level of education. This also diverges somewhat from findings of Al-Qahtani, *et al*, where a low education level was associated with an increase in dental caries prevalence amongst hearing impaired participants although risk factors for periodontal disease marginally differ (Al-Qahtani, *et al*, 2017).

Periodontitis Prevalence and Diabetes

A consistent link between periodontal disease and diabetes has been established. It is widely documented that diabetes is one of the leading risk factors for periodontal disease. Progression of periodontal disease in patients with diabetes has proved to be more rapid and the odds of destructive loss of attachment in Type 2 diabetes is about three times higher than in non-diabetic patients (Petersen and Ogawa, 2012).

An association between diabetes and hearing impairment is also apparent though when investigating the prevalence of hearing impairment in Cape Town, South Africa, Ramma and Sebothoma failed to obtain a statistically significant

association between hearing impairment and diabetes (Ramma and Sebothoma, 2016). Similarly, in this study, there was no statistically significant association between periodontitis prevalence and diabetes in hearing impaired adults. Overall, diabetes prevalence in this sample was minimal (6.5%), and only half of those with a history of diabetes (3.25%) presented with periodontitis (CAL >3mm). This may be due to the small number in the sample or a small number of participants reporting a history of diabetes resembling Ramma and Sebothoma's presumption.

Periodontitis Prevalence and Smoking

Tobacco smoking is highly prevalent worldwide and 82% of smokers live in low to middle income countries. Globally a decrease in the prevalence of tobacco smoking has been noticed which has also been an observation in South Africa. Frequent tobacco users in South Africa have also been associated with low levels of education and income (Teare and Naicker, 2018). The Western Cape has been identified as the province with the highest prevalence of tobacco smoking (32.9%) in South Africa (Reddy, *et al*, 2015). Despite the decrease in prevalence, smoking is persistent in vulnerable communities (Teare and Naicker, 2018).

Equally with diabetes, smoking has a positive association with periodontal disease and smoking alone accounts for more than 50% of periodontal disease cases. Loss of periodontal attachment related to smoking has been confirmed and the prevalence, extent and severity of periodontal disease in smokers is increased when compared to non-smokers (Madiba and Bhayat, 2017).

Smoking prevalence was observed to be lower amongst the disabled (Tantawi and Alagl, 2017) as well as knowledge of smoking in relation to periodontal disease amongst hearing impaired children (Tugeman, *et al*, 2016). In this study, a low prevalence of smoking (17.39%) was observed in hearing impaired adults and only one participant (4.17%) presenting with periodontitis (CAL>3mm) was a smoker. Almost identical to Pradhan, *et al*, only 17.3% of deaf and hard of hearing participants were smokers and this low prevalence was thought to influence the low percentage of periodontal problems observed in their study (Pradhan, *et al*, 2015).

Periodontitis Prevalence and Oral Health Care Practices

Periodontal destruction may be caused by local factors which include dental plaque biofilm. Accumulation is dependent on oral health practices related to oral health instructions and knowledge obtained. In this study, only 21.7% made use of dental floss and brushing was the most frequent oral health care practice used (100%). Brushing frequency and the use of dental floss was therefore the methods of choice used in this study to evaluate oral health care practices in relation to periodontitis prevalence. The mean plaque index (1.3 ± 0.5) for the overall sample indicates oral hygiene was fair. Lertpimonchai, *et al*, specified that there is a dose-response relationship between oral health and periodontitis, and those with a fair oral health significantly doubles the risk of periodontitis (Lertpimonchai, *et al*, 2017). The majority of participants presenting with periodontitis in this study brushed their teeth twice daily (54.17%) or at least once a day (37.5%) and 29.17% made use of dental floss. When Pradhan, *et al*, evaluated oral health status amongst hearing impaired adults, 56.8% brushed once a day while 34.6% brushed twice daily or more. The use of dental floss was less frequently observed yet it was linked to a lower prevalence of periodontitis (Pradhan, *et al*, 2015). Studies related to oral health status of hearing impaired children recommend enhanced oral health awareness and education anticipating that the gained knowledge will alter attitudes and improve practices in maintaining oral health (Tariq, *et al*, 2017).

Periodontitis Prevalence and Oral Health Knowledge

When assessing whether dental care needs in older people were met, a mere 40% had indicated that they received oral hygiene instructions and counselling on dental care (Petersen and Ogawa, 2012). Furthermore, level of education, alluded to earlier in this study, has an impact on oral health knowledge as well as the communication barriers associated with a hearing impaired disability are expected to obstruct attainment of oral health knowledge.

A self-reported level of oral health knowledge revealed that most of the participants that presented with periodontitis ($CAL > 3mm$) in this study considered their oral health knowledge as good (41.67%) and fair (41.7%). This

can be linked to oral health care practices and the fact that only one participant in this study, who did not present with periodontitis, indicated that they had never received any education regarding oral health care. As there was no statistical significance associated with this comparison, it can be assumed that oral health knowledge in this study failed to solely contribute to the prevalence of periodontal disease. However, research by Mustafa, *et al*, concluded that deaf and dumb persons are not aware of basic information and knowledge about oral health care habits (Mustafa, *et al*, 2018). Several studies also make reference to the need of implementing customised oral health education programs for the hearing impaired in order to improve oral health care and oral health status (Vichayanrat and Kositpumivate, 2014; Pradhan, *et al*, 2015; Sandeep, *et al*, 2016).

Periodontitis Prevalence and Frequency of Dental Visits

As previously stated in this study, barriers to dental care are numerous and elevated for disabled individuals including those with hearing impairment. This has been related to socioeconomic constraints, communication difficulties and oral health considered being a low priority equated to a disabling impairment.

Regular dental visits can reduce the incidence of periodontitis by 32% (Lertpimonchai, *et al*, 2017). In this study, more than half the participants (54.17%) that presented with periodontitis (CAL>3mm) indicated that they had difficulty visiting the dentist due to several barriers encountered and the overwhelming majority indicated that they only visited the dentist when they had a problem (87.5%). The difference of those participants, who did not have difficulty in visiting the dentist yet only visited the dentist when they had a problem, should be noted and participants should be informed about the benefits associated with regular dental attendance. Constraints to regular visits should also be addressed and where possible, facilitated. Adults with hearing impairments have reported a low level of dental attendance and were more likely to experience difficulties and delays in accessing health care than normal hearing individuals (Samnieng, 2014). Nqcoobo *et al*, found that in Johannesburg, South Africa, unmet treatment needs in the permanent dentition in children with hearing impairment was 100%. It was recommended that public private partnerships be strengthened

to ensure services are available for those who do not have access to oral health services (Nqobobo, *et al*, 2012). Similarly, when evaluating treatment needs in special needs children, more than half required dental treatment of which a large proportion (36.8%) required a scale and polish (Mokhtar, *et al*, 2016). This emphasizes the treatment need for periodontal disease in the disabled and highlights the importance of regular dental attendances and compliance.



CHAPTER 7

Conclusion:

Hearing impairment has been reported to be a prevalent disability in South Africa. The hearing impaired population form part of society and is entitled to health care equal to that of the normal hearing population, which includes oral health care.

Oral health care and oral health knowledge in hearing impaired adults in the Western Cape, South Africa is fair but there is a necessity for education and motivation for the need of dental flossing, the use of fluoridated toothpastes and the benefits of regular dental visits that must be emphasized. Parents and caregivers play a crucial role in oral health knowledge attainment and oral health care workers should strive to intensify efforts to facilitate a favourable periodontal health status amongst hearing impaired adults.

The aforementioned may influence the overall high prevalence rate of gingivitis (100%) and the prevalence rate of periodontitis (26.09%) observed in middle and older aged hearing impaired adults in this study.

Recommendations and Implications of Findings:

- Further research is required relating to oral health status of hearing impaired adults in the Western Cape, South Africa with larger sample sizes to support the results obtained in this study.
- Oral health programmes specifically tailored for those with hearing impairment should be implemented emphasizing the benefits of the use of dental floss, fluoridated toothpastes and regular dental visits.
- Oral health care workers should be cognisant of the barriers related to oral health and access to oral health care of those affected by hearing impairment and trained sufficiently in undergraduate programmes to facilitate a favourable periodontal status amongst the hearing impaired.

Limitations:

- As a result of non-attendance and edentulism amongst participants, a reduced sample size was obtained in comparison to the recommended sample originally calculated for this study.
- Due to the decreased sample obtained, all participants were included in the study regardless of the prevalence of other disabilities observed amongst participants.
- Due to the paucity of research related to oral health of hearing impaired adults, comparison was limited and not specifically discerned in context of country status known to be developed/developing or first/ third world and therefore cannot be generalized.
- Furthermore, due to the scarcity of research depicting prevalence rates of periodontal disease in South Africa amongst the general population, comparisons were unattainable.
- Prevalence of gingivitis was obtained based on the gingival index by Loë and Silness (1963) and not the renewed recommended methods for classifying periodontal disease based on the new classification for periodontal disease by the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) (2017). This did however allow for comparison with other related studies but may be limited for comparison with future studies.
- Periodontitis prevalence was determined based on clinical attachment loss (CAL>3mm) only. This may also be insufficient to be compared to criteria required for the new classification of periodontal disease (2017) as staging and grading cannot be determined in the absence of radiographs. Though, it should be noted that prevalence and not severity of periodontal disease was included in the aims of this study.
- Periodontitis prevalence was determined for those with a mean clinical attachment loss (CAL) of >3mm only. The prevalence rate in this study therefore cannot distinguish between active periodontitis or those that have stabilized with consequent gingival recession. These criteria were also not a requisite in the aims and objectives of this study.

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Appendix 1

Record no:



UNIVERSITY of the
WESTERN CAPE

Department of Oral Medicine and Periodontology

Faculty of Dentistry & WHO Oral Health Collaborating Centre

UNIVERSITY OF THE WESTERN CAPE, Private Bag X1, Tygerberg 7505

Questionnaire - Taking care of the mouth



Please mark with a "X" or "✓"

1. Do you brush your teeth?

Yes	No
-----	----

2. If yes, how many times?

Less than once a week on average	Once a week	Two to three times a week	Four to six times a week
Once a day	Twice a day	Three times a day	More than three times a day

3. Do you use toothpaste?

Yes	No
-----	----

Is it fluoridated?

Yes	No
Not Sure	

4. Do you use floss?

Yes	No
-----	----

5. If yes, how many times?

Less than once a week on average	Once a week	Two to three times a week	Four to six times a week
Once a day	Twice a day	Three times a day	More than three times a day

6. Do you use any of the following to keep your mouth clean?

Mouthwash	Interdental Brushes	Toothpicks	Other: (Please specify)
-----------	---------------------	------------	-------------------------

7. Do you need assistance to take care of your mouth?

Yes	No
-----	----

8. If yes, from whom?

Parent	Family Member	Caregiver/Nurse	Other: (Please specify)
--------	---------------	-----------------	-------------------------

9. What level of education did you complete?

Primary	Secondary	College Diploma	University Degree
---------	-----------	-----------------	-------------------

10. How do you rate your oral health knowledge?

Excellent	Good	Fair	Bad	Poor
-----------	------	------	-----	------

11. How do you rate your oral health care?

Excellent	Good	Fair	Bad	Poor
-----------	------	------	-----	------

12. Where did you learn how to take care of your mouth?

From my Parents	At School	From my Caregiver/Nurse	From the Television	From my Dentist
From my Oral Hygienist	No-one taught me	Other: (Please Specify)		

13. Have you been to the dentist before?

Yes	No
-----	----

14. If yes, do you visit the dentist regularly, or only when you have a problem?

Regularly	Only when I have a problem
-----------	----------------------------

15. How often do these visits take place?

Never	Less than once a year	Once a year	Twice a year	More than twice a year
-------	-----------------------	-------------	--------------	------------------------

16. Do you find it difficult to visit a dentist?

Yes	No
-----	----

17. If yes, is it because of any of the following?

<input type="checkbox"/>	I cannot make my own appointment due to my disability
<input type="checkbox"/>	I don't like to visit a dentist because I am afraid
<input type="checkbox"/>	I don't like to visit the dentist because I cannot understand anything
<input type="checkbox"/>	I don't like to visit the dentist because there is too much noise during treatment
<input type="checkbox"/>	I had a previous bad experience at the dentist
<input type="checkbox"/>	There is no dental facilities available
<input type="checkbox"/>	My parents don't want to take me
<input type="checkbox"/>	I cannot afford to go to the dentist
<input type="checkbox"/>	My disability is the main focus and not dental treatment
<input type="checkbox"/>	Other:

18. Are you satisfied with your mouth?

Yes	No
-----	----

19. If no, is it due to any of the following?

<input type="checkbox"/>	I have dental pain	<input type="checkbox"/>	I have no teeth and cannot eat properly	<input type="checkbox"/>	My teeth has an unpleasant appearance	<input type="checkbox"/>	I have bleeding gums	<input type="checkbox"/>	I have bad breath
<input type="checkbox"/>	I have dental sensitivity	Other: (Please Specify)							

20. Do you have any of the following dental habits?

<input type="checkbox"/>	I grind my teeth	<input type="checkbox"/>	I suck my thumb	<input type="checkbox"/>	I bite my pencil/ pen / nails	<input type="checkbox"/>	Other: (Please Specify)
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Appendix 2: Patient Examination Sheet

Record

No:

Gender: _____

Age: _____

Medical History:

Cause of Hearing Impairment

Congenital _____

Acquired _____

Age of Onset:

Severity of Hearing Loss

Mild	Moderate	Moderate to Severe	Severe	Profound
------	----------	--------------------	--------	----------

Other Medical Condition/s

Medication

Allergies

Other:

Social History:

Smoker

Yes

No

Smokes ___ per day Smokes for ___ years

Alcohol use

Abstention

Everyday

4-6 times per week

2-3 times per week

Once a week

1-3 times a month

Less than once a month

Don't know

Extra-Oral Examination:

Intra-Oral Examination:

Overall oral health

Excellent	Good	Fair	Bad	Poor
-----------	------	------	-----	------

Periodontal Status evaluation:

PI	V	L	TOTAL	GI	V	L	TOTAL
16				16			
21				21			
24				24			
36				36			
41				41			
44				44			
TOTAL				TOTAL			

Periodontal pocket depths	V			L			Recession		CAL	Mobility
							V	L		
16										
21										
24										
36										
41										
44										

Overall Periodontal status:

Excellent	Good	Fair	Bad	Poor
-----------	------	------	-----	------

Evaluation of oral soft tissues:

Lesion/s :

Description

Diagnosis

Previous Dental Anomalies (Already corrected e.g. Cleft Palate/Lip)

General Hard Tissue Description: Edentulous Partially edentulous Fully dentate

Other:

Denture Wearer

Yes	No
-----	----

Radiographs Required

Yes	No
-----	----

Special Investigations Required

Yes	No
-----	----

Appendix 3



Department of Oral Medicine and Periodontology

Faculty of Dentistry & WHO Oral Health Collaborating Centre

UNIVERSITY OF THE WESTERN CAPE, Private Bag X1, Tygerberg
7505

Patient Information Sheet

Title of Research Project: **“Periodontal Status and Associated Factors in Adults with Hearing Impairment”**

Aim: To determine the prevalence of periodontal disease and the associated factors in adults with hearing impairment in the Western Cape, South Africa.

Method/Procedure:

Three institutions for the hearing impaired will be approached for participants to take part in this study.

The study will include a review of the medical histories of participants and the provision of a thorough intra-oral examination in order to identify any prevalent periodontal disease (e.g. gum disease) or any prevalent oral mucosal lesions (e.g. ulcers).

Participants will also be required to complete a short questionnaire on their oral hygiene practices and care. The participants will thereafter be briefed on oral health care via visual aids.

Participants will be advised and referred if any dental treatment is required but no dental treatment will be provided in this study. Participants will be referred to the oral medicine and periodontology departments at the Tygerberg Oral Health Centre, Mitchell’s Plain Oral Health Centre or the Groote Schuur oral medicine clinic.

Other information:

This study will involve no costs and there will be no remuneration for participation

For any queries or more information about the study, please contact:

The Principal Researcher:

BMREC:

Dr Q Isaacs

Biomedical Research Ethics Committee

UWC Faculty of Dentistry

University of the Western Cape

Tygerberg Oral Health Centre

Tel: 021 9592988

Tel: 021 9373154/ 0822931811

Email: research-ethics@uwc.ac.za

Email: qisaacs@uwc.ac.za

Appendix 4
Informed Consent



UNIVERSITY of the
WESTERN CAPE

Department of Oral Medicine and Periodontology

Faculty of Dentistry & WHO Oral Health Collaborating Centre

Record no:

**UNIVERSITY OF THE WESTERN CAPE, Private Bag X1, Tygerberg
7505**

Title of Research Project: **“Periodontal Status and Associated Factors in Adults with Hearing Impairment”**

DECLARATION

I, _____, Identity No _____

(Full Name of Participant)

(ID Number)

AGREE to participate in this study.

I hereby agree that:

1. I am competent to make decisions regarding my participation in this study and during my involvement of the study
2. My decision to participate is voluntary
3. The aims, procedure, risks, advantages and disadvantages have been explained to me
4. I have been given the opportunity to make queries and was responded to with answers
5. I understand that all information is confidential and my identity will be protected at all times
6. I understand that I may withdraw from the study at any given time
7. I am aware that the results of this study may be published and I then may have access to the published results

(Signature of Participant)

(Signature of Researcher)

Signed at: _____ on ____/____/____

(dd / mm / yyyy)

Witness: _____ on _____ / _____ / _____
(Signature of Witness) (dd / mm / yyyy)



UNIVERSITY *of the*
WESTERN CAPE