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Oral Health and Quality of Life:
A Clinic-Based Sample

By

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ABSTRACT
Oral Health and Quality of Life: A Clinic-Based Sample

Kinan Al-Bitar

Marquette University, 2020

Attachment loss due to periodontal diseases is associated with functional limitations as well as physical pain and psychological discomfort, which may lead to a reduced quality of life. This manuscript is intended to answer the question, if periodontal status has an effect on oral health related quality of life. Survey data were collected in an U.S. dental school clinical setting from n=97 adults (54% females, average age 51 years) in a cross-sectional study. Quality of life related to oral health was assessed with the Oral Health Impact Profile (OHIP-49). Additional measures using the DMFT index, periodontal status, dental anxiety, as well as health literacy scores (dental and medical health literacy) were recorded and statistically analyzed. Descriptive statistics, including ANOVA and the t-test for comparison of scores within the cohort and Spearman's correlation coefficient as well as a logistic regression model were used for further data analysis.

44% of the subjects were identified as periodontitis cases (PC). These periodontitis cases demonstrated significantly lower OHIP-49 scores (66.93 ± 30.72) than subjects without signs of periodontal diseases (NP) (32.40 ± 19.27, p<0.05). There was also a significant difference between NP patients and patients with Gingivitis (66.24 ± 46.12, p<0.05). In an attempt to incorporate the new periodontal staging classification and distinguish between stages of disease, it was found that there was a statistically significant difference between Stage 3 (severe) Periodontitis and Health (p = 0.003). Pearson correlations were completed, and positive relationships were found with OHIP and DMFT (0.206, p<0.05), Modified Dental Anxiety (MDAS) (0.310, p<0.05), and Periodontal Risk Self-Assessment (PRSA) (0.237, p<0.05).

Periodontal diseases may negatively impact the oral health-related quality of life. Patients suffering from periodontitis also showed more missing teeth, which might have an effect on function. In addition to missing teeth, poorer overall quality of life is correlated with the patient's perceived assessment of self-risk as well as dental anxiety.

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CHAPTER I: INTRODUCTION

When patients are asked to evaluate their overall quality of life, it is not uncommon for them to provide an answer based primarily on how they feel from a strictly physical and psychological perspective (BORGES; REGALO; TABA; SIÉSSERE et al., 2013). It's also not uncommon for patients to completely overlook their oral health condition, regardless of its condition, and not attribute their oral health status to their overall quality of life (IRANI; WASSALL; PRESHAW, 2015). A number of studies have found that oral health and overall quality of life tend to go hand-in-hand and that poor oral health conditions have a negative effect on the overall quality of life (NG; LEUNG, 2006; SANDERS; SLADE; LIM; REISINE, 2009). In the United States alone, the majority of the population deals with gingivitis and nearly half of the population has periodontitis (EKE; DYE; WEI; THORNTON-EVANS et al., 2012). As we know with periodontitis, the loss of attachment and tooth support leads to discomfort of mobile teeth, further progression of disease and many times tooth loss. Although replacement of missing teeth is no longer a difficulty with many different available treatment options, it is the destruction of the sites where those teeth once resided and their adjacent conditions that makes the replacement difficult (ACHARYA; HAO; MATTHEOS; CHAU et al., 2014). Because of this difficulty, patients are typically put in a position that requires them to manage their predisposing oral health condition, namely periodontal disease. Severe forms of periodontal disease, periodontitis, is a chronic inflammatory process in which attachment and bone loss occur (EKE; DYE; WEI; SLADE et al., 2015; EKE; PAGE; WEI; THORNTON-EVANS et al., 2012). When bone loss is severe enough, the loss leads to significant loss of support of the teeth. For many patients, this disease process

does not happen suddenly and is a result of lack of awareness and lack of routine care with their dentist. It has been documented that the strongest risk factor for poor oral health-related quality of life, which was obtained from NHANES (National Health and Nutrition Examination Survey) data, was the perceived need to relieve dental pain (SEIRAWAN; SUNDARESAN; MULLIGAN, 2011). While many non-compliant patients would present to their dentist when they experience tooth pain, periodontitis often times progresses silently and therefore results in severe damage which is often times too late to address appropriately.

In the unfortunate cases where patients have lost teeth due to periodontal disease or caries, they are subjected to adapting to a new reality. They encounter reduced function, less esthetics and sometimes comorbidities (DYE; THORNTON-EVANS; LI; IAFOLLA, 2015). It is not unknown that there have been associations made between periodontal disease and cardiovascular and mental health (ALLEN; BADON; GREENLUND; HUFFMAN *et al.*, 2015). Although the connection is very complex and requires more research, the correlations are present to provide better answers. For example, diabetes has been shown to have a 2-way relationship with periodontal disease. In patients with uncontrolled diabetes, the body's inflammatory process leads to faster and more significant destruction of the periodontium in the presence of bacterial plaque. It is also known that due to the same pathophysiological problems (i.e. RAGE-AGE) with diabetes, that wound healing is significantly hindered. The ongoing discomfort and lack of proper healing requires patients to have more frequent visits to their dental provider and longer healing time before addressing other areas of concern (MEALEY; OATES;

PERIODONTOLOGY, 2006). With diabetes as an example, it is no surprise that there are a number of factors that influence quality of life.

CHAPTER II: REVIEW OF THE LITERATURE

In 2017, the American Academy of Periodontology (AAP) and European Federation of Periodontology (EFP) co-sponsored the development of the new World Workshop Classification of Periodontal and Peri-Implant Diseases and Conditions. The development of the new classification is no new concept, as previous classifications had been created in 1999 as well as 1989. As with the prior classifications, the reason for the development of this new classification was due to the evolution of evidence and evaluating it to create a better consensus for the purpose of better patient care. While the purpose is for the scientific community and practitioners to better provide treatment for their patients, it also effectively serves as a means to inform the public on the status of their oral health condition and management.

As part of the new World Workshop, it was important to indicate the epidemiology of the disease status of the population and at what rate it progresses. In 2012 and 2015, Eke et al., utilized data from NHANES to demonstrate that there is indeed a significant part of the population that is affected by periodontal disease. Based on their findings, 46% of US adults older than 30 years have periodontitis, with nearly 10% being a severe form of the disease (EKE; DYE; WEI; SLADE *et al.*, 2015; EKE; DYE; WEI; THORNTON-EVANS *et al.*, 2012). The current findings based on systematic review showed that the rate, or how quickly the disease deteriorates, of mean annual attachment loss was approximately 0.1mm per year. Another finding showed that mean annual tooth loss was 0.2mm per year. In regard to these findings, it should be understood that it includes people with and without periodontitis. As it is known, periodontitis is defined by attachment loss, and thus the numbers may appear to be low.

However, because it is an average, subgroup analysis was completed to show that there had a been a higher value of attachment loss progression in periodontitis groups alone (NEEDLEMAN; GARCIA; GKRANIAS; KIRKWOOD *et al.*, 2018). While the evidence available does not change the interpretation of periodontal disease due to the progression, it does give an indication that there may be differences between groups on the rate of their disease progression. With that being said, it is important to evaluate the multifactorial nature of the patient's periodontal disease.

The pathogenesis of periodontal disease has become a historically evaluated and accepted concept for many years. This understanding stemmed from the work of Page and Schroeder whom described the histological nature of periodontal disease progression. What they found showed four different stages with varying degrees of severity indicative of the stage of disease progression. The Initial stage is the earliest stage detected which can be defined as early signs of gingivitis. As the disease progresses over time, the Early stage is found and is defined by an increase in lymphocytes as well as a breakdown of collagen due to depletion of fibroblasts. The Established lesion follows the Early stage and is the final stage of gingivitis. It is defined by the proliferation and apical migration of the junctional epithelium and increase in immune response. Finally, the Advanced stage is the lesion that results in the clinical diagnosis of periodontitis as there is osteoclastic activity and thus bone loss and pocket formation (PAGE; SCHROEDER, 1976). While the scientific evaluation of disease progression became clear using histological measures, the understanding that there is a difference in patient response was noted when comparing the Sri Lankan population without access to oral health care and the Norwegian population that does. The bottom line of their findings showed that there

is some individual differences in host response and that regardless of the disease progression, that specific progression varies from person to person within a population (LÖE; ANERUD; BOYSEN; SMITH, 1978).

With the new classification there has been an emphasis to consider the patient as a whole and consider not only periodontal disease, but other dental concerns as well as overall health concerns. Previously, a patient with moderate attachment loss and generally good health was treated the same as another patient with moderate attachment loss and uncontrolled diabetes. With the new classification the perspective to consider the patient's risk evolved to utilize a "staging and grading" system. Staging is meant to assess complexity of a patient condition as well as classify the severity and extent of the patient's condition. On the other hand, Grading is intended to provide awareness of the future risk of disease as well as understand the impact the general health has on the periodontal condition. By utilizing the Staging and Grading system allows for better assessment which leads to ideal diagnosis and therefore ideal treatment (TONETTI; GREENWELL; KORNMAN, 2018).

With proper diagnosis, periodontal therapy typically will follow a typical sequence of non-surgical scaling and root planing followed by a periodontal re-evaluation to assess the effect of initial treatment. As with the diagnostic stage, it is critical to consider variable that can be controlled and modified at this point and assess whether further therapy is necessary. In cases where additional therapy is needed, surgical interventions are sought. The goals of therapy are to eliminate disease and contributing factors that precipitate disease; additional goals include educating the patient and seeing the patient regularly for maintenances at regular time intervals to ensure no regression to

a disease status (GREENWELL, 2001). The most recent classification focuses on many factors and what effects they have on the disease progression of an individual, however only once is oral health related quality of life and its validity mentioned (TROMBELLI, 2020). There have been studies to show that periodontal therapy may have a beneficial effect on patient overall well-being and quality of life (SAITO, 2020).

The Oral Health Impact Profile was developed by a conference committee meeting at University of North Carolina Chapel Hill in 1997. It resulted in a number of briefings on how to provide better standardization for completing research amongst investigators (Slade GD, ed. Measuring Oral Health and Quality of Life. Chapel Hill: University of North Carolina, Dental Ecology 1997). The OHIP was meant to identify three parameters; social, psychological and physical. It does however exclude perceptions of satisfaction with oral health, changes in oral health, prognosis or self-reported diagnoses. The use of the tool allows researchers to determine the impact a parameter may have on the oral health and create consistency amongst investigations (Slade GD, ed. Measuring Oral Health and Quality of Life. Chapel Hill: University of North Carolina, Dental Ecology 1997). The OHIP was not the only tool created, in fact there were a number of other tools fabricated for the benefit of the research world (e.g. Oral Health Related Quality of Life (OHRQOL), Dental Impact Profile). It has been shown that there are a number of other factors that have a significant effect on reducing oral health related quality of life. These include lack of financial support, smoking, being in a young to middle age cohort and being Latino as opposed to being Caucasian (MAIDA; MARCUS; SPOLSKY; WANG *et al.*, 2013). Additionally, it was found that oral health related

quality of life disparities are present in impoverished populations (HUANG; PARK, 2015).

Another factor that has shown an effect on oral health is dental anxiety. The modified dental anxiety scale is commonly used to determine the mental state of patients on presentation to the dental office; and determining how they would cooperate if they were to hypothetically have treatment. The dental anxiety scale is widely used amongst researchers, but also has been used in private clinics for providers to know how to better manage patients who may need a bit more comfort prior to sitting in the dental chair. It was shown that patients who experienced higher levels of dental anxiety actually demonstrated a significantly greater finding of caries as well as gingivitis (GUENTSCH; STIER; RASCHKE; PEISKER *et al.*, 2017). This evidence essentially confirms common logic in that patients with a greater fear of visiting the dentist may ultimately neglect their oral health and thus result in poor dental health. Using this information, it is extremely helpful to approach these patients with a different philosophy to support them and aid them in the management of their oral health condition. By improving the oral health of a patient, the oral health related quality of life can be dramatically improved as well (MCGRATH; BEDI, 1999). The use of these tools and measures has propelled other studies to evaluate the effect certain diagnoses and treatments may have on the patient as well. In patients with Chronic Periodontitis, resolution and improvement of OHRQOL was found twenty years after treatment (EL SAYED; BAEUMER; EL SAYED; WIELAND *et al.*, 2019). As McGrath (1999) indicated, with providers being heavily involved with the treatment planning and coverage for patients, it is critical for patients to

be evaluated with an awareness of "quality of life indicators" and the impact they may have on their treatment.

The purpose of this manuscript was intended to answer the question, if periodontal status has an effect on oral health related quality of life. Many studies have previously looked at smaller cohorts such as periodontal practices (NEEDLEMAN; MCGRATH; FLOYD; BIDDLE, 2004) or specific cohorts from different countries (NG; LEUNG, 2006). As indicated before, the prevalence of periodontal disease is significant in this country and with the new classification highlighting the more significant multifactorial nature of the disease, it appeared necessary to determine what effect this had on patients more than just their oral health condition. It was the intention of this investigation to look at a dental school clinic sample as the patients tend to present with typically more systemic health concerns, greater social disparities, as well as greater oral health needs and determine how different levels of periodontal disease affects the OHIP. With a sample that presents with greater needs, it would demonstrate itself as an ideal setting to determine the effect periodontal disease has on oral health related quality of life.

CHAPTER III: METHODS

Study Participants, Inclusion Criteria and IRB

Participants in this study were newly accepted patients at Marquette University School of Dentistry who were scheduled for comprehensive dental examination. These patients were admitted to the school through initial screening to ensure they qualified as patients and were approached during their radiology appointment prior to their comprehensive examination. Participants were approached prior to receiving their radiographs and were informed of the study.

Participants were required to be literate in English and be able to complete the study during their initial appointment. The participant would be brought back for clinical examination to confirm periodontal diagnosis. Participants were excluded if they could not read or write in English. They were also excluded in the event that they could not stay to complete the study. Participants that were evaluated but did not return for clinical examination were also excluded. Further exclusion criteria were age <18 years and mental, vision or hearing impairments.

Permission to complete this study was obtained and approved by IRB (HR#: 3148) at Marquette University School of Dentistry.

Questionnaires

The session involved surveys and questions from Rapid Estimate of Adult Literacy in Dentistry-30 (REAL-30D), Short Assessment of Healthy Literacy (SAHL),

Periodontal Self-Risk Assessment, OHIP-49, Modified Dental Anxiety Scale and general demographic information.

REALD-30

Literacy was tested using a validated dental word recognition instrument (LEE; ROZIER; LEE; BENDER *et al.*, 2007). The interviewer provided the participant a sheet of the 30 words (Figure 1). Participants were asked to read each one out loud and the investigator marked if they were able to correctly read the word. Participants were asked not to guess and say "Pass" in the event they needed to guess or did not know the pronunciation of the word. To ensure no non-verbal cues were given, the investigator stood behind the patient for the duration of the questionnaire.

1. Sugar	11. Abscess	21. Periodontal
2. Smoking	12. Extraction	22. Sealant
3. Floss	13. Denture	23. Hypoplasia
4. Brush	14. Enamel	24. Halitosis
5. Pulp	15. Dentition	25. Analgesia
6. Fluoride	16. Plaque	26. Cellulitis
7. Braces	17. Gingiva	27. Fistula
8. Genetics	18. Malocclusion	28. Temporomandibular
9. Restoration	19. Incipient	29. Hyperemia
10. Bruxism	20. Caries	30. Apicoectomy

Figure 1: REALD-30 Questionnaire

SAHL

The SAHL test illustrated medical literacy via word association. Participants were given a list of eighteen words (Figure 2). Participants were asked to read the words out loud and waited for the investigator to say two words. One of the words was directly related, while the other word was relevant but not as closely associated. The participant was advised to select the word that was most directly related. In the event the participant did not know which option to choose, they were asked to simply state that they did not know. The threshold score was 14 and anything below this score was considered low risk.

1.	**__kidney**	__urine	__fever	__don't know
2.	**__occupation**	__work	__education	__don't know
3.	**__medication**	__instrument	__treatment	__don't know
4.	**__nutrition**	__healthy	__soda	__don't know
5.	**__miscarriage**	__loss	__marriage	__don't know
6.	**__infection**	__plant	__virus	__don't know
7.	**__alcoholism**	__addiction	__recreation	__don't know
8.	**__pregnancy**	__birth	__childhood	__don't know
9.	**__seizure**	__dizzy	__calm	__don't know
10.	**__dose**	__sleep	__amount	__don't know
11.	**__hormones**	__growth	__harmony	__don't know
12.	**__abnormal**	__different	__similar	__don't know
13.	**__directed**	__instruction	__decision	__don't know
14.	**__nerves**	__bored	__anxiety	__don't know
15.	**__constipation**	__blocked	__loose	__don't know
16.	**__diagnosis**	__evaluation	__recovery	__don't know
17.	**__hemorrhoids**	__veins	__heart	__don't know
18.	**__syphilis**	__contraception	__condom	__don't know

Figure 2: SAHL Questionnaire

Periodontal Self Risk Assessment (PRSA)

The PRSA survey was created and made available by the American Academy of Periodontology (AAP). The AAP web-based self-assessment tool estimates on basis of

the answers a "Gum-Disease Risk Score" which can be low, medium, or high. See Figure 3 below.

Figure 3: PRSA Questionnaire

Oral Health Impact Profile (OHIP-49)

The OHIP-49 is a questionnaire that was developed to assess oral health related quality of life from a patient perspective. The questionnaire is comprised of 49 questions with answers on a scale of 0 to 4. The answers are then tallied for a grand total (maximum of 196). The greater the number the lower assessed oral health related quality of life (see appendix for full questionnaire).

Modified Dental Anxiety Scale (MDAS)

The MDAS (HUMPHRIS; DYER; ROBINSON, 2009) was administered in questionnaire format with each question having up to 5 points attributed to it (Figure 4). Each question is tallied for a total with the maximum being 25. With the MDAS, the threshold is 19 or above which indicates a highly dentally anxious or potentially dental phobic patient.

1. **If you went to your Dentist for TREATMENT TOMORROW, how would you feel?**

   Not Anxious ☐   *Slightly Anxious* ☐   *Fairly Anxious* ☐   *Very Anxious* ☐   *Extremely Anxious* ☐

2. **If you were sitting in the WAITING ROOM (waiting for treatment), how would you feel?**

   Not Anxious ☐   *Slightly Anxious* ☐   *Fairly Anxious* ☐   *Very Anxious* ☐   *Extremely Anxious* ☐

3. **If you were about to have a TOOTH DRILLED, how would you feel?**

   Not Anxious ☐   *Slightly Anxious* ☐   *Fairly Anxious* ☐   *Very Anxious* ☐   *Extremely Anxious* ☐

4. **If you were about to have your TEETH SCALED AND POLISHED, how would you feel?**

   Not Anxious ☐   *Slightly Anxious* ☐   *Fairly Anxious* ☐   *Very Anxious* ☐   *Extremely Anxious* ☐

5. **If you were about to have a LOCAL ANAESTHETIC INJECTION in your gum, above an upper back tooth, how would you feel?**

   Not Anxious ☐   *Slightly Anxious* ☐   *Fairly Anxious* ☐   *Very Anxious* ☐   *Extremely Anxious* ☐

Figure 4: Modified Dental Anxiety Scale

Demographics

Basic demographic information was collected from all patients to create a profile and help identify possible risk indicators. Patient were asked to fill out the questionnaire to the best of their ability.

Study Process

Once the patient completed the questionnaires, they notified the investigator who ensured the completion of the study and requested a signature indicating receipt of a monetary compensation for participating. Patients were dismissed and no longer directly needed for the study. As patients were de-identified, clinical information was collected solely based on Axium chart numbers to assess periodontal disease diagnosis. All participants were diagnosed based on comprehensive exam information including full mouth radiographs as well as periodontal charting. This exercise was completed by two investigators (AG & KA) independently to ensure consistency. Oral health status was diagnosed based on the World Workshop of Periodontal Classification (G CATON; ARMITAGE; BERGLUNDH; CHAPPLE *et al.*, 2018; PAPAPANOU; SANZ; BUDUNELI; DIETRICH *et al.*, 2018; TONETTI; GREENWELL; KORNMAN, 2018)

Statistical Analysis

Initial sample size aimed for 250 participants, however due to enough statistical power, 115 total participants and their data were used in this study. Of the 115 participants used, 97 were used for further statistical analysis due to complete data. Using GPower 3.1 a sample size of 97 with effect size of 0.40 the computed achieved power for using ANOVA fixed effect with alpha being 0.05 was 89% (FAUL; ERDFELDER; BUCHNER; LANG, 2009).

Once data was collected, patient data was identified using the patient chart ID number (AXIUM dental software). As patient information was identified, individual

information was deidentified in accordance to the protocol using the AXIUM ID number only. All data was then transferred to a spreadsheet for data organization and analysis. All the variables were described using appropriate statistics. For example, category variables were described as frequency and percentage, whereas all continuous variables were described as means and standard deviations.

Pearson correlation coefficient was used for comparison of other variables (OHIP, DMFT, PRSA, Age, SAHL, MDAS). The t-test for independent samples was used for comparison of OHIP score for two groups (Disease & No Disease). The one-way ANOVA was used for comparison of OHIP score for six groups (six stages 0 to 5 of periodontal disease). For multiple comparison of six groups the Bonferroni test was performed. For all statistical tests the alpha was set at 0.05 and all statistical analysis was done using SAS version 9.4, SAS Institute, Cary, NC.

CHAPTER IV: RESULTS

There were 115 questionnaires collected and analyzed. Of the 115 participants collected, a total of 97 were analyzed for statistical analysis. Eighteen participants were excluded due to incomplete data (inadequate completion of surveys or patient not returning for examination in student clinics). Of the 97 participants, the average age was 49 years with a range from 18-84; 56.7% identified as female. Approximately 32.9% of participants indicated that their average salary was between $20,000-$39,999 and 41.3% indicated that they were presently married. When asking about participant race, 62.4% of the participants indicated they were "White," with 19.4% indicating they were "Black." Reported socioeconomic status values indicated that 42.55% of the participants had completed high school or obtained a GED, 37.23% completed college, and 19.15% have completed graduate school. (See appendix for descriptive data table).
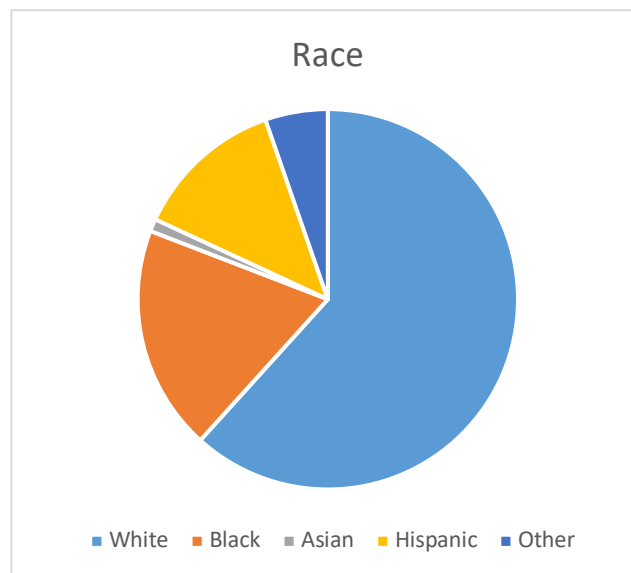
Figure 5: Race Distribution of Participants

	Periodontitis	Non-Periodontitis
Age (mean $\pm$ SD)	59 $\pm$ 14 years	43 $\pm$ 18 years
Gender (female)	48 %	64 %
Body Mass Index (BMI)	27.8 $\pm$ 4.7	29.3 $\pm$ 8.3
Decayed teeth	4.4 $\pm$ 4.3	4.14 $\pm$ 4.8
Missing teeth	3.9 $\pm$ 3.6*	2.8 $\pm$ 3.4
Filled teeth	7.3 $\pm$ 4.6	7.4 $\pm$ 4.8
DMFT	15.5 $\pm$ 5.6	13.8 $\pm$ 6.9
* $p < 0.05$		

Table 1: Summary of Patient Findings

Periodontal disease was the primary outcome looked at to see what association there was with OHIP (Figure 5). To do this, participants were put into groups indicating disease or no disease.
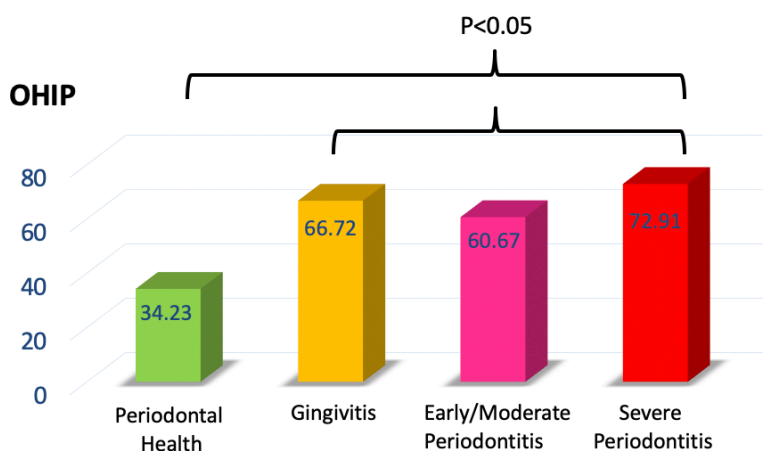
Figure 6: OHIP Scores in Periodontal disease showing significance between groups

There were 85.6% of patients with varying degrees of periodontal disease which included gingivitis. The mean scores for the two groups was compared using t test for independent samples and results showed that mean of OHIP scores for patients with disease was higher compared to the OHIP scores for the patient without disease (t= 4.26 df=35; 63.6$\pm$

vs 34.6; p <0.001). Mean OHIP scores for three group of patients (Health, Gingivitis, and Periodontitis) were compared using one-way ANOVA. Overall, there was significant differences in the means for three groups ($F=7.47$ df=2, 94; $p = 0.001$). Furthermore, Bonferroni comparisons showed that mean of the patient with periodontitis (66.93) was higher than the patient with periodontal health (32.4) ($p<0.05$). Similarly, Bonferroni comparisons showed that mean of the patient with gingivitis (66.24) was higher than the patient with periodontal health (32.4) ($p<0.05$).

Further analysis was completed to assess if the severity of periodontal disease had an impact on the OHIP. Utilizing the World Workshop Periodontal Classification (2017), each participant was evaluated to provide the appropriate stage of periodontal disease. Stages 1-4 were consistent with the classification, however stage 0 and stage 5 were arbitrarily added to include "gingivitis" and "periodontal health", respectively (Figure 7).
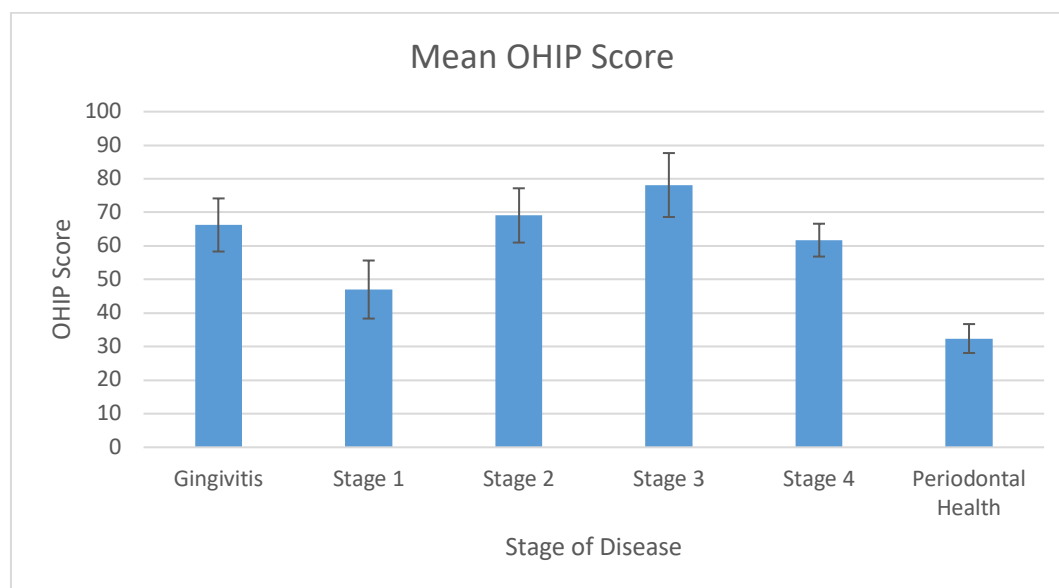
Figure 7: OHIP Scores based on Stages of Periodontal Disease (Means with Standard Error)

When completing the analysis using this categorization, there was a significant finding between groups. Mean OHIP scores for 6 group of patients (Stages 0-5) were compared using one-way ANOVA. Overall there was significant differences in the means for six groups (F=3.90 df=5, 96; p = 0.003). Furthermore, Bonferroni comparisons showed that the mean of the patient with Stage 3 periodontitis (78.13) was higher than the patient with gingivitis (66.24) (p<0.05). Similarly, Bonferroni comparisons demonstrated that the mean of patients with gingivitis (66.24) was higher than the mean of the patient with periodontal health (32.4) (p<0.05).

When simplifying the disease categories to health vs periodontal disease (including gingivitis and periodontitis), area under the curve analysis showed that with a OHIP score of 43, there was a 74% probability of predicting disease. Additionally, area under the curve for PRSA demonstrated that a PRSA score of 19 would provide a 68% probability of predicting disease.
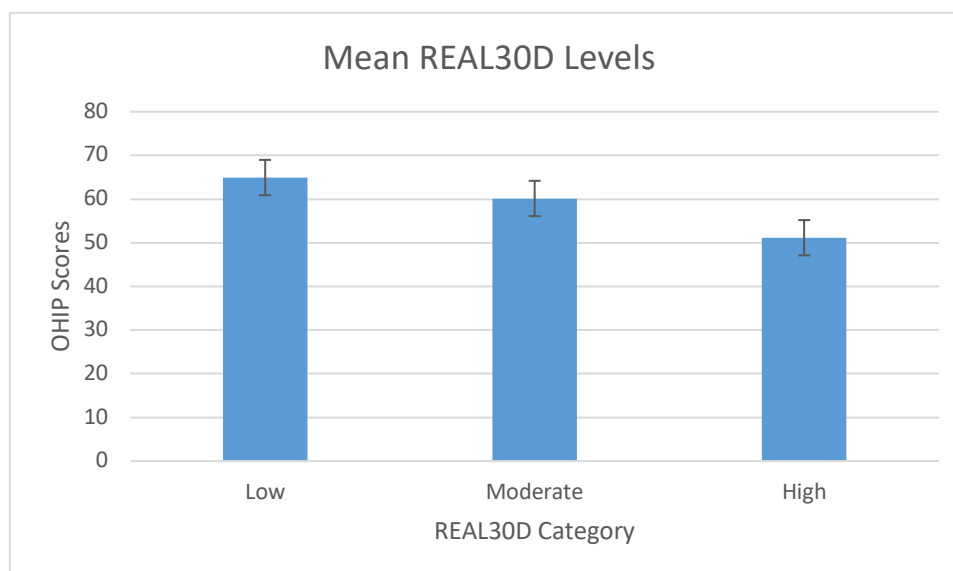
Figure 8: REAL30D Level compared to OHIP (Low, Moderate, High)

Dental Literacy assessment showed that 71.4% met the threshold for adequate dental literacy with 42.8% having "Low" dental literacy (Figure 7). Although there was a general trend showing a relationship, when the ANOVA and regression were completed, there were no statistically significant findings between groups and logistic regression showed that there was no significant relationship between OHIP and dental literacy.

	DMFT	SAHL	PRSA	Age	MDAS	OHIP
DMFT	1.0	0.098	0.019	0.360*	-0.011	0.206*
SAHL		1.0	0.054	0.060	-0.148	0.012
PRSA			1.0	0.111	0.073	0.237*
Age				1.0	-0.124	0.044
MDAS					1.0	0.310*
OHIP						1.0

Table 2: Pearson Correlations (*Statistical Significance $p < 0.05$)

Medical literacy (SAHL) showed that overall 91.7% had a "high" level of medical literacy. When compared to OHIP, there was no significant finding connecting the SAHL to OHIP. Periodontal Risk Self-Assessment measures showed that all participants demonstrated a moderate to high PRSA score. Pearson correlation coefficient was computed for the PRSA and OHIP scores. The correlation coefficient between PRSA and OHIP was a positive (r= 0.237; p = 0.0194). Further evaluation of the correlation looking at specific questions of PRSA and OHIP demonstrated that four questions (Q, 4, 5, 6, & 10) were statistically significantly correlated with OHIP (see Table 3 for correlations values). Other positive correlations found were between "DMFT" and OHIP (r = 0.206, p= 0.0428) and Modified Dental Anxiety Scale (MDAS) and OHIP (r = 0.31005, p = 0.0020).

	Correlation	p-Value
Q4. Are your teeth loose?	0.276	0.0068
Q5. Have your gums receded, or do your teeth look longer?	0.204	0.0472
Q6. Do you smoke or use tobacco products?	0.234	0.022
Q10. Have you ever been told that you have gum problems, gum infection or gum inflammation?	0.209	0.0436

Table 3: PRSA Questions with Statistically Significant Correlations to OHIP

Although mean of OHIP score is higher for MDAS > 19, it did not reach statistical significance as the variances in the two groups are unequal (F= 4.93 df = 6, 89; p = 0.0004). Additionally, even with a positive correlation with MDAS, there were 89.9% of patients who did not meet the threshold for having dental anxiety, which was not statistically significant. Participant age did not demonstrate any statistically significant results in relation to OHIP (Table 2).
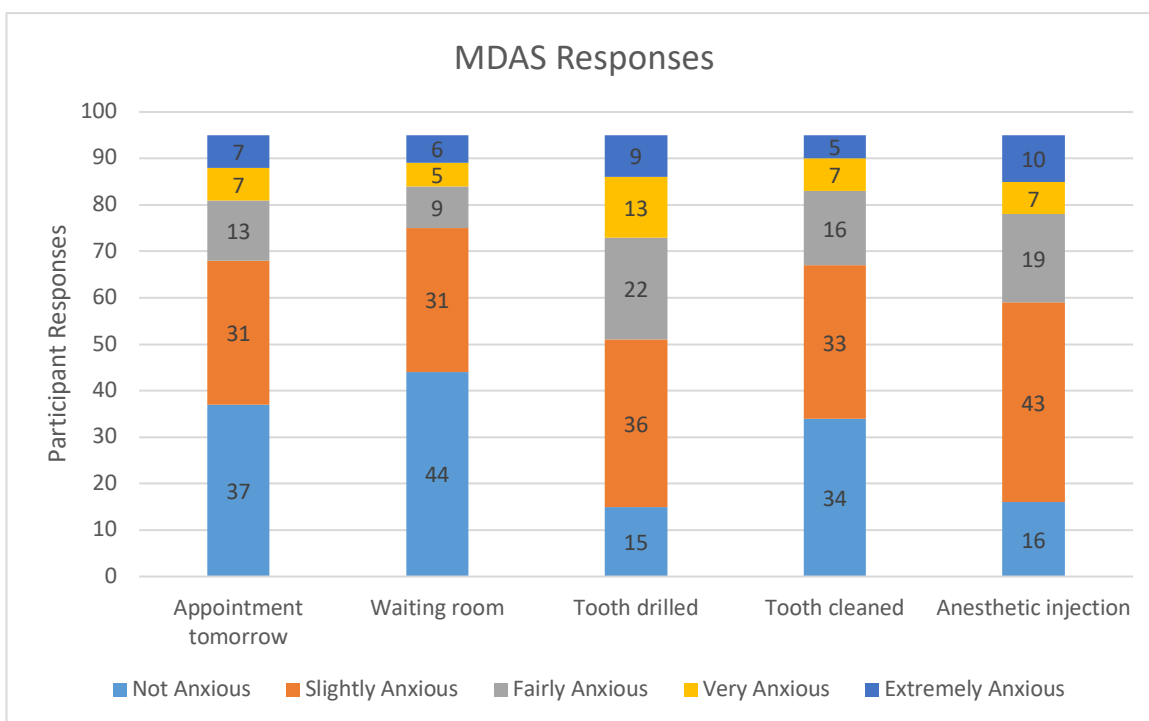

Figure 9: MDAS Questionnaire Response Distribution

CHAPTER V: DISCUSSION

To our knowledge, this is one of the first studies looking at overall quality of life and its association with periodontal status in a dental school setting. The patient pool in a dental school typically presents with a specific background in terms of socioeconomic status, education level and overall health condition. Because of these characteristics, patients may not experience the most ideal oral health status nor the most ideal or controlled overall health quality (MAIDA; MARCUS; SPOLSKY; WANG *et al.*, 2013). The study was completed to determine if there was an association between the periodontal health and quality of life patients experienced and attempt to identify factors that predispose or highlight possible risk associations. Data has been collected over the years and compiled in the NHANES studies to highlight patient populations and patient factors that are more at risk of periodontal disease. However, the attempt to find the predictors is the next step in helping patients achieve adequate oral health based on their profile.

Our findings indicate that in fact there are significant associations with periodontal diseases and reduced overall quality of life. From a broad standpoint, we found that indeed the patients with any form of periodontal diseases had higher OHIP score meaning that their overall quality of life was less than those with periodontal health. Because the finding was so broad, the approach to zoom in and separate periodontal health from gingivitis and periodontitis was done and again, the finding showed that in both cases, patients with gingivitis and periodontitis had worse overall quality of life scores than those with periodontal health. While this finding was not overly surprising based on the existing literature (KARAASLAN, 2020), the attempt to further

isolate the severity of the periodontal disease and compare it to the overall quality of life was followed using the new periodontal disease classification (World Workshop 2017). The staging and grading system was implemented to facilitate better communication with patients and dentists to identify the multifactorial nature of the disease (CATON; ARMITAGE; BERGLUNDH; CHAPPLE *et al.*, 2018). Of course, this new classification is harmonious with our goal to determine which factors may have an association with periodontal disease status. When using the staging system, we elected to add two separate stages in addition to the Stage 1-4. Stage 0 and Stage 5 were added to represent gingivitis and periodontal health respectively. This allowed us to determine which stage of periodontal disease was more closely associated with lesser overall quality of life. Interestingly, patients with Stage 3 periodontitis showed a higher OHIP score indicating poor overall quality of life. This finding was also consistent with our Stage 0, gingivitis, which had a higher average OHIP score indicating lesser overall quality of life. The interesting aspect of this finding is that Stages 1, 2, and 4 did not have statistically significant difference in OHIP scores. This may indicate that a patient with gingivitis is more aware of the periodontal changes occurring, whereas Stage 1 and 2 typically are more silent to a patient who has progressed past gingivitis. On the other hand, when a patient reaches Stage 3, the awareness is increased due to possible discomfort of the gingival tissues and teeth. This finding and hypothesis was consistent with previous literature (BUSET; WALTER; FRIEDMANN; WEIGER *et al.*, 2016). The other component we see with Stage 3 is comorbidities. Patients with an advanced stage of periodontitis are more likely to have general health issues (e.g. diabetes, cardiovascular disease) that may be poorly controlled and contributing to the patient's poor oral health

and/or poor overall quality of life (NAITO; YUASA; NOMURA; NAKAYAMA *et al.*, 2006). While this study is not able to identify the single factor that predisposes one to the other, the study does confirm that there is an association between a patient's overall quality of life and oral health.

When further evaluating the patient's periodontal status, we attempted to look at other parameters that may help identify a patient's risk of having a lesser overall quality of life. It may be of no surprise, but the correlation between "DMFT" (Decayed, Missing, Filled Teeth), and OHIP scores was positive and significant. This indicated that someone who has had more dental treatment or lack thereof, is likely to experience a poorer overall quality of life. Correlations were also found with the Modified Dental Anxiety Scale which required a threshold score to be met to be considered dentally anxious. Consistent with the literature (GUENTSCH; STIER; RASCHKE; PEISKER *et al.*, 2017) showing the finding was also significant for a positive correlation. The final correlation found was the most intriguing as it related to the patient's perceived self-risk assessment (PRSA) as the finding was significant for a positive correlation. Existing literature demonstrates what this may indicate, that a patient typically is aware of their condition and may be able to perceive what may be affecting their overall condition as well (CARRA; GUEGUEN; THOMAS; PANNIER *et al.*, 2018). When looking at the previous observations that Stage 3 Periodontitis is highly associated with higher OHIP scores, this may also indicate that it is at this stage of periodontitis that a patient may be aware of their oral health condition and thus is more adept to being self-aware of their overall quality of life. This may be useful in helping patients address their concerns, but also help patients who may not have as severe of disease yet. Patients who are diagnosed with Stage 1 or 2, may be

instructed that their condition may not be notable to them at the time, but their condition will worsen, and at which point they will notice via their periodontal symptoms. Based on our findings, this may also indicate that they may be experiencing another condition or conditions that are contributing to reducing their overall quality of life.

Another factor looked at included dental and medical health literacy. Dental literacy was evaluated using the REAL30D and the general trend showed that with increased dental literacy there was a decrease in OHIP scores. While this was not statistically significant, the trend could be further evaluated in future studies to determine if the lack of dental literacy is related to education levels or if it's a predictive entity in and of itself. In the medical field, it is known that the patient awareness of general health concerns is critical in self-care and helping patients seek care when they suspect ailments (ELTAS; USLU; ELTAS, 2016). The same could be said for the dental world and it may be critical for the dental community to be more of an advocate for patient to help them self-screen even in cases where symptoms are not as apparent. A possible manner to enhance this, is to include our colleagues in medicine to also advocate the oral-systemic connection and educate the patients accordingly.

CHAPTER VI: CONCLUSION

Periodontal diseases may negatively impact the oral health-related quality of life. Patients suffering from periodontitis also showed more missing, filled and decayed teeth, which may have an effect on function and comfort. In addition to missing teeth, poorer oral health related quality of life is positively correlated with the patient's perceived assessment of self-risk as well as dental anxiety. It is the hope of this dental school clinic-based sample to illustrate the significant connection between periodontal disease and the oral health related quality of life. With the smaller sample selection, it would be imperative to determine the connections found on a larger scale through national databases such as, NHANES. The ultimate goal would be to discover additional support for studies evaluating patient risks and manners to provide more personalized oral health care to facilitate better surveillance of patient's overall quality of life through their dental provider.

CHAPTER VII: BIBLIOGRAPHY

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CHAPTER VIII: APPENDIX

Oral Health Impact Profile-49 Questionnaire

Over the past ONE MONTH...

1. Have you had difficulty chewing any foods because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

2. Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

3. Have you noticed a tooth which doesn't look right?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

4. Have you felt that your appearance has been affected because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

5. Have you felt that your breath has been stale because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

6. Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

Over the past ONE MONTH...

7. Have you had food catching in your teeth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

8. Have you felt that your digestion has worsened because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

9. Have you felt that your dentures have not been fitting properly?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

10. Have you had painful aching in your mouth?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

11. Have you had a sore jaw?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

12. Have you had headaches because of problems with your teeth, mouth or

dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

13. Have you had sensitive teeth, for example, due to hot or cold foods or drinks?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

Over the past ONE MONTH...

14. Have you had toothache?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

15. Have you had painful gums?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

16. Have you found it uncomfortable to eat any foods because of problems with

your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

17. Have you had sore spots in your mouth?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

18. Have you had uncomfortable dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

19. Have you been worried by dental problems?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

20. Have you been self conscious because of your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

Over the past ONE MONTH...

21. Have dental problems made you miserable?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

22. Have you felt uncomfortable about the appearance of your teeth, mouth or

dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

23. Have you felt tense because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

24. Has your speech been unclear because of problems with your teeth, mouth or

dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

25. Have people misunderstood some of your words because of problems with your teeth, mouth or dentures?

   0   1   2   3   4

   Never   Hardly ever   Occasionally   Fairly often   Very often

26. Have you felt that there has been less flavour in your food because of problems with your teeth, mouth or dentures?

   0   1   2   3   4

   Never   Hardly ever   Occasionally   Fairly often   Very often

   ## Over the past ONE MONTH...

27. Have you been unable to brush your teeth properly because of problems with your teeth, mouth or dentures?

   0   1   2   3   4

   Never   Hardly ever   Occasionally   Fairly often   Very often

28. Have you had to avoid eating some foods because of problems with your teeth, mouth or dentures?

   0   1   2   3   4

   Never   Hardly ever   Occasionally   Fairly often   Very often

29. Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?

   0   1   2   3   4

   Never   Hardly ever   Occasionally   Fairly often   Very often

30. Have you been unable to eat with your dentures because of problems with them?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

31. Have you avoided smiling because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

32. Have you had to interrupt meals because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

33. Has your sleep been interrupted because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

Over the past ONE MONTH…

34. Have you been upset because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

35. Have you found it difficult to relax because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

36. Have you felt depressed because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

37. Has your concentration been affected because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

38. Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

39. Have you avoided going out because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

40. Have you been less tolerant of your spouse or family because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

Over the past ONE MONTH...

41. Have you had trouble getting on with other people because of problems with your teeth, mouth or dentures?

0	1	2	3	4

Never   Hardly ever   Occasionally   Fairly often   Very often

42. Have you been a bit irritable with other people because of problems with your

    teeth, mouth or dentures?

    0   1   2   3   4

Never   Hardly ever   Occasionally   Fairly often   Very often

43. Have you had difficulty doing your usual jobs because of problems with your

    teeth, mouth or dentures?

    0   1   2   3   4

Never   Hardly ever   Occasionally   Fairly often   Very often

44. Have you felt that your general health has worsened because of problems with

    your teeth, mouth or dentures?

    0   1   2   3   4

Never   Hardly ever   Occasionally   Fairly often   Very often

45. Have you suffered any financial loss because of problems with your teeth,

    mouth or dentures?

    0   1   2   3   4

Never   Hardly ever   Occasionally   Fairly often   Very often

46. Have you been unable to enjoy other people's company as much because of

    problems with your teeth, mouth or dentures?

    0   1   2   3   4

Never   Hardly ever   Occasionally   Fairly often   Very often

Over the past ONE MONTH...

47. Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

48. Have you been totally unable to function because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

49. Have you been unable to work to your full capacity because of problems with your teeth, mouth or dentures?

0	1	2	3	4
Never	**Hardly ever**	**Occasionally**	**Fairly often**	**Very often**

Figure 10: Descriptive Frequency of Demographic Questionnaire