Somatization and treatments received by patients with painful TMD over an eight-year follow-up: A descriptive study

Neetha Aniya Antony

A Thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Science in Dentistry

University of Washington

2022

Committee:

Stuart Taylor

Cameron Randall

Rashmi Mishra

Program Authorized to Offer Degree:
Oral Medicine

University of Washington

Abstract

Somatization and treatments received by patients with painful TMD over an eight-year follow-up: A descriptive study

Neetha Aniya Antony

Chair of the Supervisory Committee:
Stuart Taylor, Clinical Assistant Professor – Dental Pathway
Department of Oral Medicine

Aim: Our study aims to retrospectively analyze treatments received by subjects diagnosed with painful TMDs and their association with somatization over 8 years. The second objective was to identify if high baseline somatization was a risk factor for subjects seeking irreversible dental/surgical treatments.

Methods: This is a secondary analysis of the dataset collected during the RDC/TMD Validation project (baseline) and Impact study (follow up). At baseline, demographics, pain characteristics, diagnosis of painful TMDs, somatization scores were collected for analysis. At follow up, demographics and treatments received were collected. Chi square test and Spearman correlation analysis were done.

Results: We identified 195 participants who fit into the inclusion criteria at baseline. Combination of myofascial pain and arthralgia (51.8%) was most prevalent, 45.6% of the participants had myofascial pain alone and only 2.6% had arthralgia alone. Among the participants, 47.7% reported normal somatization scores, 34.5% reported moderate somatization and 18.4% of the participants reported severe somatization.

The average treatments received were 6.5 (± 6.4), with a median of 5. The maximum number treatments received among all the participants was 33. Of the total participants, 13.7% participants had not received any treatments for painful TMD, whereas 23% had explored over 10 of the treatment options.

Severe somatization showed a statistically significant association with use of strong analgesics or "pain killers" (*p- value = 0.038*) and dental restorations or reconstruction (crowns, bridges) to improve the bite (*p- value = 0.0002*) and with soft diet, jaw exercise, and use of herbs and nutrition and physiotherapy- soft tissue manipulation (*p – value < 0.05)*. There was no statistically significant association with moderate somatization with any individual treatments.

There was a positive correlation between somatization scores and total number of treatments received but it was not statistically significant. Although all the grouped treatments showed a positive correlation with somatization, the correlation was only statistically significant for use of alternative and complementary medicine *(p- value < 0.05)*.

Conclusions: Somatization was not statistically associated with treatments received over 8 years. Severe somatization was associated with dental restorations or reconstructions to improve bite but not other types of irreversible treatments.

Table of Contents

List of Tables

List of Figures

Acknowledgement

Foremost, I would like to express my sincere gratitude to my committee members, Dr. Stuart Taylor, Dr Cameron Randall and Dr Rashmi Mishra, for their continued mentorship and support during my Master's research. I will always appreciate their enthusiasm, motivation and encouragement at every step. I am honored to work with a great committee for their valuable insights and vast experiences.

I would also like to express thanks to Kathy Scott, Dr Brian Leroux, Dr. Yasmin Fadol, Dr Flavia Kapos, Dr Lloyd Mancl, Dr Hayley Cowan, and Dr Lisa Heaton for their timely guidance, direction, and support in completion of this project.

Thank you to my fellow residents Dr Suhaib Borgeia and Dr Ohood Mohammad for being there during sunny and rainy days. I would also like to acknowledge and express thanks my Department Chair, Dr Mark Drangsholt and Program Director, Dr David Dean. Finally, I would like to express gratitude to the faculty and staff of Department of Oral Medicine providing me with a friendly nurturing environment. I will forever appreciate my two years as part of the Oral Medicine department in the University of Washington.

Dedication

I would like to dedicate this work my beloved husband Arun, my precious little girl Nora.

and to my parents Antony Chacko and Lisy Antony.

Chapter 1. Introduction

Temporomandibular disorders (TMD) is a collective term for dysfunction and/or pain affecting the masticatory complex, including the muscles of mastication, temporomandibular joints (TMJ) and their associated structures. TMD may present as pain, discomfort, limitation in mouth opening or neurosensory disturbances in the head and neck region (Slade et al., 2013). Pain in TMD is of non-odontogenic origin and can be both acute and chronic (Slade et al., 2013; Slade et al., 2016). Pain arising from the temporomandibular complex can refer into the teeth and other orofacial structures, making it hard to diagnose (List & Jensen, 2017). Pain and discomfort associated with TMD can be emotionally distressing and impact quality of life (Fillingim et al., 2013; List & Jensen, 2017). The etiology of TMD is multifactorial and still being studied (Slade et al., 2013). Female gender, being pre-menopausal, and parafunctional oral habits are known risk factors for developing TMDs. (Von Korff et al., 2003; Von Korff et al., 1988). Temporomandibular disorders have an incidence rate of 4% - 6% and prevalence rate of up to 20% within the general population (Häggman-Henrikson et al., 2020; Lim et al., 2010; Slade et al., 2016). TMD has a higher incidence and prevalence among younger persons compared to older persons, peaking around age 44 (Slade et al., 2013). TMDs are at least twice as prevalent in women as men and can cause significant pain and disability (Slade et al., 2016). TMD affects between 5-12% of the population (NIDCR, 2018).

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) was developed by (Dworkin & LeResche, 1992) as a tool to diagnose and classify TMD for research purposes. The DC-TMD is an evidence-based protocol which can be used in diagnosing TMD in both clinical and research settings (Schiffman et al., 2014). It uses a dual-axis system based on the biopsychosocial model of pain; Axis I for physical findings and Axis II for psychosocial

findings. Using a biopsychosocial model to assess patients' TMD may help clinicians develop a comprehensive conceptualization of a patient's pain condition and can help prevent overdiagnosis and overtreatment (Widmer, 1989). Use of the biopsychosocial model also helps in setting patient expectations and promotes better adherence to treatment and management strategies (Bair et al., 2003; Meints & Edwards, 2018).

Somatization is the expression of psychological distress as somatic symptoms and frequently cooccurs with depression. Somatization is itself distressing and typically increases the healthcare burden on an individual, oftentimes leading to dissatisfaction and frustration with healthcare outcomee (Barsky et al., 2005). Depression and somatization are common diagnoses among patients with TMDs (Yap et al., 2002).

Recommended treatment for TMD is usually conservative, reversible and evidence-based with the treatments usually tailored to managing symptoms and improving function and quality of life (Greene et al., 2010). In addition to dentists and oral medicine specialists, patients with chronic TMD also may seek care from allied health professionals and alternative medicine (White et al., 2001). Seeking care from multiple providers for longstanding TMDs, particularly by those that suffer from increased impedance in daily functioning, can lead to significant healthcare-related costs, compounding the physical and emotional burden experienced by those with TMDs. National Institute of Dental and Craniofacial Research estimated the annual cost of TMDs management in the USA, not including imaging, is $4 Billion (NIDCR, 2018).

Psychological distress presenting as somatic symptoms has been investigated as a cause of excessive healthcare seeking (Barsky et al., 2005). Somatization may be risk factor in the course of chronic TMD symptomatology (Maísa Soares & Rizzatti-Barbosa, 2015; Slade et al.,

2013) and related treatment-seeking patterns; however, there are few studies addressing this potential association. To that end, this study aims to describe patients who suffer from painful TMD symptoms and the types of treatment they receive over an 8-year period following diagnosis.

1.1 Pain

Pain is a multidimensional experience that involves factors beyond nociceptive stimuli alone. Factors associated with the experience of pain include tissue damage, peripheral and central nervous system activity/function, psychological factors, gender, age, temperature, socioeconomic status, physical activity and heritable factors (van Hecke et al., 2013). The experience of pain can vary considerably from patient to patient—and even within the same patient over time—making it difficult to assess and quantify. There have been formal attempts to study pain since the ages of Greek philosophers, and perhaps even earlier. Historically, pain was associated linearly with tissue damage, such that, with increasing tissue damage, there would be an expectation of increasing pain. As the understanding of pain has evolved, nociception has been increasingly distinguished from the amount of tissue damage present.

In 1979 the International Association for the Study of Pain (IASP) council defined pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage.” In 2020, the IASP introduced a revised definition of pain: (Raja et al., 2020)

“An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage,” introducing six Key Notes and the etymology of the word ‘pain’ for further valuable context. The Key Notes comprising this expansion are:

- “Pain is always a personal experience that is influenced to varying degrees by biological, psychological, and social factors.
- Pain and nociception are different phenomena. Pain cannot be inferred solely from activity in sensory neurons.
- Through their life experiences, individuals learn the concept of pain.
- A person’s report of an experience as pain should be respected.
- Although pain usually serves an adaptive role, it may have adverse effects on function and social and psychological well-being.

Verbal description is only one of several behaviors to express pain; inability to communicate does not negate the possibility that a human or a nonhuman animal experiences pain.”

Use of evidence-based self-report tools is the gold standard of pain assessment. Such tools include pain diagrams, visual analogue scales, and several validated instruments to assess the different aspects of pain. These, along with patient’s description of pain experience, allow clinicians and patients to develop a comprehensive conceptualization of pain and its impact on the individual’s life. Though patient self-report represents the recommended approach to pain assessment, it is important to note that barriers in communication may create gaps in accurate history taking (Haefeli & Elfering, 2006).

There are various definitions for different classifications of pain, with some overlap between them. Pain can be classified as acute, sub-acute or chronic, or in other broad categories based on the type of injury or pain fibers involved (Johnson et al., 2013). For instance, acute pain is pain lasting up to 6 weeks duration, subacute pain from 6 to 12 weeks or chronic pain which lasts 12 weeks or more (van Tulder et al., 1997). Acute pain is usually associated with

inflammation and reduces in intensity as healing progresses; chronic pain is more complex in terms of neurological mechanisms, biomarkers, and temporality, and it is influenced by non-biological factors (Cohen et al., 2021). In the absence of visible tissue damage, pain assessment and diagnosis can be more challenging, and if not assessed appropriately, a patient's pain experience can be underestimated (Eccleston et al 2021). Back pain is the most prevalent chronic pain condition (St Sauver et al., 2013). Chronic daily headaches, migraines, and neck pain are also among the most prevalent chronic pain conditions (Rice et al., 2016). Among chronic, non-dental, orofacial pain conditions, temporomandibular pain is the most common (Greene & Manfredini, 2021). TMDs and primary headaches are known comorbidities (Réus et al., 2022).

1.2 Nociception vs Pain

Nociception is the process whereby stimulation of nerves is conveys information about potential tissue damage to the brain, where it is detected. Pain, in contrast, is subjective and multi-dimensional (Woolf, 2010). It is a perception and experience that results from the transduction, transmission, and modulation of sensory information. For pain to be registered, an organism must be conscious, and the pain experience is the result of a combination of factors that include an organism's genetic composition, prior experiences, psychological status, and sociocultural influences (Gatchel, 2004).

Engel, in 1977, put forward a new medical model that included multiple dimensions of disease beyond biological/pathological. The biopsychosocial model, it includes social, psychological, and behavioral aspects of illness, in addition to the biological/pathological aspects included in the existing biomedical model. Pain behaviors—which are overt verbal and non-verbal communications of pain, distress, expectations, and coping methods—also play in a role in a person's experience of pain (Meints & Edwards, 2018). A model that focuses on only one of

these dimensions will be incomplete and inadequate in pain evaluation. (Gatchel, 2004). Looking beyond physical signs and symptoms has huge benefits for both the patient and the provider in curating treatment plans. In a recent review paper on chronic pain, Cohen et al (2021) wrote about pain management beyond medications and surgical interventions, like the benefits of integrative approaches involving physiotherapy, psychotherapy, and complementary medicine. Physiotherapy and exercise may be beneficial to reverse physical deconditioning, improve sleep, and release endorphins. Psychotherapy helps restructure maladaptive thoughts and behaviors (Cohen et al., 2021).

1.3 Psychosocial Factors Associated with Pain

Pain and psychological distress have a reciprocal (i.e., bi-directional) relationship (Bair et al., 2003). Psychological distress is common in patients with pain, more so in patients with high impact and long-standing pain conditions (Macfarlane, 2003). Assessment of emotion, psychosocial functioning, and pain-related behavior is an essential part of the chronic pain diagnostic process, and this approach is still evolving. Such a comprehensive assessment can provide valuable information on the multidimensional characteristic of pain, disability, and impairment associated with the pain disorder (Bair et al., 2003).

A population-based study examined psychosocial variables in participants with somatic syndrome complex and found psychological conditions like depression, anxiety, and health-related anxiety had an exposure-response relationship with the number of somatic symptom complexes. Multiple somatic symptom complexes could predict health status, even after adjusting for other known factors. (Creed et al., 2018)

Major depression may present with painful physical symptoms and non-specific

symptoms. It is recommended that treatment of depression and its three presentations—psychological, somatic, and painful physical symptoms—can help achieve sustained remission in primary care pain patients (Lépine & Briley, 2004).

Lingering somatic symptoms are not often considered as an aspect of depression and can go unaddressed. Functional limitations and somatic complaints in patients with comorbid depression and pain have been associated with higher healthcare costs, more examinations and investigation of an organic cause, and more medication use in long term follow up (Bair et al., 2003).

1.3.1 Somatization

Non-specific somatic symptoms without an underlying physical etiology can be a manifestation of psychological distress. Somatization is the term used to describe this phenomenon. Somatic symptoms are usually non-specific and may be functional (e.g., palpitation, sleep disturbances, dyspepsia etc.). Simon et al., (1999) identified three different conceptualizations of somatization used in earlier investigations. The first involves patients with psychiatric disorders who present with somatic symptoms and seek care for those symptoms. The second describes patients with somatization as those who have psychological disorders, but who report multiple unexplained somatic symptoms. The third incudes those whose psychological distress manifests as somatic symptoms. Somatization and depression were found to be highly correlated (Simon et al., 1999).

As previously mentioned, moderate to high levels of depression and somatization play roles in chronic musculoskeletal pain conditions. Somatization was also shown to be a statistically significant predictor for clinically significant pain (LeResche et al., 2007). Somatization along with other psychosocial factors play an important role in high-risk pain and

lower quality of life. Somatization in patients with chronic pain leads to excessive healthcare seeking and alterations in lifestyle (Dworkin, 1994). Somatization also increases healthcare utilization even with no comorbid depression or anxiety (Barsky et al., 2005).

There are validated questionnaires to screen for somatization. The Revised Symptom Checklist-90 (SCL- 90R) is a widely used validated questionnaire for the self-report of psychological distress and multiple aspects of psychopathology, which is recommended as part of the evaluation of patients with chronic pain and other non-psychiatric populations (Hardt et al., 2000). The SCL-90R can also be used as a screening tool for evaluating of anxiety, depression, somatization with and without pain. Other relevant questionnaires include the Pain History Questionnaire (PHQ) 15 and the Somatic Symptom Scale (SSS)-8, both of which have been validated for use as a clinical screening tool (van Driel et al., 2018).

1.4 Psychosocial Factors in TMD

There have been multiple studies that show the reciprocal relationship between orofacial pain, specifically TMDs, and psychosocial distress (Manfredini et al., 2010; Turner et al., 2001; Yap et al., 2002). In the orofacial region, there are musculoskeletal factors, neurovascular factors, and dental factors that interplay to create dysfunction, and the psychosocial factors add another dimension to this structurally complex region.

The Diagnostic Criteria for TMD (DC/TMD) is an evidence-based criteria that clinicians can use to assess patients and develop multidisciplinary treatment plans tailored to individual needs of the patient (Schiffman et al., 2014). The biopsychosocial model of pain is incorporated into the DC-TMD for clinical diagnosis, by using a physical assessment (Axis I), and an assessment of psychosocial status and pain-related disability (Axis II). Axis II factors can be

predictors for pain severity, chronicity, and health-related quality of life (Dworkin & LeResche, 1992).

Screening for behavioral, psychologic, and psychosocial function can be done using self-report questionnaires that are straightforward and in easy-to-understand formats (Dworkin et al., 2002). These tools are not meant to diagnose a disorder but instead can be used to screen for Axis II dysfunction. Axis II components, which include depression, somatization, and chronic pain dysfunction, are based on established psychologic tests or behavioral measures that have been determined to be reliable in previous studies (Manfredini et al., 2011; Schiffman et al., 2014).

1.5 Treatment Seeking in TMD

Patients with non-odontogenic pain may have difficulty determining who would be the right provider to treat them. Primary care providers and dentists are most likely to see patients with orofacial pain (Stowell et al., 2007). Otolaryngologists, neurologists, oral medicine specialists, and orofacial pain specialists are all providers manage patients with orofacial pain (Glaros et al., 1995). In one population-based survey (Macfarlane, 2003) described healthcare seeking among individuals with orofacial pain. It found that characteristics of pain (e.g. pain duration, pain frequency, pain level, etc.) were associated with healthcare seeking. That study excluded dental pain as a variable and still found that 64% of the participants took medication for orofacial pain. In another study, the decision to seek care was associated with pain intensity and fear of jaw movements in women (Rollman et al., 2012). The two top predictors for the number of health care practitioners' visits were, catastrophizing and use of painkillers. Care seeking was also found to have a linear relationship with age (Rollman et al., 2012). Duration and perception of illness was also associated with treatment seeking (Rollman et al., 2012). More research is

needed to study healthcare seeking in patients with TMDs.

A review of the literature revealed very few studies on treatment seeking habits of TMD patients. There is also a gap in the literature on different types of treatments for TMD received by participants over a long interval, and its association with somatization. Therefore, this study examines the association somatization with the types and number of treatments received in participants with painful TMDs.

Chapter 2. Objectives

The goal of this study is to retrospectively analyze treatments received by subjects diagnosed with painful TMDs and their association with somatization over time. For the present study, painful TMDs at baseline will be defined as the presence of at least one pain related TMD diagnosis in the baseline study. The main objective was to identify if baseline somatization was a risk factor among subjects seeking multiple treatments for painful TMD. The second objective was to identify if high baseline somatization was a risk factor for subjects seeking irreversible dental/surgical treatments.

2.1 Hypotheses

For the main objective, we hypothesized that somatization is positively associated with treatments received during 8 years after diagnosis (Hypothesis I). For the second objective, we hypothesized that there would be a positive association between high somatization and subjects seeking irreversible treatments for TMDs (Hypothesis II).

Chapter 3. Methodology

3.1 Data

This is a cross-sectional observational study and a secondary analysis of the multicenter Validation project for the RDC/TMD (baseline) and TMJ Impact study (follow up). Institutional Ethics Review Board at each site approved the study prior to initiation of the project. The original study was conducted in 3 sites University of Minnesota, University at Buffalo and University of Washington between 2003 and 2006. The study had a total 705 participants, 614 cases and 91 controls. The aim of the validation study was to infer reliable and valid revised Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) for both Axis I and II diagnostic system. 401 participants were approved for follow up.

For the present study, only cases from the University of Washington arm of the study were included. The written informed consent was obtained from all participants in the study. The anonymized data from the studies were used after permission was obtained from the primary investigators. For ease of understanding, the Validation project will be referred to as ‘baseline study’ and the Impact project as ‘follow up study’.

3.2 Sample and Variables Collected

This study uses a subset of the sample from the larger baseline study. The study subjects were aged between 18 to 70 years old and were enrolled as either TMD cases or controls based on inclusion and exclusion criteria. For TMD cases, participants qualified if they reported at least one of the three cardinal signs and symptoms of TMD: Jaw pain, limited mouth opening, or TMJ sounds.

The Axis I or physical diagnosis used a set of standardized clinical exam and questionnaires. Subjects at baseline were examined through a clinically by two calibrated examiners and gold standard TMD diagnoses were derived based on the Axis I RDC/TMD algorithm. Axis II factors were assessed using questionnaires. The revised Symptom Checklist-90 (SCL-90R) (Derogatis & Melisaratos, 1983) scores were used for depression, somatization, and anxiety scales. Continuous scores categorized as normal, moderate, or severe based on the cutoffs described in the RDC/TMD protocol (Dworkin et al., 2002).

The final diagnoses include a set of three diagnostic groups and 8 sub-diagnoses.

- Group I Muscle Disorders: Myofascial pain(Ia); Myofascial pain with limited opening (Ib).
- Group II Disc Displacement: disc displacement with reduction (IIa); disc displacement without reduction with limited opening (IIb); disc displacement without reduction without limited opening (IIc)
- Group III Arthralgia, Arthritis, Arthrosis: arthralgia (IIIa); osteoarthrosis (IIIb); osteoarthritis (IIIc).

The baseline study exclusion criteria were:

1. From the history
   - Systemic rheumatic, neurogenic/neuropathic, endocrine, or immune/autoimmune disease or widespread pain.
   - Radiation treatment to head and neck.
   - TMJ surgery.
   - Trauma to jaw in the last 2 months.

- Presence of non-TMD orofacial pain disorders.
- Pregnancy.
- Unable to participate due to language barrier or mental intellectual disability.
- Use of narcotic pain medication, muscle relaxants or steroid therapy unless discontinued for 1 week prior to examination.
- Use of antidepressant drugs unless the participant has been on a stable dose for 60 days.
- Use of prescription or over-the-counter nonsteroidal anti-inflammatory medications unless the medication(s) were discontinued for 3 days prior to the examination (use of acetaminophen was allowed as a rescue drug).
- Drug abuse.
- Ongoing dental treatment.
- Wearing dentures.
- Contraindications for imaging.
- Ongoing TMD treatment unless on a stable regimen for at least 2 months.
- Unable or unwilling to give informed consent.

2. From clinical examination
   - Presence of non-TMD orofacial pain disorders.
3. Imaging
   - MRI positive for pathology (exception for cases: TMJ disc displacement).
   - CT is positive for osseous pathology (except for cases: TMJ osteoarthritis).
   - Panoramic radiograph is positive for osseous (non-TMJ related) or odontogenic lesions.

Inclusion criteria specific to the current study at baseline were as follows:

- Myofascial pain diagnosis: Myofascial pain(Ia); Myofascial pain with limited opening (Ib).
- Joint pain diagnosis: arthralgia (IIIa)
- Combination of Myofascial pain diagnosis and arthralgia (Ia or Ib and IIIa).

Participants with a disk displacement with no pain were excluded as they did not fit in the criteria for painful TMDs. There was a total of 195 participants that fit this inclusion criteria. From the follow up study dataset, participants who were followed up had to complete the physical examination and had to have a completed the self- reported Survey of Treatments Received to be included. This included a total of 102 participants. The flow of inclusion criteria can be visualized in Figure 1. Variables collected were as follows:

For this study of somatization, the somatization scores will be used, categorized as follows:

- Normal < 0.50
- Moderate 0.50 - <1.00
- Severe >1.00

Pain characteristics at baseline will be described by:

- Duration of facial pain in years
- Other painful sites in the body
  - Generalized body pain not associated with exercise
  - Headache
  - Chest

  - Back
  - Abdominal pain
- Pain persistence
  - Persistent
  - Recurrent
  - One time
- If care was sought prior to first study:
  - Never
  - More than 6 months ago
  - Less than 6 months ago.

The study will also describe demographic data using sex, age, race, ethnicity, total household income and education level at both baseline and follow up.

The survey of treatments received consists of a questionnaire with 39 Yes/No items to the question “Have you received any of the following treatments for your jaw condition (TMD, TMJ, facial pain) since your initial evaluation for this project on the above date?”. For certain statistical analysis, the treatments were grouped into 5 categories based on a previous study (Kapos et al., 2018). These groups were, standard conservative, alternative/complementary, mind-body, specialist whole body, and irreversible. Due to ambiguity of some types of treatments, we deemed in necessary for the present analysis that certain treatments should be included in multiple groups. For example, hypnosis therapy can be a part of either alternative or mind body therapy depending on provider. Hence, it was included in both groups. The clustering of the treatments is shown in Table 1.

3.3 Statistical Analysis

Subject demographic data and pain characteristics are summarized and organized using descriptive statistics. We use the software R 4.2 for the statistical analysis. Means and standard deviations were used to describe continuous variables. Bivariate analysis using Chi square test and Fisher's exact test were done for individual treatments and somatization. Spearman's correlation coefficient was used to identify association between different somatization groups and treatment groups.

Chapter 4. Results

In total, 195 participants fit the inclusion criteria of the study at baseline, at follow up there were 102 participants. The average time to follow up was 7.8 years. The participants in the study were predominantly female (84.6%), non-Hispanic (87.7%) Caucasians. Age at baseline ranged from 18 – 67 years, mean age of 37.41 ± 13.2. Table 2 shows the demographic distribution of the study sample at baseline and Table 3 shows the demographic sample at follow up.

The most prevalent diagnosis at baseline was a combination of myofascial pain and arthralgia (51.8%). About half (45.6%) of the participants had myofascial pain alone and only 2.6% had arthralgia alone. Among those with a diagnosis of myofascial pain, 16.8% showed referred pain, 26.8% had pain with limited mouth opening and 24.7% had both referred pain and limited mouth opening. Figure 2 and Figure 3 shows the prevalence of different painful TMDs and its subdivisions diagnosis at baseline.

Headache was the most prevalent coexistent pain complaint among 70.2% of the participants, followed by back pain (43.5%). For the total number of comorbid body pain conditions, 36.9% of the participants had at least one other pain complaint, 31.2% had two other areas of pain. 21.5% had no comorbid pain complaints. Only 1.5% presented with four areas of body pain, in addition to their TMD. About half (51.7 %) of the participant said that the facial pain was a persistent complaint, 46.6% reported that facial pain was recurrent. Majority of the participants 88.8% had sought care for their TMDs prior to the study. The pain characteristics (other areas of body pain its prevalence) can be visualized in Figure 4 and Figure 5

At baseline, 47.7% of the participants reported normal somatization scores, 34.5% reported moderate somatization and 18.4% of the participants reported severe somatization.

In the follow up study, the mean age of the population was 47.66 years (± 13.3). The most prevalent pain condition was myalgia (34.3%), followed by myofascial pain (28.5%). On standardized examination 31.37% of the participants did not have a painful TMD diagnosis at follow up. Figure 6 shows prevalence of the different TMD diagnoses at follow up.

The reported average treatments received were 6.5 (± 6.4), with a median number of 5. The maximum number treatments received among all the participants was 33. Of the total participants, 13.7% participants had not received any treatments for painful TMD, whereas 23% had explored more than 10 of the various treatment options. Figure 7 shows the distribution of participants and treatments received.

Among the different treatments received, severe somatization was showed a statistically significant association with use of strong analgesics or "pain killers" (*p- value = 0.038*) and dental restorations or reconstruction (crowns, bridges) to improve the bite (*p- value = 0.0002*). Severe somatization was also shown to be associated with soft diet, jaw exercise, and use of herbs and nutrition and Physiotherapy- soft tissue manipulation (*p – value < 0.05)*. The association of somatization and the individual treatments can be visualized in Table 4. There was no statistically significant association with moderate somatization with any individual treatments.

There was a positive correlation between somatization scores and total number of treatments received and a participant, but it was not statistically significant. Although all the grouped treatments showed a positive correlation with somatization, it only reached a statistically significant level with use of alternative and complementary medicine *(p- value < 0.05)*. Table 5 grouped treatments and its correlation with somatization. Figure 8 shows the

scatter plot of total treatments and somatization.

Chapter 5. Discussion

Our study was aimed at analyzing the association of somatization and treatment seeking for painful TMD. This study is a secondary analysis of the data collected for the RDC/TMD baseline and follow up study.

Our study found that there is a positive correlation with painful TMDs and somatization, but it was not found to be statistically significant ($p > 0.05$). Among the study participants, 14.75% of the follow up participants did not seek any care. In the general population, only a minority (5% to 7%) of patients have TMDs impactful enough to seek care (Wright & North, 2009). Many TMDs tend to resolve completely or get better over time with occasional flares in symptoms. In the follow up clinical examination after 8 years, there were 32 (31.3%) participants that did not meet the clinical diagnosis of TMDs with pain. Painful TMDs were present predominantly in women (85%) at both baseline and follow up. Participants of the larger study were recruited at TMD specialist clinics compared to general population; this could explain the overrepresentation of female participants. Women have been shown to have twice the risk of developing TMDs as well as a higher prevalence in all the diagnostic groups (Bueno et al., 2018) male sex is known to be at higher risk of developing musculoskeletal pain including TMDs, presenting with more impactful pain and having persistent pain (Häggman-Henrikson et al., 2020; Slade et al., 2016).

Somatization scores in our study was recorded from the SCL – 90R instrument. (Dworkin et al., 2002) showed this instrument had good reliability to clinically assess over-reporting of symptoms in the RCD/TMD Axis 1 clinical examination, particularly in those individuals with severe somatization. Dworkin et al (2002) recommended the use of the term “Non-Specific

Physical Symptoms" over somatization. DC/TMD also recommends use of the PHQ-15 to record non-specific physical symptoms (Schiffman & Ohrbach, 2016). In our study, 18.4% of participants showed severe somatization and 34.4% showed moderate somatization at baseline. In our study, we used somatization scores only from the baseline study. Presentation of somatization in patients' symptoms can be transient, therefore, having multiple measures over different timepoints could give a clearer picture of how impactful somatization is on a person's condition. Depression has been shown to be a strong comorbidity of somatization in the setting of chronic pain conditions (Bair et al., 2003). Our study did not control for depression, and it may be a confounding factor.

This study also showed a statistically significant association between somatization and the use of alternative/ complementary medicine. The group for alternative/ complementary medicine in our study included yoga, herbs/nutrition, homeopathy, craniosacral, massage, chiropractic, acupuncture and hypnosis. There is a lack of high-quality evidence in the literature supporting the use of these particular treatments. Manual therapy and acupuncture have shown to be somewhat effective in short term pain relief, especially in combination with self-care or behavioral therapy (de Melo et al., 2020; Fernandes et al., 2017). There was also a statistically significant association of PT soft tissue manipulation, soft diet, jaw exercise, chiropractic treatment and severe somatization. TMDs being a musculoskeletal pain condition does benefit from tissue manipulation, exercise and rest which is known to improve function and reduce pain.

The irreversible treatment group in our study included the following treatments: extensive treatment to change the bite, grinding on the chewing surfaces of the teeth, dental restoration or reconstruction, Orthodontia or braces, TMJ surgery, TMJ arthrocentesis, jaw surgery to realign the bite, treatment for broken jaw and major jaw surgery for any reason.

Among these treatments, there was only a statistically signification association between dental restoration or reconstruction to improve bite and severe somatization. Research has shown that teeth occlude only during function and occlusion exists in a dynamic rather than a static state (Racich, 2018). Currently, there is no high-level evidence in the literature that supports dental restoration or irreversible dental treatments for management of most TMDs. It is also important for clinicians to evaluate for TMDs when patients present with tooth ache in the absence of dental pathology. TMDs and other orofacial pain conditions can refer into the teeth, or mimic dental pain (Pigg et al., 2021; Renton, 2020; Wright, 2000) and so should be on a differential diagnosis for toothache.

Participants who responded positively for TMJ surgery, TMJ arthrocentesis, jaw surgery to realign the bite, treatment for broken jaw and major jaw surgery for any reason, were very low (< 2) in each individual group. Statistical analysis for these tests should be interpreted with caution as the test may have not been powered adequately for accurate results.

Our study also showed an association between use of opiate-based painkillers and severe somatization. These is a lack of high-quality evidence in literature to support the use of opiate based painkillers to manage TMDs. NSAIDs, muscle relaxants and antidepressants seem to be preferred pharmacological interventions, over the use of painkillers (Mujakperuo et al., 2010).

Most of the treatments surveyed in this study have low level of evidence supporting their use, or inadequate evidence in literature. The current recommendation for managing TMD is the use of conservative and reversible treatments. Certain newer evidence-based treatments, (e.g. dry needling, cognitive behavioral therapy) are not included as this a secondary analysis of a larger study that pre-dates widespread use of these newer interventions.

Our study could not assess true healthcare utilization by the patients. Somatization has been shown to be associated with high healthcare utilization. (Barsky et al., 2005). Bates et al showed that patients with non-specific symptoms have a two-fold utilization of both inpatient and outpatient health care utilization independent of comorbid psychiatric illness, and an estimated $265 billion in medical expenditure can be attributed to this. Multiple studies have shown that somatization is a known comorbidity of painful TMDs and is an important Axis II factor in TMD diagnosis. White et al found that patients with TMDs had increased health care utilization in all areas in a health maintenance hospital setting. Stowell et al found that early biopsychosocial intervention could be effective in jaw pain related costs (White et al., 2001) (Stowell et al., 2007).

Treatment seeking habits and factors associated with it have not been adequately studied in patients with TMDs. There is a lack of high-quality studies on types of treatment modalities and its benefits. Current evidence supports use conservative and reversible treatment which include physical therapy and pharmacotherapy to manage pain in TMDs (Greene et al., 2010).

As mentioned before, TMDs tends to resolve overtime, but psychological and social stressors can cause exacerbations in symptoms. Evaluating the psychosocial (Axis II) factors, such as somatization early on in the intervention/treatment/management process may help prevent excess healthcare utilization (Turner et al., 2006). For example, early cognitive behavioral therapy has shown to be effective in management impact of back pain and TMDs in patients with somatization (Linden et al., 2014; Turner et al., 2006; Vibe Fersum et al., 2019).

This study has several strengths. First, this was a longitudinal study and with a follow up of 8 years. Secondly, this study included multiple treatments, both common and unconventional

ones. Very few studies have included medical, dental, surgical, psychological and alternative medicine treatments for analysis. A big limitation of this study is the small sample size due to the study being an analysis of data from an existing study. Also, the study only explores if someone received a treatment or not and did not have further information on the frequency of treatment received, patient satisfaction and benefits/ risks of treatment. There was also no information on cost or accessibility of treatment which could help identify certain barriers to receiving care. Somatization was only analyzed at one time point. There is also a question about the generalizability of the results, as the study was conducted in a city with a TMD specialty clinic.

Future research in areas of patient explanatory models, other known psychosocial factors associated with TMDs and subjective reports of success or failure of treatments, could provide more information on health care utilization of patients with painful TMD.

5.1 Conclusion

To summarize our study did not find a statistically significant association with somatization and number of treatments received over 8 years. There was a statistically significant association between dental restorative treatment to improve the bite and severe somatization. Assessing the potential presence of somatization before dental treatments in patients with diagnosed TMD could be valuable to help prevent unnecessary irreversible and costly treatments.

Bibliography

Bair, M. J., Robinson, R. L., Katon, W., & Kroenke, K. (2003). Depression and pain comorbidity: a literature review. Arch Intern Med, 163(20), 2433-2445. doi:10.1001/archinte.163.20.2433

Barsky, A. J., Orav, E. J., & Bates, D. W. (2005). Somatization increases medical utilization and costs independent of psychiatric and medical comorbidity. Arch Gen Psychiatry, 62(8), 903-910. doi:10.1001/archpsyc.62.8.903

Bueno, C. H., Pereira, D. D., Pattussi, M. P., Grossi, P. K., & Grossi, M. L. (2018). Gender differences in temporomandibular disorders in adult populational studies: A systematic review and meta-analysis. J Oral Rehabil, 45(9), 720-729. doi:10.1111/joor.12661

Cohen, S. P., Vase, L., & Hooten, W. M. (2021). Chronic pain: an update on burden, best practices, and new advances. Lancet, 397(10289), 2082-2097. doi:10.1016/s0140-6736(21)00393-7

Creed, F., Tomenson, B., Chew-Graham, C., Macfarlane, G., & McBeth, J. (2018). The associated features of multiple somatic symptom complexes. Journal of psychosomatic research, 112, 1–8. https://doi.org/10.1016/j.jpsychores.2018.06.007

Derogatis, L. R., & Melisaratos, N. (1983). The Brief Symptom Inventory: an introductory report. Psychol Med, 13(3), 595-605.

de Melo, L. A., Bezerra de Medeiros, A. K., Campos, M. F. T. P., Bastos Machado de Resende, C. M., Barbosa, G. A. S., & de Almeida, E. O. (2020). Manual Therapy in the Treatment of Myofascial Pain Related to Temporomandibular Disorders: A Systematic Review. Journal of oral & facial pain and headache, 34(2), 141–148. https://doi.org/10.11607/ofph.2530

Dworkin, S. F. (1994). Somatization, distress and chronic pain. Qual Life Res, 3 Suppl 1, S77-83. doi:10.1007/BF00433380

Dworkin, S. F., & LeResche, L. (1992). Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord, 6(4), 301-355.

Dworkin, S. F., Sherman, J., Mancl, L., Ohrbach, R., LeResche, L., & Truelove, E. (2002). Reliability, validity, and clinical utility of the research diagnostic criteria for Temporomandibular Disorders Axis II Scales: depression, non-specific physical symptoms, and graded chronic pain. J Orofac Pain, 16(3), 207-220.

Eccleston, C., Aldington, D., Moore, A., & de, C. W. A. C. (2021). Pragmatic but flawed: the NICE guideline on chronic pain. Lancet, 397(10289), 2029-2031. doi:10.1016/s0140-6736(21)01058-8

Engel G. L. (1977). The need for a new medical model: a challenge for biomedicine. Science (New York, N.Y.), 196(4286), 129–136. https://doi.org/10.1126/science.847460

Facial Pain | National Institute of Dental and Craniofacial Research (nih.gov)

Fernandes, A. C., Duarte Moura, D. M., Da Silva, L. G. D., De Almeida, E. O., & Barbosa, G. A. S. (2017). Acupuncture in Temporomandibular Disorder Myofascial Pain Treatment: A Systematic Review. Journal of oral & facial pain and headache, 31(3), 225–232. https://doi.org/10.11607/ofph.1719

Fillingim, R. B., Ohrbach, R., Greenspan, J. D., Knott, C., Diatchenko, L., Dubner, R., . . . Maixner, W. (2013). Psychological factors associated with development of TMD: the OPPERA prospective cohort study. J Pain, 14(12 Suppl), T75-90.

doi:10.1016/j.jpain.2013.06.009
Gatchel R. J. (2004). Comorbidity of chronic pain and mental health disorders: the biopsychosocial perspective. The American psychologist, 59(8), 795–805. https://doi.org/10.1037/0003-066X.59.8.795
Glaros, A. G., Glass, E. G., & Hayden, W. J. (1995). History of treatment received by patients with TMD: a preliminary investigation. J Orofac Pain, 9(2), 147-151.
Greene, C. S., Klasser, G. D., & Epstein, J. B. (2010). Revision of the American Association of Dental Research's Science Information Statement about Temporomandibular Disorders. J Can Dent Assoc, 76, a115.
Greene, C. S., & Manfredini, D. (2021). Transitioning to chronic temporomandibular disorder pain: A combination of patient vulnerabilities and iatrogenesis. Journal of oral rehabilitation, 48(9), 1077–1088. https://doi.org/10.1111/joor.13180
Haefeli, M., & Elfering, A. (2006). Pain assessment. Eur Spine J, 15 Suppl 1(Suppl 1), S17-24. doi:10.1007/s00586-005-1044-x
Häggman-Henrikson, B., Liv, P., Ilgunas, A., Visscher, C. M., Lobbezoo, F., Durham, J., & Lövgren, A. (2020). Increasing gender differences in the prevalence and chronification of orofacial pain in the population. Pain, 161(8), 1768-1775. doi:10.1097/j.pain.0000000000001872
Hardt, J., Gerbershagen, H. U., & Franke, P. (2000). The symptom check-list, SCL-90-R: its use and characteristics in chronic pain patients. European journal of pain (London, England), 4(2), 137–148. https://doi.org/10.1053/eujp.2000.0162
Johnson, Q., Borsheski, R. R., & Reeves-Viets, J. L. (2013). Pain management mini-series. Part I. A review of management of acute pain. Mo Med, 110(1), 74-79.
LeResche, L., Mancl, L., Sherman, J. J., Gandara, B., & Dworkin, S. F. (2003). Changes in temporomandibular pain and other symptoms across the menstrual cycle. Pain, 106(3), 253-261. doi:10.1016/j.pain.2003.06.001
LeResche, L., Mancl, L. A., Drangsholt, M. T., Huang, G., & Von Korff, M. (2007). Predictors of onset of facial pain and temporomandibular disorders in early adolescence. Pain, 129(3), 269–278. https://doi.org/10.1016/j.pain.2006.10.012
Lépine, J. P., & Briley, M. (2004). The epidemiology of pain in depression. Human psychopharmacology, 19 Suppl 1, S3–S7. https://doi.org/10.1002/hup.618
Lim, P. F., Smith, S., Bhalang, K., Slade, G. D., & Maixner, W. (2010). Development of temporomandibular disorders is associated with greater bodily pain experience. The Clinical journal of pain, 26(2), 116–120. https://doi.org/10.1097/AJP.0b013e3181c507ef
List, T., & Jensen, R. H. (2017). Temporomandibular disorders: Old ideas and new concepts. Cephalalgia, 37(7), 692-704. doi:10.1177/0333102416686302
Macfarlane, T. V., Blinkhorn, A. S., Davies, R. M., Kincey, J., & Worthington, H. V. (2003). Factors associated with health care seeking behaviour for orofacial pain in the general population. Community dental health, 20(1), 20-26.
Manfredini, D., Piccotti, F., Ferronato, G., & Guarda-Nardini, L. (2010). Age peaks of different RDC/TMD diagnoses in a patient population. Journal of dentistry, 38(5), 392–399. https://doi.org/10.1016/j.jdent.2010.01.006
Manfredini, D., Winocur, E., Ahlberg, J., Guarda-Nardini, L., & Lobbezoo, F. (2010). Psychosocial impairment in temporomandibular disorders patients. RDC/TMD axis II findings from a multicentre study. Journal of dentistry, 38(10), 765–772. https://doi.org/10.1016/j.jdent.2010.06.007

Manfredini, D., Ahlberg, J., Winocur, E., Guarda-Nardini, L., & Lobbezoo, F. (2011). Correlation of RDC/TMD axis I diagnoses and axis II pain-related disability. A multicenter study. Clin Oral Investig, 15(5), 749-756. doi:10.1007/s00784-010-0444-4

Maísa Soares, G., & Rizzatti-Barbosa, C. M. (2015). Chronicity factors of temporomandibular disorders: a critical review of the literature. Braz Oral Res, 29. doi:10.1590/1807-3107BOR-2015.vol29.0018

Meints, S. M., & Edwards, R. R. (2018). Evaluating psychosocial contributions to chronic pain outcomes. Prog Neuropsychopharmacol Biol Psychiatry, 87(Pt B), 168-182. doi:10.1016/j.pnpbp.2018.01.017

Mujakperuo, H. R., Watson, M., Morrison, R., & Macfarlane, T. V. (2010). Pharmacological interventions for pain in patients with temporomandibular disorders. The Cochrane database of systematic reviews, (10), CD004715.

Pigg, M., Nixdorf, D. R., Law, A. S., Renton, T., Sharav, Y., Baad-Hansen, L., & List, T. (2021). New International Classification of Orofacial Pain: What Is in It For Endodontists?. Journal of endodontics, 47(3), 345–357. https://doi.org/10.1016/j.joen.2020.12.002

Racich M. J. (2018). Occlusion, temporomandibular disorders, and orofacial pain: An evidence-based overview and update with recommendations. The Journal of prosthetic dentistry, 120(5), 678–685. https://doi.org/10.1016/j.prosdent.2018.01.033

Raja, S. N., Carr, D. B., Cohen, M., Finnerup, N. B., Flor, H., Gibson, S., . . . Vader, K. (2020). The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. Pain, 161(9), 1976-1982. doi:10.1097/j.pain.0000000000001939

Renton T. (2020). Tooth-Related Pain or Not?. Headache, 60(1), 235–246. https://doi.org/10.1111/head.13689

Réus, J. C., Polmann, H., Souza, B. D. M., Flores-Mir, C., Gonçalves, D. A. G., de Queiroz, L. P., Okeson, J., & De Luca Canto, G. (2022). Association between primary headaches and temporomandibular disorders: A systematic review and meta-analysis. Journal of the American Dental Association (1939), 153(2), 120–131.e6. https://doi.org/10.1016/j.adaj.2021.07.021

Rice, A. S. C., Smith, B. H., & Blyth, F. M. (2016). Pain and the global burden of disease. Pain, 157(4), 791–796. https://doi.org/10.1097/j.pain.0000000000000454

Rollman, A., Visscher, C. M., Gorter, R. C., & Naeije, M. (2012). Care seeking for orofacial pain. J Orofac Pain, 26(3), 206-214.

Schiffman, E., Ohrbach, R., Truelove, E., Look, J., Anderson, G., Goulet, J. P., List, T., Svensson, P., Gonzalez, Y., Lobbezoo, F., Michelotti, A., Brooks, S. L., Ceusters, W., Drangsholt, M., Ettlin, D., Gaul, C., Goldberg, L. J., Haythornthwaite, J. A., Hollender, L., Jensen, R., Orofacial Pain Special Interest Group, International Association for the Study of Pain (2014). Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: recommendations of the International RDC/TMD Consortium Network* and Orofacial Pain Special Interest Group†. Journal of oral & facial pain and headache, 28(1), 6–27.

Schiffman, E., & Ohrbach, R. (2016). Executive summary of the Diagnostic Criteria for Temporomandibular Disorders for clinical and research applications. Journal of the American Dental Association (1939), 147(6), 438–445. https://doi.org/10.1016/j.adaj.2016.01.007

Simon, G. E., VonKorff, M., Piccinelli, M., Fullerton, C., & Ormel, J. (1999). An international

study of the relation between somatic symptoms and depression. The New England journal of medicine, 341(18), 1329–1335. https://doi.org/10.1056/NEJM199910283411801

Slade, G. D., Bair, E., Greenspan, J. D., Dubner, R., Fillingim, R. B., Diatchenko, L., . . . Ohrbach, R. (2013). Signs and symptoms of first-onset TMD and sociodemographic predictors of its development: the OPPERA prospective cohort study. J Pain, 14(12 Suppl), T20-32.e21-23. doi:10.1016/j.jpain.2013.07.014

Slade, G. D., Fillingim, R. B., Sanders, A. E., Bair, E., Greenspan, J. D., Ohrbach, R., . . . Maixner, W. (2013). Summary of findings from the OPPERA prospective cohort study of incidence of first-onset temporomandibular disorder: implications and future directions. J Pain, 14(12 Suppl), T116-124. doi:10.1016/j.jpain.2013.09.010

Slade, G. D., Ohrbach, R., Greenspan, J. D., Fillingim, R. B., Bair, E., Sanders, A. E., . . . Maixner, W. (2016). Painful Temporomandibular Disorder: Decade of Discovery from OPPERA Studies. J Dent Res, 95(10), 1084-1092. doi:10.1177/0022034516653743

Stowell, A. W., Gatchel, R. J., & Wildenstein, L. (2007). Cost-effectiveness of treatments for temporomandibular disorders: biopsychosocial intervention versus treatment as usual. J Am Dent Assoc, 138(2), 202-208. doi:10.14219/jada.archive.2007.0137

St Sauver, J. L., Warner, D. O., Yawn, B. P., Jacobson, D. J., McGree, M. E., Pankratz, J. J., Melton, L. J., 3rd, Roger, V. L., Ebbert, J. O., & Rocca, W. A. (2013). Why patients visit their doctors: assessing the most prevalent conditions in a defined American population. Mayo Clinic proceedings, 88(1), 56–67. https://doi.org/10.1016/j.mayocp.2012.08.020

Turner, J. A., Dworkin, S. F., Mancl, L., Huggins, K. H., & Truelove, E. L. (2001). The roles of beliefs, catastrophizing, and coping in the functioning of patients with temporomandibular disorders. Pain, 92(1-2), 41–51. https://doi.org/10.1016/s0304-3959(00)00469-3

Turner, J. A., Mancl, L., & Aaron, L. A. (2006). Short- and long-term efficacy of brief cognitive-behavioral therapy for patients with chronic temporomandibular disorder pain: a randomized, controlled trial. Pain, 121(3), 181–194. https://doi.org/10.1016/j.pain.2005.11.017

Vibe Fersum, K., Smith, A., Kvåle, A., Skouen, J. S., & O'Sullivan, P. (2019). Cognitive functional therapy in patients with non-specific chronic low back pain-a randomized controlled trial 3-year follow-up. European journal of pain (London, England), 23(8), 1416–1424. https://doi.org/10.1002/ejp.1399

van Driel, T. J. W., Hilderink, P. H., Hanssen, D. J. C., de Boer, P., Rosmalen, J. G. M., & Oude Voshaar, R. C. (2018). Assessment of Somatization and Medically Unexplained Symptoms in Later Life. Assessment, 25(3), 374–393. https://doi.org/10.1177/1073191117721740

van Hecke, O., Torrance, N., & Smith, B. H. (2013). Chronic pain epidemiology - where do lifestyle factors fit in? Br J Pain, 7(4), 209-217. doi:10.1177/2049463713493264

van Tulder, M. W., Koes, B. W., & Bouter, L. M. (1997). Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions. Spine (Phila Pa 1976), 22(18), 2128-2156. doi:10.1097/00007632-199709150-00012

Von Korff, M., Dworkin, S. F., Le Resche, L., & Kruger, A. (1988). An epidemiologic comparison of pain complaints. Pain, 32(2), 173-183. doi:10.1016/0304-3959(88)90066-8

White, B. A., Williams, L. A., & Leben, J. R. (2001). Health care utilization and cost among health maintenance organization members with temporomandibular disorders. J Orofac Pain, 15(2), 158-169.
Widmer, C. G. (1989). Temporomandibular joint sounds: a critique of techniques for recording and analysis. J Craniomandib Disord, 3(4), 213-217.
Woolf C. J. (2010). What is this thing called pain?. The Journal of clinical investigation, 120(11), 3742–3744. https://doi.org/10.1172/JCI45178
Wright E. F. (2000). Referred craniofacial pain patterns in patients with temporomandibular disorder. Journal of the American Dental Association (1939), 131(9), 1307–1315. https://doi.org/10.14219/jada.archive.2000.0384
Wright, E. F., & North, S. L. (2009). Management and treatment of temporomandibular disorders: a clinical perspective. The Journal of manual & manipulative therapy, 17(4), 247–254. https://doi.org/10.1179/106698109791352184
Yap, A. U., Tan, K. B., Chua, E. K., & Tan, H. H. (2002). Depression and somatization in patients with temporomandibular disorders. J Prosthet Dent, 88(5), 479-484. doi:10.1067/mpr.2002.129375

Table 1 *Grouping of treatments for correlation analysis*

Standard multidisciplinary	**Medications**	**Alternative Medicine**	**Mind Body Therapy**	**Irreversible treatments**	**Specialist whole body**
Counseling by dentist or dental staff	Muscle relaxant medication (e.g., Robaxin, Valium, meprobamate, Flexiril, Zanaflex)	Yoga	Counseling by dentist	Extensive treatment to change your bite (i.e., the way your teeth fit together)	PT - Heat cold, ultrasound
Use of heat or ice	Strong analgesics / painkillers (eg., codeine, Percodan, Fiorinal)	Herbs/ Nutrition	Biofeedback	Grinding the chewing surfaces of the teeth (bite adjustment, occlusal equilibration)	PT- TENS
Soft diet	Anti-inflammatory medication (by prescription only, e.g., Motrin, Ibuprofen, Feldene, cortisone)	Homeopathy	Relaxation (whole body)	Dental restorations or reconstruction (crowns, bridges) to improve the bite	PT-Soft tissue manipulation
Rest or relax jaw	OTC NSAIDs	Craniosacral treatment	Stress Management	Orthodontics (braces)	PT- TMJ manipulation
Jaw exercise	Tylenol (acetaminophen)	Massage	Psychotherapy	TMJ surgery	Craniosacral
Muscle relaxant medications	Antidepressant medication (e.g., Elavil, amitriptyline, Sine quan, Desyrel, Prozac, Zoloft)	Chiropractic treatment (including jaw manipulation)	Hypnosis	TMJ arthrocentesis (flushing out joint with a needle instead of surgery)	Massage
OTC anti-inflammatory medications	Antibiotics	Acupuncture		Jaw surgery to realign your bite	Chiropractic
Relaxation (whole body)		Hypnosis		Treatment for a broken jaw	Acupuncture

	(jaw surgery, fixation)	
Stress management Mouth appliance (splint, bite plate, night guard, repositioning appliance)	Major jaw surgery for any other reason	Biofeedback

Note. PT – Physiotherapy, TENS – Transcutaneous Electric Nerve Stimulation, TMJ – Temporomandibular joint, OTC – over the counter

Table 2 *Demographics of participants at baseline*

Gender (N =195)	**N, (%)**
Male	30, (15.38462)
Female	165, (84.61538)
Age	**N, (%)**
18-24	39, (20)
25-35	56, (28.717)
36-47	46, (23.589)
48-67	54, (27.692)
Hispanic Ethnicity	**N, (%)**
No	188, (96.923)
Yes	7, (3.589)
Race	**N, (%)**
American Indian or Alaska Native	2, (1.0256)
Asian	9, (4.615)
Native Hawaiian or Other Pacific Islander	1, (0.512)
Black or African American	5, (2.564)
White	171, (87.692)
American Indian or Alaska Native and White	2, (1.0256)
Asian and white	1, (0.512)
Native Hawaiian or Other Pacific Islander and white	1, (0.512)
Black or African American and white	2, (1.0256)

No Data	1, (0.512)
Schooling	**N, (%)**
No schooling	0
Elementary 1-8	0
High school 9-12	2, (1.025)
College 13- 18	148, (75.897)
Beyond college	44, (22.564)
No Data	1, (0.512)
Total Household income	**N, (%)**
<10,000	26, (13.33333)
10,000-19,999	15, (7.69230)
20,000- 29,999	16, (8.20512)
30,000- 39,999	19, (9.74358)
40,000- 49,999	9, (4.61538)
50,000- 59,999	21, (10.76923)
60,000- 69,999	17, (8.71794)
70,000- 79,999	13, (6.666666)
>80,000	56, (28.71794)
No Data	3, (1.53846)

Table 3 *Demographics of participants at follow up*

Gender N= 102	**N, (%)**
Male	17, (16.667)
Female	85, (83.334)
Age	**N, (%)**
25-35	27, (26.47)
36-46	20, (19.607)
47-57	24, (23.529)
58-68	24, (23.529)
68-78	7, (6.862)
Schooling	**N, (%)**
Through high school or less	7, (6.862)
Some college	24, (23.529)
College graduate	35, (34.313)
Professional or Post-graduate level	36, (35.294)
Total Household Income	**N, (%)**
$0 - $19,999	8, (7.84)
$20,000 - $39,999	14, (13.72)
$40,000 - $59,999	2, (1.96)
$60,000 - $79,999	12, (11.76)
$80,000 - $99,999	16, (15.68)
$100,000 - $149,999	17, (16.66)
$150,000 or higher	13, (12.74)

Do not know	2, (1.96)
Do not wish to disclose	18, (17.64)

Table 4 *Association of treatments received with normal, moderate and extreme somatization*

Treatments Received	**Somatization Normal**			**Somatization Moderate**			**Somatization Severe**		
	N	**%**	**p-value**	**N**	**%**	**p-value**	**N**	**%**	**p-value**
Evaluation only, no treatment	11	40.7	0.309	9	33.3	1	7	25.9	0.162
Counseling by dentist or dental staff	19	44.1	0.331	15	34.8	0.331	9	20.9	0.333
Use of heat or ice	15	35.7	0.173	17	40.4	0.286	10	23.8	0.107
Soft Diet	6	24.0	0.004	9	36.0	0.935	10	40.0	0.0004
Rest or relax Jaw	23	46.0	0.43	16	32.0	0.944	11	22.0	0.147
Jaw Exercise	8	34.7	0.126	8	34.7	2	7	30.4	0.05
Yoga	4	40.0	0.69	4	40.0	0.906	2	20.0	1
Herbs/ nutrition	3	27.2	0.17	3	27.2	0.901	5	45.4	?
Homeopathy	3	42.8	0.957	2	28.5	1	2	28.5	0.665

Muscle relaxant medications (e.g., Robaxin, Valium, meprobamate, Flexeril, Zanaflex)	10	35.7	0.093	11	39.2	0.582	7	25.0	0.198
Strong analgesics or “pain killers” (e.g, codeine, Percodan, Fiorinal)	3	17.6	0.006	8	47.0	0.301	6	35.2	0.038
Anti-inflammatory medications (by prescription only: e.g., Motrin, ibuprofen, Feldene, cortisone)	14	38.8	0.11	15	41.6	0.124	6	16.6	1
Over-the-counter anti-inflammatory medications	16	36.3	0.709	15	34.0	1	8	18.1	0.742
Tylenol (acetaminophen)	18	40.9	0.115	17	38.6	0.436	9	20.4	0.379
Antidepressant medications (e.g,, Elavil, amitriptyline, Sinequan, Desyrel, Prozac, Zoloft)	3	30.0	0.287	3	30.0	1	4	40.0	0.077
Antibiotics	2	25.0	0.244	2	25.0	0.896	4	50.0	0.022

Physical therapy: heat, cold, ultrasound	3	20.0	0.02	7	46.6	0.373	5	33.3	0.098
Physical therapy: TENS (transcutaneous electrical nerve stimulation)	0	0.0	0.116	2	50.0	0.856	2	50.0	0.221
PT-Soft tissue manipulation	1	12.5	0.057	3	37.5	1	4	50.0	0.022
PT- TMJ manipulation	0	0.0	0.06	2	40.0	1	3	60.0	0.0305
Craniosacral treatment	3	42.8	0.957	3	42.8	?	1	14.2	0.005
Massage	11	36.6	0.099	14	46.6	0.106	5	16.6	1
Chiropractic treatment (including jaw manipulation)	4	26.6	0.078	6	40.0	0.766	5	33.3	0.0988
Acupuncture	5	38.4	0.503	5	38.4	0.916	3	23.0	0.706
Biofeedback	0	0.0	0.116	2	50.0	0.856	2	50.0	0.221
Relaxation (whole body)	4	26.6	0.078	7	46.6	0.373	4	26.6	0.377
Stress management	6	42.8	0.713	5	35.7	1	3	21.	0.81

								4	
Psychotherapy	1	16.6	0.189	2	33.3	1	3	50.0	0.071
Hypnosis	1	100.00	1	0	0.00	1	0	0.00	1
Extensive treatment to change your bite (i.e., the way your teeth fit together)	5	50.0	1	2	20.0	0.556	3	30.0	0.393
Mouth appliance (splint, bite plate, night guard, repositioning appliance)	15	36.5	0.029	18	43.9	0.1	8	19.5	0.552
Grinding the chewing surfaces of the teeth (bite adjustment, occlusal equilibration)	8	19.5	0.27	10	24.3	0.194	3	7.32	1
Dental restorations or reconstruction (crowns, bridges) to improve the bite	3	23.0	0.063	3	23.0	0.5997	7	53.8	0.0002
Orthodontics (braces)	5	50.0	1	1	10.0	0.195	4	40.0	0.77
TMJ surgery	0	0.0	0.457	1	50.0	1	1	50.	0.714

								0	
TMJ Arthrocentesis (flushing out joint with a needle instead of surgery)	1	50.0	1	0	0.00	0.007	1	50.0	0.714
Jaw surgery to realign your bite	1	50.0	1	0	0.00	0.8007	1	50.0	
Treatment for a broken jaw (jaw surgery, fixation)	0	0.0	0.843	0	0.00	0.0007	0	0.00	0.059
Major jaw surgery for any other reason	0	0.0	0.457	0	0.00	0.8007	2	100	0.059
Others	2	50.0	1	0	0.00	0.367	2	50.0	0.8

Note. PT – Physiotherapy, TENS – Transcutaneous Electric Nerve Stimulation, TMJ – Temporomandibular joint, OTC – over the counter.

Table 5 *Grouped treatments and spearman correlation analysis*

Treatment Group	**Rho value**	**p value**
Total treatments received	0.18	0.077
Medication	0.129	0.196
Alternative and complementary medicine	0.192	0.05
Irreversible Treatments	0.080	0.421
Standard clinical protocol	0.185	0.062
Mind – Body Therapy	0.087	0.382
Specialized whole body	0.178	0.073

Figure 1

Flow of patients included in the study

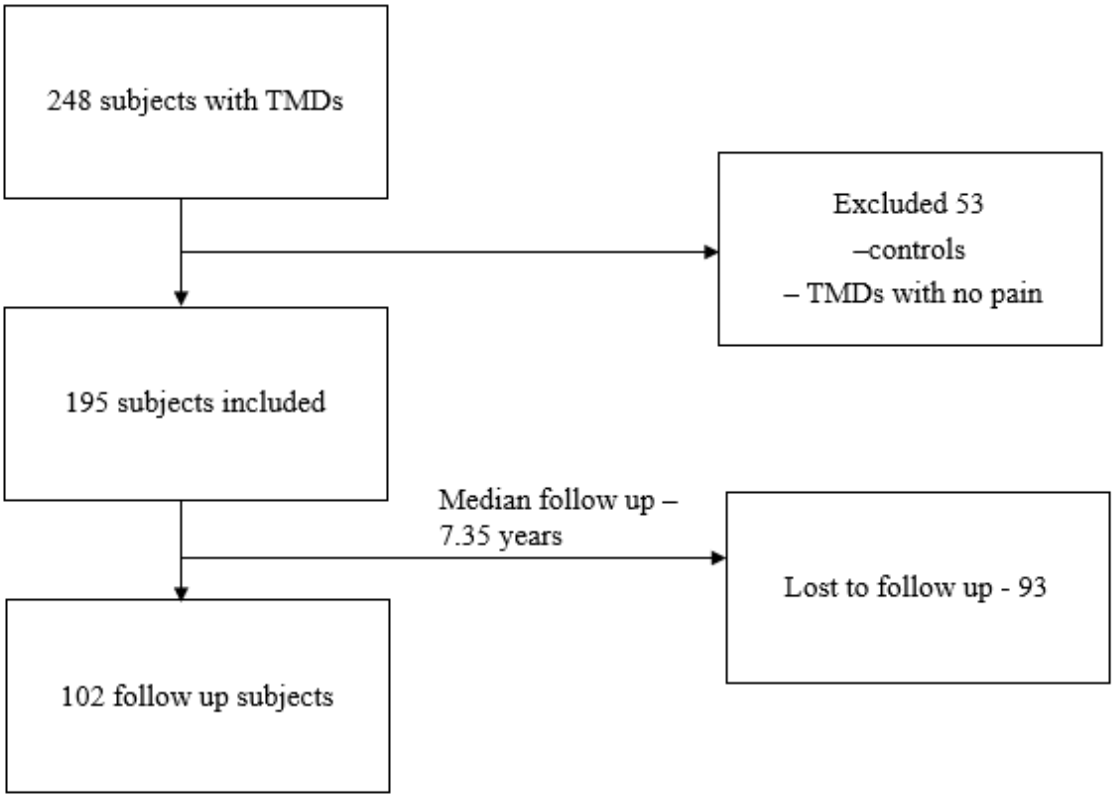


Figure 2

Prevalence of Diagnosis of painful TMDs at baseline

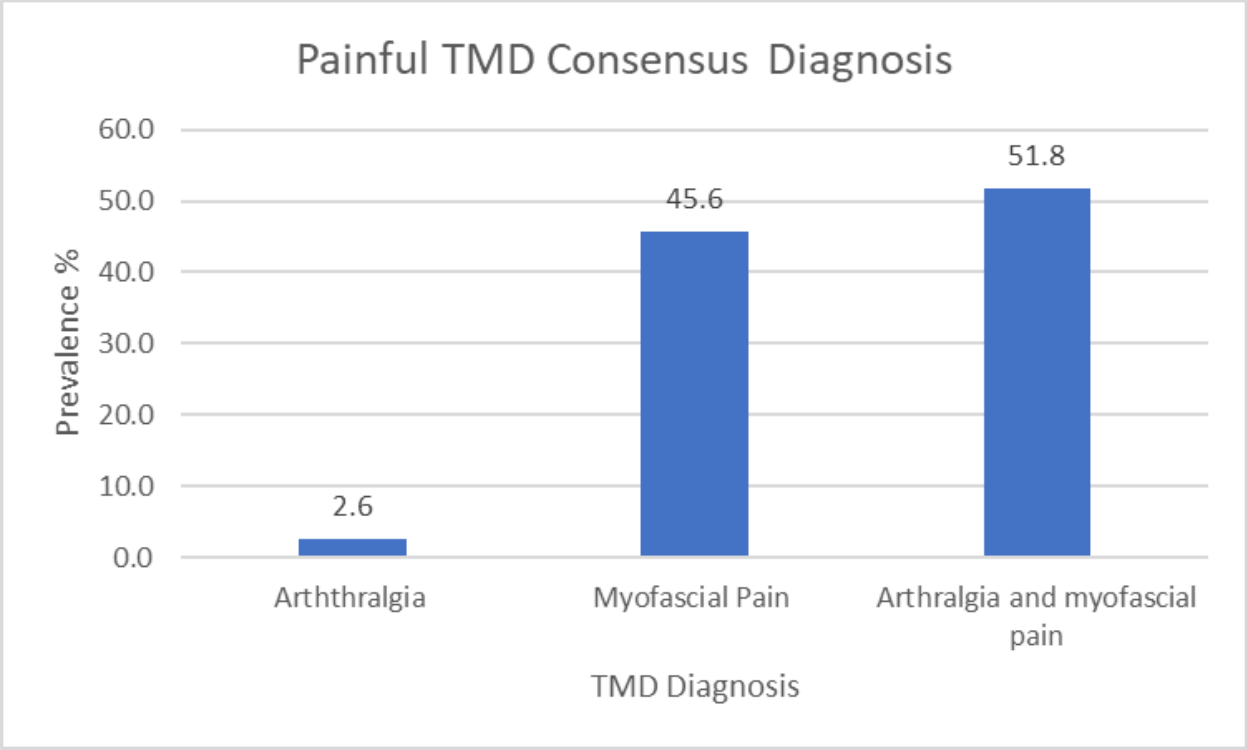


Figure 3

Subdivisions of Myofascial pain diagnosis

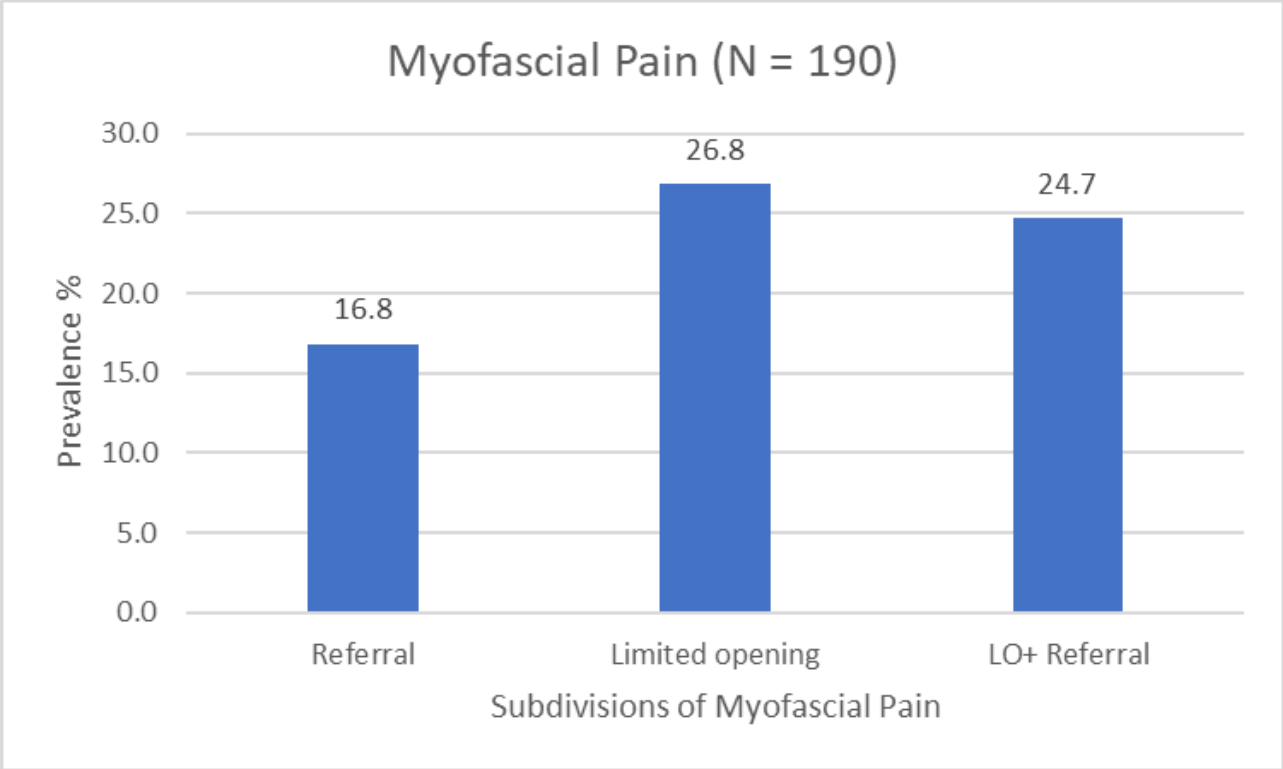


Figure 4

Other areas of body pain

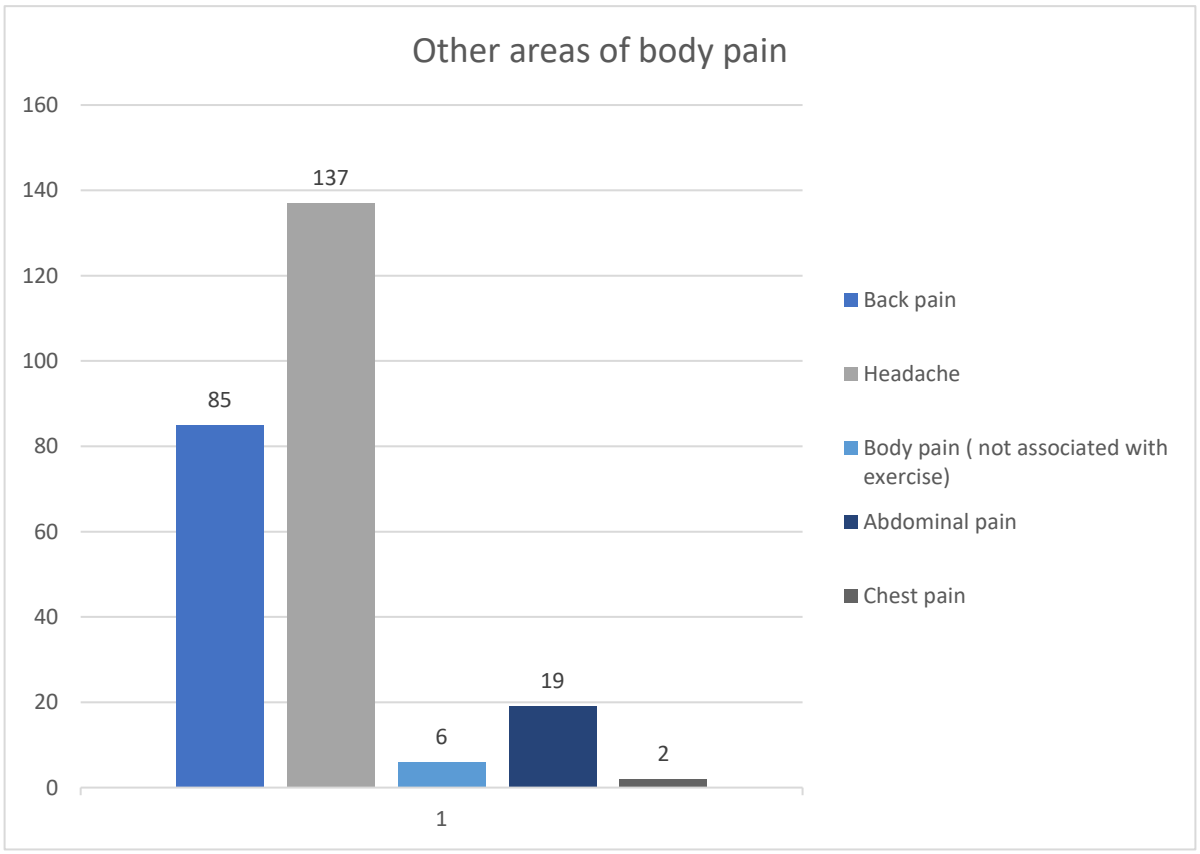


Figure 5

Prevalence of more than one area of body pain

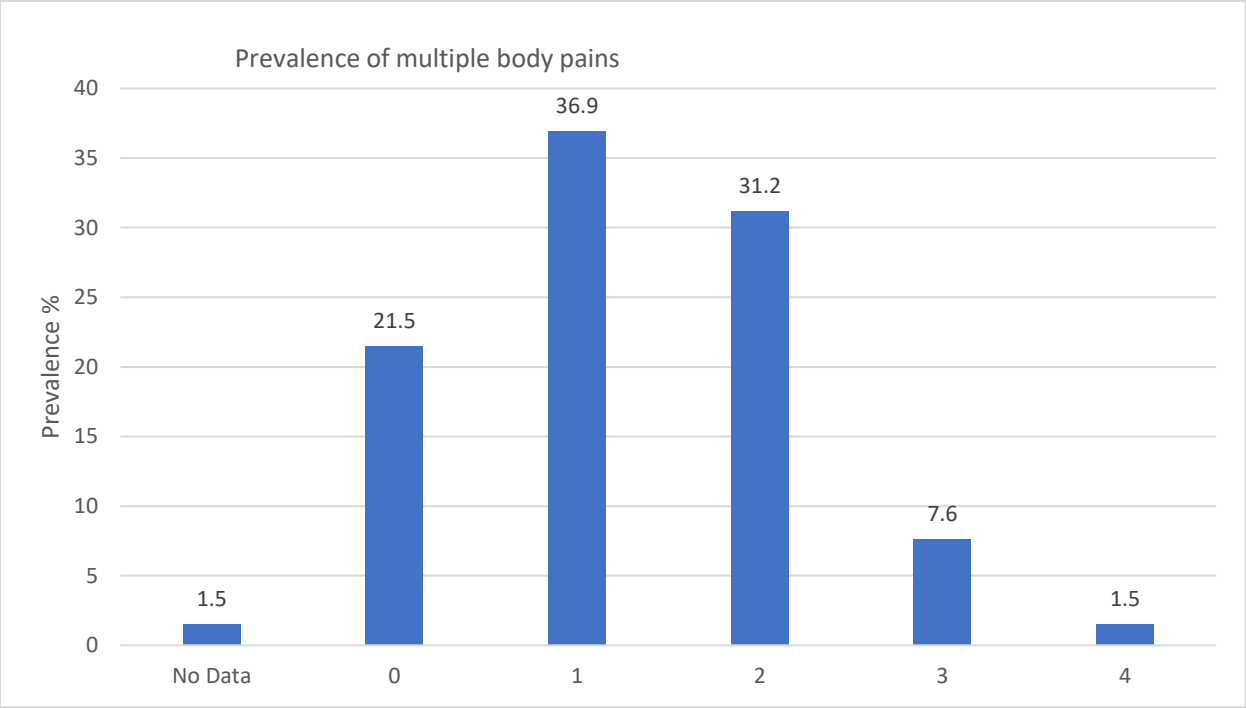
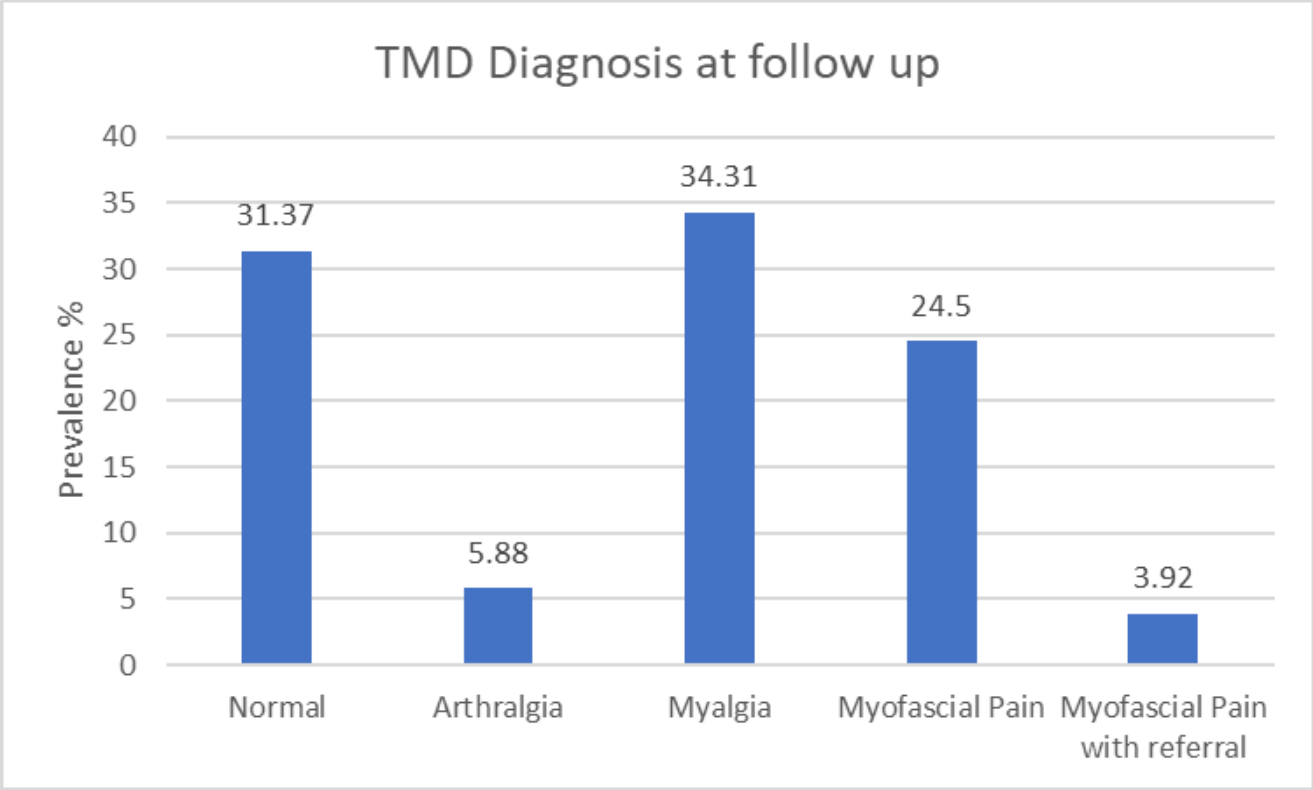


Figure 6

TMD diagnoses at after 8 years follow up



Note. Normal included patients who did not have any positive responses in the Axis I/ physical examination component of the RDC/TMD criteria

Figure 7

Number of treatments received at follow up study after 8 years

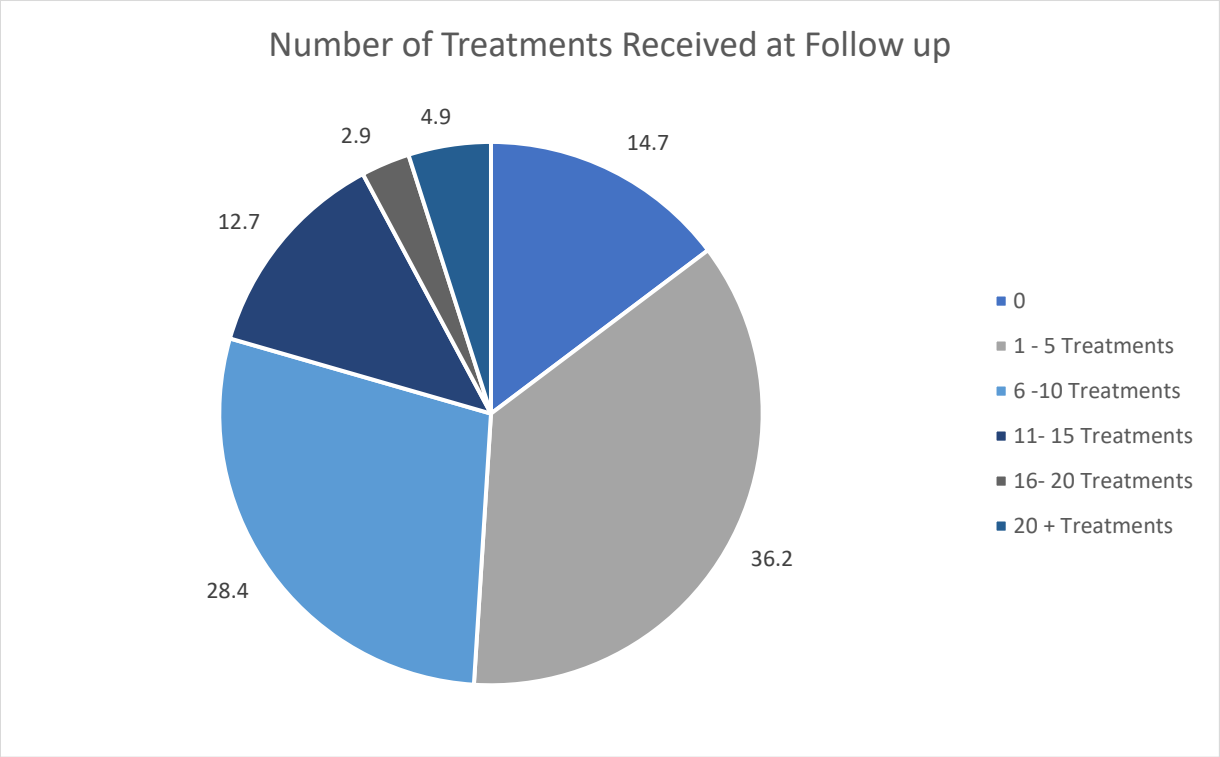


Figure 8

Correlation analysis between somatization and its association with treatments received