

COMPARING THE ORAL HEALTH RELATED QUALITY OF LIFE IN FOUR
OROFACIAL PAIN CONDITIONS

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Sarah Shueb

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Donald R. Nixdorf

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Dedication

I dedicate my dissertation work to my late beloved brother (Waeil) and in the memory of all the Libyan youth who sacrificed their lives for a better future of the Libyan people.

I also dedicate this dissertation to my beloved husband Adel for his practical and emotional support. A great appreciation for his encouragement that he provided and the sacrifices that he made during my graduate education.

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Abstract

Objectives: Pain is known to reduce quality of life. Concurrently, it is believed that orofacial pain reduces the oral health-related quality of life (OHRQoL). While the impact that painful temporomandibular disorders (TMD) have on OHRQoL has been well described, little has been reported about the impact of acute dental pain (ADP). Moreover, the impact of trigeminal neuralgia (TN) and persistent dentoalveolar pain disorder (PDAP) on OHRQoL has not been reported yet. The aim of this study was, therefore, to compare the OHRQoL impairment among four orofacial pain conditions, *i.e.*, participant with TMD, ADP, TN, and PDAP and compare the results with people without orofacial pain.

Methods: OHRQoL was measured using the OHIP-49 questionnaire, using a convenience sample of four orofacial pain conditions (pain groups with TMD (n=30), ADP (n=27), TN (n=21), PDAP (n=16)). To provide a frame of reference for pain-related OHRQoL impairment, we also included a group of pain-free control participants (n=20). The mean OHIP-49 summary score, with its 95% confidence interval (95% CI), described the level of impact. The differences in mean values across the four pain conditions were analyzed using Analysis of Variance (ANOVA). The second part of the analysis was performed by comparing the OHIP-49 mean score of each condition and the OHIP mean score of the control group using Student's two sample *t-test*. Finally the absolute score differences between groups were judged according to: the Minimal Important Difference (MID) and the Effect sizes (ES).

Results: OHRQoL was measured using OHIP-49 in a convenience sample of four conditions (patient groups with orofacial pain; TMD (n=30), acute dental pain (n=27), TN

(n=21), PDAP (n=16)). Our results showed significant impairment in the OHRQoL for the four conditions compared to the control group. The mean OHIP-49 score (95% CI) was 60.8 (48-74) for TMD, 61 (48-74) for ADP, 58 (41-75) for TN, and 66 (46-86) for PDAP. For comparison purposes, the mean OHIP-49 score (95% CI) was 8 (3-13) for the pain free group. The difference was statistically significant and clinically relevant between pain groups and the control group (all comparisons: $P < 0.001$). Each of the four orofacial pain conditions had similar levels of impact on the OHRQoL when compared to each other. Using the Minimum Important Difference (MID) there was a clinical significance between chronic conditions (TMD, TN, PDAP) and the ADP (11 (-6 to 28), 8.4 (-11 to 28), and 17(-4 to 37)) respectively, also a clinical significance between the four orofacial conditions and the control group was detected. A moderate effect size was detected between participants with PDAP and ADP (ES=0.5, 95%CI (-0.1 to 1.1)).

Conclusion: Our data supported the hypothesis that orofacial pain conditions have a substantial impact and adversely affect the quality of life of participants with four orofacial pain conditions as compared to those with no pain.

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1. Introduction:

Pain in the orofacial region is a common problem with estimates suggesting 28% of people suffer from such pains in the USA¹. The most common reason for pain in the orofacial region is acute dental pain ADP, which involves inflammation of the pulp and/or periodontium². It is estimated to affect 12% of the American population, affecting males and females equally¹. Another common type is pain associated with temporomandibular disorders (TMD), which is defined as "a group of conditions that cause pain and dysfunction in the jaw joint and the muscles that control jaw movement"³. It is estimated to affect between 5 to 12% of the U.S. population and believed to be the second most common musculoskeletal pain conditions after chronic low back pain, with an annual cost estimated at \$4 billion⁴. It affects women 3 times more than men⁵ and occurs most often during the menstrual years, between 18 and 44 years of age⁶. A rare type of orofacial pain is trigeminal neuralgia (TN), which is defined as "sudden recurrent, severe pain in the distribution of one or more of the branches of the fifth cranial nerve"⁷. It is estimated to have a prevalence of 0.01 to 0.02%, affecting three women to every two men, and with a typical onset occurring after the age of 60 years old⁸. Another orofacial pain condition is persistent dentoalveolar pain disorder (PDAP), which is defined as a persistent pain present in the dentoalveolar region that is not caused by dental pathology or referred from another region⁹. It is estimated to occur in 1.6% of all patients who received root canal therapy¹⁰, affecting females three to eight times more often than males, and has been reported to have an average onset between the ages of 40 and 50 years old⁹.

Pain in general is known to negatively impact the person experiencing it, affecting social functioning, physical functioning, and psychological well being¹¹. Global

measurements of these impacts are commonly captured using quality of life instruments¹². Orofacial pains are also known to have a negative impact on the person experiencing it and oral health-related quality of life (OHRQoL) is a well-acknowledged method for measuring this impact¹³ and the most widely used¹². There are many instruments have been developed to measure the construct of OHRQoL (Table 1)¹⁴, with the most commonly used comprehensive instrument being 49 item Oral Health Impact Profile (OHIP-49)¹⁵. This instrument is a problem index, meaning higher scores representing high levels of oral health impairment, with the studies reporting general population having scores ranging from 9.7 to 17.1^{16,17,18} and a 6 point different being considered statistically significant¹⁹.

Orofacial pains are known to exert a considerable burden on the society. TMD exerts a considerable burden on the people experiencing it with increased lost workdays and the use of the health care²⁰. Multiple studies have used OHIP-49 to measure the amount of impairment that TMD has on participants, with those studies reporting a ranged of 42.9 up to 60.6 OHIP-49 points^{16, 17, 18, 21}. The impact of ADP on the oral health related quality of life was measured using the OHIP-49 for the measuring the responsiveness of the Croatian version and it was found to be elevated with 108.48 mean OHIP score²², similar results were found in a study done in Canada were a 72.7 OHIP mean score was detected using 17 items of the OHIP-49 version²³. No studies have been found to measure the impact TN has on OHRQoL using OHIP-49 but the impact of TN on general health status has been measured using the modified Short Form Brief Pain Inventory (mBPI-SF) and EuroQol (EQ-5D) survey. This research found employment was affected in 34% of participants with TN and 33% of the participants reported the use of antidepressants, anxiolytic and/or sleep medications²⁴. Little is known about on the impact of PDAP on the people experiencing

it²⁵ and a search of the literature did not reveal any reports measuring this impact using a standard construct of OHRQoL, such as OHIP-49.

Given that considerable information is known about the OHRQoL, as measured by OHIP-49, with common orofacial pains, namely TMD and to some degree ADP, the use of this metric allows for comparison of these conditions with other painful orofacial conditions, namely TN and PDAP. Obtaining this comparison is helpful in understanding the burden being experienced by those suffering from the less common orofacial pain conditions. Therefore, we sought to measure the impact various orofacial pain conditions have on the individuals experiencing using a standardized measure to characterized this impact and allow for comparisons between different orofacial pain conditions.

2. Specific Aims:

Using OHIP-49 we assessed the impact on the OHRQoL of four orofacial pain conditions (TMD, ADP, TN, and PDAP) on those experiencing them, with a comparison with a group of pain-free participants to serve as controls.

Hypotheses:

1. The mean OHIP-49 score for participants with TN and PDAP is not different from the mean OHIP-49 score of either participants with TMD or ADP.
2. The mean OHIP-49 score for participants with TMD, PDAP, TMD, and ADP is higher than the mean OHIP-49 score of pain-free controls, as assessed by minimum importance difference (MIP) and effect size (ES).
3. There is no difference in the specific item prevalence between participants with TMD, ADP, TN and PDAP.

3. Material and Methods:

3.1 Study design:

This study was cross-sectional in nature and was comprised of a convenience sample for each of the five difference groups, four groups of participants with different orofacial pain conditions and one group of pain-free controls. This research was part of a parent study designed to identify question items to be used for the development of a screening questionnaire for PDAP. This parent study included six questionnaires, of which OHIP-49 was one, and these questionnaires were presented in random order to each participant. The local research ethics committee at the University of Minnesota approved this study and all participants provided written informed consent prior to their participation.

3.2. Settings:

Participants were given instructions and explanations of the different aspects and questions contained in the questionnaire, which was generally completed at the clinic in the presence of one of the investigators. For logistical and practical reasons, few participants filled the questionnaires at home and if they encountered difficulty in understanding the text, the research investigator helped the participants understanding the questions at the next visit. Participants were paid a nominal compensation of \$20 for their time in participating in this research.

Each participant was given a number of questionnaires presented in random order (Table 2). The TMD, TN, and PDAP participants were mostly recruited by faculty at the TMD, Orofacial Pain, and Dental Sleep Medicine Clinic at the University of Minnesota.

Two of the PDAP participants were recruited by Dr. Cory Herman at the Minnesota Head and Neck Clinic. All participants with ADP diagnosis were recruited by Dr. Alan Law at The Dental Specialists clinic in Lake Elmo, Minnesota. All dentists recruiting participants were board certified in their respective disciplines. Pain-free controls were recruited from the School of Dentistry clinics by approaching pain-free patients, relatives and friends accompanying the participants, and people in the University community.

3.3 Participant selection criteria:

The following criteria were used to select participants for this study:

Inclusion Criteria:

- Age, 18 years old and older.
- Participants were fully able to cooperate and respond to the questions.
- ADP sample: participants diagnosed with irreversible pulpitis and/ or symptomatic apical periodontitis, following the diagnostic criteria by Gutmann, 2009 ²⁶.
- TMD pain sample: participants with TMD diagnosis including myalgia, myofascial pain, arthralgia or headaches attributed to TMD following the DC/TMD diagnostic criteria²⁷.
- For TN participants the diagnosis was performed following the ICHD-II Diagnostic Criteria for Classical Trigeminal Neuralgia²⁸.
- Participants with persistent dentoalveolar pain disorder the diagnosis was made by experienced board certified clinician following the diagnostic criteria Nixdorf et al. in 2012⁹.([Figure 1](#))

- Pain free had to response "NO" to the following question, "Have you had any pain in your face, mouth, teeth, jaw or ears, in the last 3 month", and with no treatment seeking behavior. As well, they had to have no history of TMD problems, clenching, or a higher degree of tooth wear and were fully able to cooperate and respond to the questions

Exclusion Criteria:

- A history of traumatic injuries to the orofacial region.
- A major systemic illness related to altered pain sensitivity, such as fibromyalgia or other widespread bodily pain conditions.
- A history of TMJ surgery or inter-articular steroid injection.
- Unable to give informed consent.
- Previously enrolled in this study.

3.4. Questionnaire:

OHRQoL was measured using the oral health impact profile (OHIP-49); it is considered one of highly used tools in evaluating the OHRQoL¹⁷. An example of an OHIP statement is "Have you found it difficult to relax because of problems with your teeth, mouth or dentures?" responses were made on a scale 0 (never), 1 (hardly ever), 2 (occasionally), 3 (fairly often), 4 (very often). OHRQoL impairment was characterized by the OHIP-49 summary score, which is the simple sum of all 49-item responses and can range from 0 to 196 OHIP units (with 196 representing a participant answering "very often" to all 49 items). A zero sum score of the 49 item indicate a non-existing impairment on the OHRQoL and the higher the OHIP summary score the higher is the impairment of OHRQoL.

3.5. Data management and analyses:

Data were managed using the spreadsheet software Microsoft Excel (Microsoft Excel 2010 for PC: Microsoft Corporation) and all analyses were performed using the statistical software package STATA release 9 (Stata Corp LP, College Station, TX).

The four condition's OHIP49 mean values (including their 95% confidence intervals) were compared with controls to assess the condition-specific impact on OHRQoL. They were also compared with each other to assess whether OHRQoL impairment is different across orofacial pain conditions. Differences in mean values across the four pain conditions were analyzed using Analysis of Variance (ANOVA) possibly followed up by t-tests in case the ANOVA omnibus test is statistically significant. The magnitude of differences was assessed with two approaches. Absolute score differences between groups were judged according to the Minimal Important Difference (MID) for OHIP-49 scores²⁹. The MID is defined as “the smallest difference in score in the domain of interest which patients perceive as beneficial and which would mandate, in the absence of troublesome side effects and excessive cost, a change in the patient's management”¹⁹. Differences between groups were also expressed in a relative metric using effect sizes (ES) which we calculated as standardized difference between two means according to Cohen. Cohen's d is the difference between two means divided by a standard deviation for the data, and guidelines exist judging the magnitude of an ES of 0.2 as “small”, an ES of 0.5 is “medium” effect, and an ES of 0.8 is a “large.”³⁰. In addition to comparing OHIP-49 mean values across groups, the distribution of scores for all four orofacial pain conditions was presented as empirical cumulative distribution functions to assess whether OHRQoL

impairment varies across groups. We aimed to visually compare the four score distributions for substantial differences and to compare key quantiles such as the median.

The second part of the analysis we computed the summary scores of the ordinal responses and the numerical frequencies for each participant and assessed whether the ordinal OHIP mean summary scores different significantly from that for the control group using Student's two sample t-test. After assessment of the magnitude of scores differences, we analyzed differences in score means statistically with an Analysis of Variance (ANOVA), possibly followed up by t-tests for pairwise comparisons in case the ANOVA omnibus test is statistically significant. A regression analysis with OHIP-49 scores as dependent variable and the 4 pain conditions as indicator (independent) variables, controlled for age (median split into lower versus higher age), education (level 1= less than High School, 2= High school, 3= Some college, versus 4= college degree and 5= Advanced or graduate degree), and sex, allowed the assessment how large OHIP-49 differences between pain groups are when sociodemographic factors are controlled. These adjusted groups difference were again compared to the OHIP-49 MID²⁹.

As the last step of our analytic approach, for exploratory purposes, we computed differences in item prevalence for OHIP problems occurring “fairly often” or “very often” for all 6 pairwise contrasts of the four pain conditions. We calculated $6(\text{number of comparisons}) * 49(\text{number of OHIP items}) = 294$ differences with their confidence intervals to explore which items differed the most between group. However, only the differences exceeding 30% as the absolute difference between any two pain conditions were presented to gain insight about the magnitude of item

prevalence differences, which problem areas are affected the most, and which group contrasts are most prevalent.

4. Results:

A total number of 114 participants were recruited for the study, of which 30 were TMD participants, 27 ADP participants, 21 TN participants, 16 PDAP participants, and 20 pain free controls. All individual questions of the OHIP-49 questionnaire were answered by each participant resulting in no missing responses.

4.1. Participants' characteristics:

Basic demographic data and clinical data are presented in (Table 3). The mean age of cases was 49.6 years. The majority of participants were female (73%), white (90%), and (34%) had graduate degree. Forty-seven percent of participants reported an annual household income equal or greater than \$50,000 per year. The most significant difference between groups was the level of education; being higher in participants with PDAP, 44% had an advanced or graduate degree. Compared to controls, orofacial pain participants were older, more often women and less educated; however, in general, these differences were not large. Among orofacial pain conditions, sociodemographic differences were less pronounced.

4.2. Magnitude and statistical significance of OHIP-49 summary scores differences inter pain conditions and between pain conditions and controls:

All OHIP-49 differences between each of the four pain conditions and the control group were statistically significant (all comparisons: $p < 0.001$). When OHIP-49 means were tested across pain conditions with an ANOVA across the four pain conditions, the omnibus test was not statistically significant ($p = 0.43$) and excluded any statistically significant differences across the four groups.

As expected, the four pain conditions were remarkably different from control participants in terms of OHRQoL impairment. The conditions' differences (compared to controls) were at least 41 OHIP score points and exceeded by far the MID of 6 OHIP points (Table 4). Among pain conditions, the chronic types (TMD, TN, PDAP) had at least 8 OHIP-49 points higher OHRQoL levels than the acute tooth pain, again exceeding the MID. The differences are not statistically significant among pain conditions using analysis of variance (Figure 2); however, a considerable uncertainty around OHIP differences were observed. Using standardized differences, *i.e.*, effect sizes, to compare groups, large effect with at least 1.8 were observed and exceeded by far the 0.8 threshold for large effects. Again, as for the absolute differences, confidence intervals were wide.

Among the four pain conditions, differences were not so large with only 4 of the 6 pairwise group differences exceeding the MID. In particular, the chronic pains (TMD, TN, PDAP) seemed to form a cluster of conditions that was different compared to the acute tooth pain. All differences included in the lower limit of the 95% confidence interval the MID. The ES comparing the groups were medium (N=1), small (N=3), or no effect (N=2), supporting a pattern of small differences among groups that appeared despite wide confidence intervals around point estimates. This pattern was also observed when the entire distribution of scores for the 4 pain conditions was compared (Figure 3). Median and other quantiles of score distributions were similar across conditions. No pattern was apparent that a particular condition's score distribution had always lower (or higher) quantiles than other distributions.

Furthermore, in a regression analysis comparing the four pain conditions (base category: PDAP) adjusted for age, gender, and education in their influence on OHIP-49,

none of the pain conditions was statistically different (as previously observed) but only ADP exceeded with a 15 OHIP-49 the MID of 6 points. This means, in terms of OHRQoL magnitude, differences among chronic pain conditions were all smaller than the MID and each chronic condition had a larger OHRQoL influence compared with ADP as judged by the MID (Table 5).

4.3. Comparing OHIP item prevalences among the four pain conditions:

Among the 294 calculated pairwise differences of item prevalences were 16 differences that were greater than 30% (Table 6). Except for two items “Worried by dental problem” (appeared two times) and “difficulty chewing”, all items described various aspect of dental, oral, and orofacial pain. The item with the largest difference (“headaches”) had a rather low prevalence (less than 10%) in TN and ADP participants and a substantial prevalence in TMD participants produced the largest contrast between item prevalences. “Sore jaw” was the item that appeared the most in these comparisons with 3 occurrences. It seemed to differentiate the best across pain conditions with a high prevalence in TMD (67%) and lower prevalence in PDAP (19%), ADP (22%) and in TN (24%) participants. TMD was present the most with 11 occurrences and ADP was present the least with 5 occurrences, leading to the impression that TMD had somewhat higher impact, followed by PDAP and TN and ADP last. However, overall, this pattern was not very strong based on this exploratory data interpretation.

5. Discussion:

The ability of dental clinicians and researchers to estimate oral health and to promote for dental care has been hindered by a limitation in measurements of the level of dysfunction, discomfort, and disability associated with oral conditions³¹. Therefore, we used the Oral Health Impact Profile 49 (OHIP-49), which is a standardized and internationally satisfactory measure for the evaluation of OHRQoL, to characterize the level of impairment of individuals affected by four different orofacial pain conditions. Built on Locker's conceptual model of oral health¹⁵, initially OHIP-49 items were grouped into 7 domains: Functional Limitation, Physical Pain, Psychological Discomfort, Physical Disability, Psychological Disability, Social Disability, and Handicap. The Dimensions of OHRQoL Project (DOQ) suggested based on exploratory factor analytic results in N=5,173 international participants and confirmatory factor analytic results in N=5,022 that Oral Function, Orofacial Pain, Orofacial Appearance, and Psychosocial Impact are four major aspects of patient-perceived OHRQoL^{32, 33}. However, the DOQ Project also cautioned the use of dimensions scores because they need more methodological work and recommended that OHRQoL measured with OHIP can also be sufficiently described with one, overall summary score³³. Therefore, the simple sum of the 49 OHIP items was used as our OHRQoL measure.

This study is the first to investigate the effect of TN and PDAP on the perceived OHRQoL of these participants' using OHIP-49. The OHIP summary scores indicated a lower OHRQoL in PDAP participants (mean sum score: 66.2; 95% CI: 46.3-86.0) then came next participants with TMD (mean sum score: 60.8; 95% CI: 47.7-74), participants with TN (mean sum score: 57.9; 95% CI: 40.9-75), and last participants with ADP (mean

sum score: 49.5; 95% CI: 38.4-60.7). However, the difference was statistically insignificant. Nonetheless, following the use of effect sizes for characterizing the group differences there was a moderate effect size between the ADP and PDAP groups. The distribution of the four orofacial pain participants' summary scores was yet markedly different from the general population (mean sum score: 8.35; 95% CI: 3.3-13.4), indicating that general population participants represented the lowest impact of OHRQoL among groups. In this study, as expected, participants who were seeking treatment had significantly more issues, as defined by OHIP-49 mean score, than pain free participants. Among the four conditions female prevalence was noted. The chronic pain conditions (TMD, TN, PDAP) seemed to cluster together in the magnitude of their impact and were different from ADP when compared in terms of absolute OHIP-49 differences using the instrument's Minimal Important Difference as benchmark or in terms of relative (standardized) OHIP-49 differences expressed as effect sizes and using widely applied guidelines for interpretation. The difference may be related to the chronicity of the pain, with ADP being acute and being less troubling than TMD, TN, and PDAP.

The impact of TMD have been intensely studied using OHIP instruments, therefore, TMD has a great reference value in our study since much has been known about its impact¹⁷. There is a great interest in studying OHRQoL for these participants that has led to the development of a condition-specific OHIP³⁴. Our results are in line with previous studies that measured the OHRQoL in participants with TMD diagnosis. The impact of TMD, in particular painful TMD, on OHRQoL is well documented by a meta-analysis³⁵ and we are able to compare our results with previous work using the OHIP-49. Among the

studies that have been performed to measure the OHRQoL in TMD participants is a study using OHIP-G, the German translation of the OHIP-49, the OHRQoL was noticeably affected in the TMD participants with a mean OHIP score of 42.9 compared to the general population¹⁷. Moreover, participants with all diagnosis, using the RDC/TMD, had a similar impact except participants with disc displacement with reduction with an OHIP score of (32.8). That justify why we have not excluded participants with disc displacement with reduction without TMD pain from the control group. The OHIP mean value was almost identical to results found in a British group of TMD participants, this study attempted to rank the OHIP items by prevalence for participants with TMD using the OHIP-49. The results revealed an impaired oral health quality of life, with mean OHIP-49 score for participants with TMD 60.6 suggesting impairment in OHRQoL¹⁸. Moreover, a relationship between deteriorated general health and TMD has been recognized and numerous studies have detected coexistence of TMD symptoms and other painful conditions in the same individual³⁶ which indicate the great impact of TMD on participants' lives. Furthermore, TMD was not only used in measuring its effect on the OHRQoL, but it has been also used in the development and validation of long and short editions of the OHIP. The result of our study also is consistent with these other studies^{16,13}

For the ADP, fewer studies are available that describe the impact of this condition on OHRQoL. In a study performed to develop a Croatian version of OHIP-49, a group of participants with ADP were used to measure the responsiveness of the profile²². The OHIP score of those groups of participants was elevated, at 108.5, for the OHIP summary score before treatment. Dugas *et. al.* investigated the effect of dental pain on the OHRQoL using 17 items from the OHIP-49, and compared the change in the OHIP score following

endodontic treatment the result for this study revealed an impaired OHRQoL before treatment and followed by a significant improvement after endodontic treatment²³. In longitudinal prospective study that measured the OHRQoL of participants with ADP using the OHIP-14 before and after treatment it has been found that the OHIP-14 score have been elevated before endodontic treatment³⁷. In another study that investigated the conformity between different pain scales, it has been found that the OHIP-14 of participants seeking emergency dental treatment for ADP was elevated indicating impaired OHRQoL³⁸. It is difficult to compare our results with the above-mentioned two studies because one used 17 item of the OHIP-49²³ and the others^{37,38} used OHIP-14 instead of OHIP-49, which is used in our study. However, in general both studies indicate impairment in the OHRQoL in participants suffering of ADP even though using different metric, which is consistent with our results.

Surprisingly, even though trigeminal neuralgia has been known to be one of the most painful conditions affecting the human being³⁹, our results suggest participants suffering of TN had a similar OHIP score to those with other orofacial pain conditions. One reason for this is that OHIP-49 may not be sensitive to capturing this type of pain that is known to have pain-free intervals, and therefore may not be valid because they may not have had an attack in the last month. Another reason could have impacted the results is that some of the trigeminal neuralgia participants had treatment initiated and were experiencing considerable pain relief and some were not. Even so, this study demonstrated a significant burden related to trigeminal neuralgia and its effect on the quality of life, which is consistent with what has been reported in other studies. To illustrate this point, the overall burden of TN on participants using modified Short Form Brief Pain Inventory (mBPI-SF)

and EuroQol Survey found that more impairment occurred during severe pain and it mostly affected mood and the general activity of affected participants²⁴.

Characterizing TN and PDAP participants with an OHRQoL measures is new. We did not find any literature that described the burden of these conditions using OHIP-49. The mean summary score of OHIP score for PDAP participants was elevated (66.2) reflecting an impaired quality of life and showed significant difference between the OHIP mean summary score between PDAP participants and normal control participants. There are no studies investigating the burden of PDAP on participants using OHIP-49, however, some studies investigated the burden of using other methods and revealed a significant psychological and social impact on PDAP participants²⁵. In a longitudinal study that followed PDAP participants for seven years, results have shown that only one third of the PDAP participants report improvement in their symptoms⁴⁰. That study indicated that participants with PDAP, unlike other orofacial pain conditions (TMD, ADP, TN), are not successfully managed leading to higher impact on their quality of life. Therefore, our results further suggest that research is needed to improve the management of patients with PDAP because their pain, which is similar to ADP in quality, has similar OHRQoL impairment. Thus, it appears that these patients continuously suffer for a “toothache” that is refractory to most treatments.

While we used a convenience sample of control participants, others used a random sample of the general population without an RDC/TMD diagnosis or with Helkimo Classification A0/D0, *i.e.*, without (self-reported) symptoms or (clinical) sign according to the Helkimo Index⁴¹, to define their comparison participants for providing a framework about the magnitude of OHRQoL impairment¹⁶. However, our control group, while

methodologically inferior to a random sample, yielded a similar a mean OHIP-49 score of 9.7 to these other studies^{16,42}. Moreover, a relationship between deteriorated general health and TMD has been recognized and numerous studies have detected coexistence of TMD symptoms and other painful conditions in the same individual³⁶ which indicate the great impact of TMD on patients' lives.

Synthesizing our main findings with our exploratory analyses, we have some hypotheses why OHRQoL differences are not large among orofacial pain conditions. First, orofacial pain conditions are often co-morbid, that is pain conditions often coexist. For example, patients with PDAP often suffer from TMD⁴³. As well, ADP patients also experience TMD pain⁴⁴. Conversely, TMD can also sometimes be referred to the tooth area⁴⁵. The co-existence of orofacial pain conditions, even if one condition is clinically dominating, would make pain impact across conditions more similar – a situation we observed. Second, report of dental, oral, and orofacial pain conditions cluster together. They form a “dimension” of OHRQoL and are an important and distinct area within the umbrella construct of OHRQoL. For example, the original 49-item OHIP suggested a dimension Physical Pain that contains tooth, gum, jaw and other pains items. Recently, the dimension of orofacial pain was empirically confirmed and was distinct from the other OHRQoL dimensions Oral Function, Orofacial Appearance, and Psychosocial Impact⁴². Likewise, more qualitative studies with experts assigning OHIP items to dimensions¹⁷, or experts studying the 14-item OHIP responses by U.K. and Australian general population participants. They studied whether the OHIP items fit into a conceptual OHRQoL model⁴² (which also contains the dimension discomfort/pain)¹⁵ led also support for a dimension pain in the stomatoganthic system. All these findings support that dental, oral, and orofacial

pain are an important component (dimension) how patients perceive their oral health and the several pains correlate and influence each other.

Limitations of the study:

One of the limitations of this study is that the study sample being small and there is substantial uncertainty indicated by the width of the confidence intervals. Therefore, mean values for individual orofacial pain conditions should be interpreted with caution. However, we believe that the overall pattern of OHRQoL across pain conditions, but in particular chronic conditions (TMD, TN, PDAP), is reasonably robust because several measures such as mean, median, and entire score distribution provided similar findings. In addition, results for TMD pain participants and ADP were compatible with the results observed by others. Results for TN and PDAP are new. For these two groups, it is often challenging to collect large samples because the prevalence of these conditions is substantially lower than TMD pain or ADP. For future studies a bigger study sample is recommended.

A second limitation is that some of the participants among the four orofacial conditions were engaged in care even though they were still symptomatic; we think they might have experienced some reduction in their symptom of pain and that could have affected the OHIP score. If participants were recruited as they first received the diagnosis and have not yet received any treatment that could have changed the results. In particular, TN group, where participants who received medical treatment for their complaint have not been excluded of the study, our results are not compatible with the fact that TN pain is among the worst.

A third limitation is only the physical impact of TMD, TN and PDAP was considered. The specific impact of conditions such as depression and anxiety was not regarded. However, it is well documented that there is a relationship between these conditions and OHRQoL¹⁷; implying OHIP may be suitable to catch some of the impact of these conditions in a single measure¹⁶. Even though the psychological status of participants was not examined, this limitation is not of a great significance. OHIP-49 is thought to identify 3 out of 4 aspects of axis II (R) DC/TMD¹⁷; therefore, we expect that OHIP device has the property of measuring the psychological significance of other conditions, too.

For future studies a broader implication of OHIP could be used, such as investigating the clinical outcome, satisfaction, and quality of life in a longitudinal study. Moreover, a larger sample size and a more careful selection of the participants are recommended.

6. Conclusion:

Our data supported the hypothesis that orofacial pains have a substantial impact, negatively affecting the quality of life of participants with the four orofacial conditions compared to those with no pain. However, differences among the chronic orofacial pains are likely not substantial. There was some difference in the item prevalences between orofacial groups and all items seemed to describe various aspects of dental, oral and orofacial pain with TMD having the highest occurrence.

Tables:

Table 1: Example of currently available Oral health measures ¹³

Authors	Name of Measure
Cushing et al, 1986	Social Impacts of Dental Disease
Atchison and Dolan, 1990	Geriatric Oral Health Assessment Index
Strauss and Hunt, 1993	Dental Impact Profile
Slade and Spencer, 1994	Oral Health Impact Profile
Locker and Miller, 1994	Subjective Oral Health Status Indicators
Leao and Sheiham, 1996	Dental Impact on Daily Living
Adulyanon and Sheiham, 1997	Oral Impacts on Daily Performances
McGrath and Bedi, 2000	OH-Qol UK

Table 2: Questionnaires were given to the participants

Questionnaire 1	Questionnaire 2	Questionnaire 3	Questionnaire 4	Questionnaire 5	Questionnaire 6
New PDAP instrument (Items=14) Likert scale	Generic Neuropathic instrument: S-LANSS (Items = 7) Converted to statements and use Likert scale	Tooth pain instrument: (Pau et al 2005) (Items=14)	TMD screener: (Gonzalez et al 2011) (Items=6)	OHIP 49 (Slade and Spencer 1994) (Items=49)	Multidimensional instrument: Hapak instrument (Hapak et al 1994) (Items = 24)

Table 3: Sociodemographic and clinical characteristics for four orofacial pain conditions and control participants

Characteristics	<i>TMD</i>	<i>ADP</i>	<i>TN</i>	<i>PDAP</i>	<i>Controls</i>
	N=30	N=27	N=21	N=16	N=20
Age [years] mean (SD)	46 (17)	47 (12)	60 (18)	52 (14)	45 (14)
Gender (Female %)	80	67	88	67	65
Race (white %)	90	82	95	100	90
Level 4-5 *education %	85	75	52	60	52
OHIP-49 (SD)	66 (6)	50 (5)	58 (8)	66 (9)	8 (2)

*Level of education 4-5: participants with collage, advanced or graduate degree.

Table 4: OHIP mean score differences and effect sizes for pairwise comparisons of four orofacial pain conditions (PDAP, TN, TMD, or ADP) versus control participants and the each conditions versus the three remaining condition

	OHIP-49 score differences				Effect sizes			
	<i>PDAP</i> N=16	<i>TN</i> N=21	<i>TMD</i> N=30	<i>ADP</i> N=27	<i>PDAP</i> N=16	<i>TN</i> N=21	<i>TMD</i> N=30	<i>ADP</i> N=27
	<i>Mean (95% confidence interval)</i>							
<i>Pain condition vs. controls</i>	-57.8 (-75.6 to -40.1)	-49.6 (-67.3 to -31.9)	-52.5 (-68.9 to -36.1)	-41.2 (-54.6 to -27.8)	-2.2 (-3.1 to 1.4)	-1.8 (-2.5 to 1.0)	-1.9 (-2.5 to 1.2)	-1.8 (-2.5 to 1.1)
<i>PDAP vs. other pain conditions</i>	-	8.2 (-17.0 to 33.4)	5.4 (-17.1 to 27.8)	16.7 (-3.6 to 36.9)	-	0.2 (-0.4 to 0.9)	0.1 (-0.5 to 0.8)	0.5 (-0.1 to 1.1)
<i>TN vs. other pain conditions</i>		-	-2.9 (-23.6 to 17.8)	8.4 (-10.7 to 27.5)			-0.1 (-0.6 to 0.5)	0.3 (-0.3 to 0.8)
<i>TMD vs. other pain conditions</i>				11.3 (-5.8 to 28.4)				0.4 (-0.2 to 0.9)

Table 5: Regression analysis, comparing the TN, TMD, and ADP against the base category PDAP, adjusted for age, gender and education

OHIP-49	Coef	Std. Err.	t	P> t 	[95% C.I.]
<i>TMD</i>	-4.9	10.9	-0.45	0.7	-26.6 - 16.7
<i>ADP</i>	-14.6	11.3	-1.29	0.2	-37.1 - 7.9
<i>TN</i>	-4.3	11.7	-0.37	0.7	-27.5 - 18.9
<i>Age_2cat</i>	-5.3	7.7	0.69	0.5	-20.5 - 9.9
<i>Female</i>	8.3	8.5	0.97	0.333	-8.7 - 25.3
<i>Educa_4or5</i>	6.6	7.3	0.90	0.370	-7.96 - 21.1
<i>controls</i>	62.6	19.1	3.28	0.001	24.69 - 100.6

Table 6: Differences in prevalence greater than 30% for OHIP items mentioned “fairly often” or “very often” among possible 294 pairwise comparisons for six orofacial pain conditions and 49 OHIP items

Item	Pair of conditions	Item prevalence condition 1	Item prevalence condition 2	Difference in prevalence (95% CI*)
1	TMD- PDAP	0.25	0.57	0.32 (-0.59 to-0.04)
10	PDAP-TN	0.81	0.33	0.48 (0.20 to 0.76)
10	PDAP-ADP	0.81	0.41	0.41 (0.14 to 0.67)
11	TMD- PDAP	0.19	0.67	0.48 (-0.73 to -0.22)
11	TMD-ADP	0.67	0.22	0.44 (0.21 to 0.67)
11	TMD-TN	0.24	0.67	0.43 (-0.68 to -0.18)
12	TMD-TN	0.05	0.57	0.52 (-0.72 to -0.32)
12	TMD-ADP	0.57	0.07	0.49 (0.29 to 0.70)
12	TMD- PDAP	0.25	0.57	0.32 (-0.59 to-0.04)
14	PDAP-TN	0.56	0.19	0.37 (0.08 to 0.67)
14	ADP-TN	0.19	0.52	0.33 (-0.58 to-0.08)
15	PDAP-TN	0.50	0.10	0.40 (0.13 to 0.68)
15	PDAP-TMD	0.50	0.10	0.40 (0.13 to 0.67)
17	PDAP-TMD	0.44	0.13	0.30 (0.03 to0.58)
19	TMD-ADP	0.60	0.26	0.34 (0.10 to 0.58)
19	TMD-TN	0.29	0.60	0.31 (-0.58 to-0.05)

Figures:

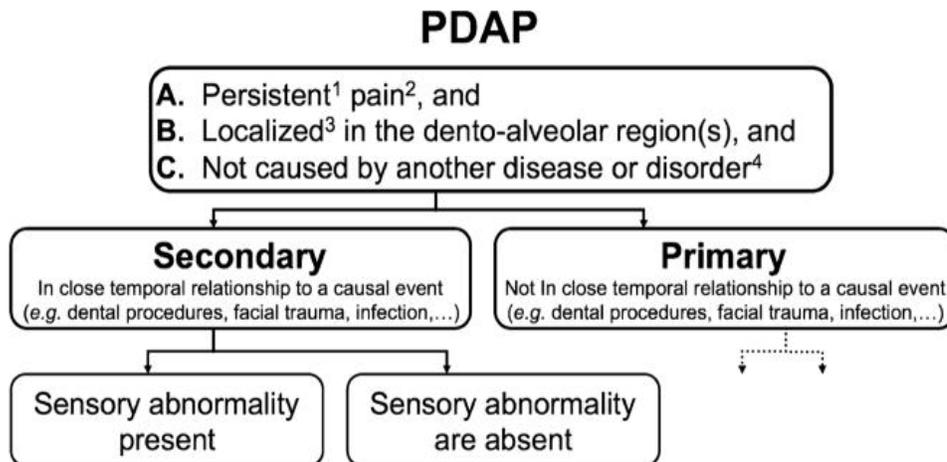


Figure 1: Diagnostic Criteria for PDAP (Nixdorf et al, 2012)

Criteria:

¹ persistent meaning pain present at least 8 h per day ≥ 15 days or more per month for ≥ 3 months during

² pain is defined as per IASP criteria (includes dysesthesia)

³ localized meaning the maximum pain defined within an anatomical area

⁴ extent of evaluation non-specified (dental, neurological examination +/-) imaging, such as intra-oral, CT and / or MRI).

Figure 2: Empirical cumulative distribution functions for OHIP-49 scores of four orofacial pain conditions

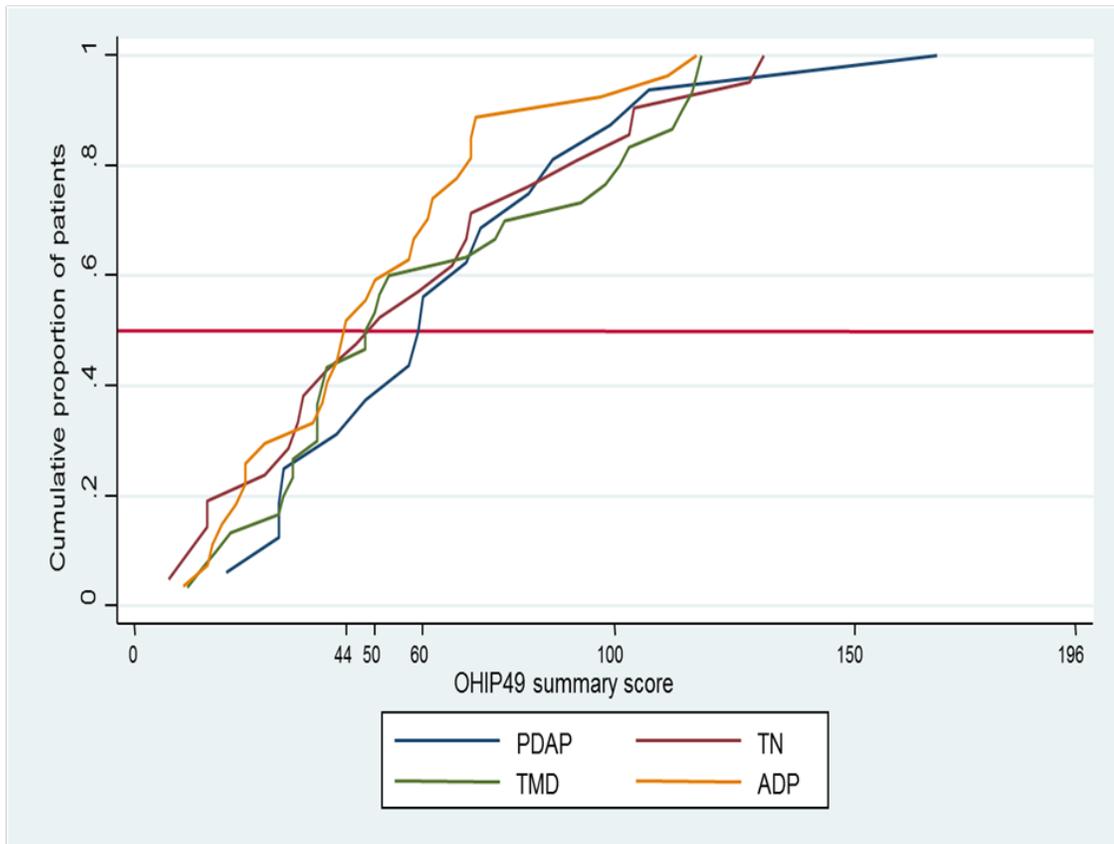
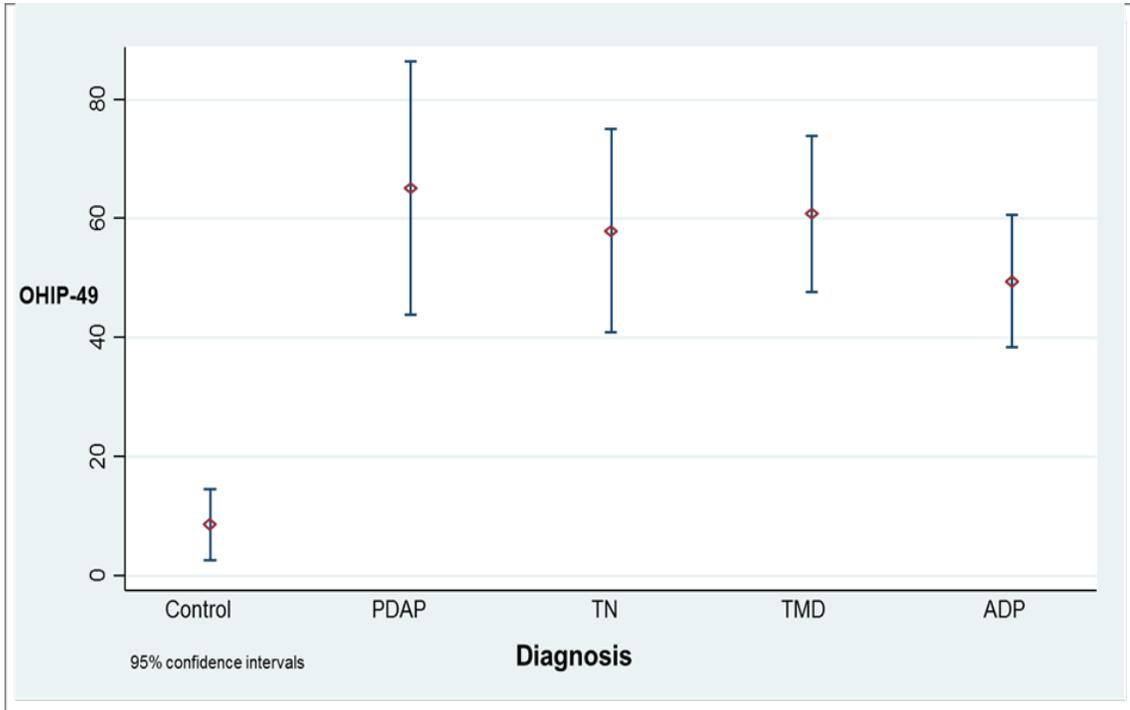


Figure 3: OHIP mean score in relation to four different Orofacial Pain conditions in comparison with pain free control. Differences are not statistically significant among pain conditions in Analysis of Variance



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