A RETROSPECTIVE ANALYSIS OF IN-PATIENT TEMPOROMANDIBULAR DISORDERS

By

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A Retrospective Analysis of Inpatient Temporomandibular Disorders

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ABSTRACT

Disorders of Temporomandibular Joint (including capsulitis of TMJ, degenerative arthritis, internal derangement, dislocation, myofacial pain, ankyloses, headache, sleep disorders, trigeminal neuralgia, Cranio-maxillofacial trauma, and other related TMJ diseases) are some of the leading causes of chronic pain.

The serious personal consequences of severe, constant facial, head and neck pain from these disorders make these problems a major social issue. One of the greatest challenges facing health care systems internationally is meeting the health needs of their populations with the available resources especially for In-patient.

This study explored the association of temporomandibular joint complexity with socio-demographic variables, multi-disciplinary management of the TMD during patient hospitalization and selected co-morbidities characteristics based on the 2003 to 2010 nationwide inpatient sample (NIS) of the health care cost and utilization project (HCUP) provided by the agency for health care research and quality (AHRQ) data for TMD In-patients between 2 and 97 years old.

There is a strong positive correlation between temporomandibular disorders and hypertension and a weaker but nonetheless positive correlation between temporomandibular disorders and diabetes, temporomandibular disorders and depression, and temporomandibular disorders and weight.

The finding of this study support the hypotheses that Socio-demographic factors (age, race, disposition of patient, primary expected payer, patient location, gender, source, length of stay, and median income) affect incidence of TMD and hospital stays, Co-morbidities exist that are significantly related to TMD incidence and hospitalization costs.

Results of eight years nationwide epidemiological estimates of hospitalizations attributed to temporomandibular joint disorders in the United States demonstrate changes in socio-demonstrate and hospital related factors.

Also eight-year trend analysis of hospitalizations for temporomandibular disorders showed that mean length of stay between (3.06 - 3.25) while per year charge increased.

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It is with my sincerest gratitude that I take this opportunity to thank those, without whom, this PhD Dissertation would not have been possible. I am truly and deeply indebted to so many people that there is no way to acknowledge them all. I sincerely hope that everyone who knows that they have contributed towards the achievement of my goals feels the satisfaction that they have helped.

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Chapter I

INTRODUCTION

Background Of the problem

What is temporomandibular disorder?

The conundrum of the temporomandibular disorders (TMD) first appeared in the literature in 1887, and has since been a confusing disorder with different terminology and lists of associated symptoms. Also It had different abbreviations; such as TMJ, TMJD, MPDS, MDS, CMD and TMD (1). Finally, Bell (1982) introduced the term temporomandibular disorder (TMD) which has, since then, become widely used (2).

Temporomandibular disorders (TMD) are a group of related disorders with considerable prevalence and costs. They represent a major cause of non-dental pain in the head, neck and face region and are considered a subclass of musculoskeletal and neuromuscular disorders that involve the temporomandibular joint (TMJ), the masticatory muscles, and all associated tissues (3-15).

Temporomandibular disorders are among the most challenging diseases of modern society, diagnostically, prognostically and in terms of treatment. TMDs are described as a primary disease entity involving the temporomandibular joint (TMJ) with the key symptom of pain. It is very unique in many respects and complex joint too, and it is still subject to the same disorders affecting other synovial joints. Recent study clearly showed that TMDs 76% a pain disorder (16). Pain associated with TMD can be clinically expressed as masticatory muscle pain or TMJ pain (synovitis, capsulitis, or osteoarthritis). TMD pain can be, but is not necessarily, associated with dysfunction of the masticatory system

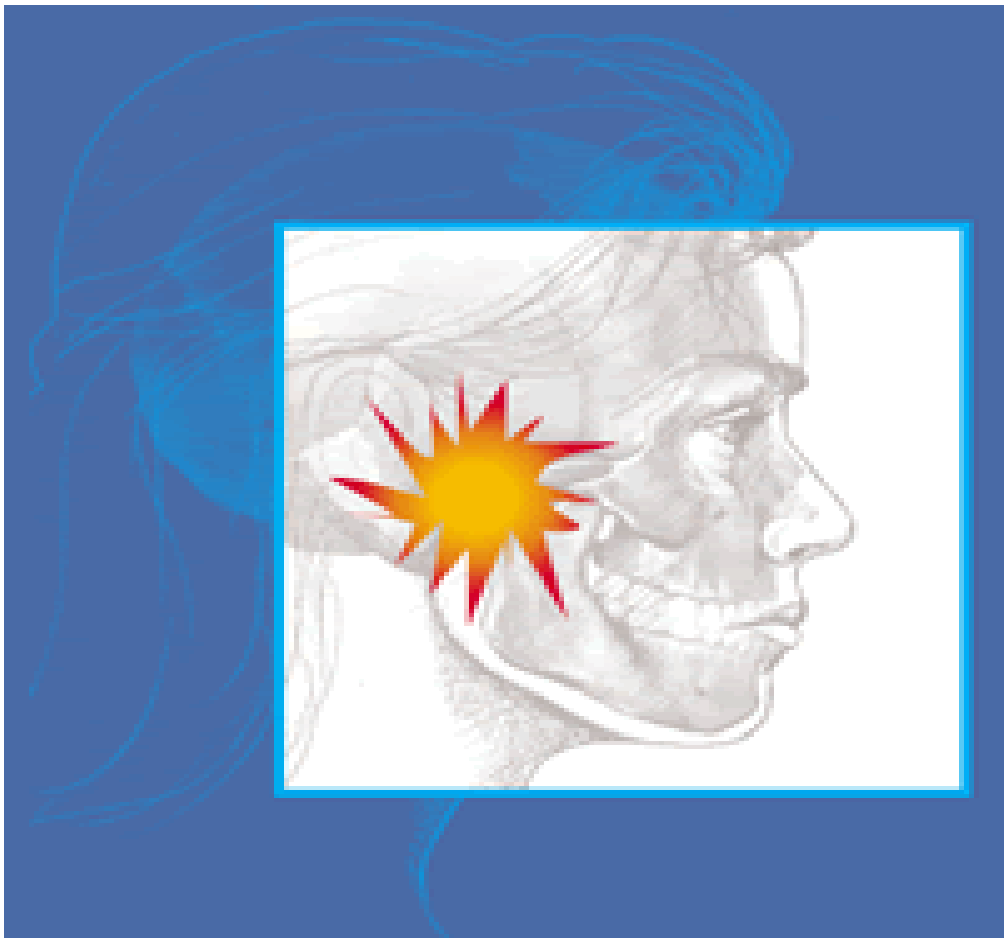

Figure.1.Temporomandibular Joint (Source; National Institute of Dental and Craniofacial Research 2014)

Epidemiology and Statistics of TMD

TMD- related has been reported in between 5% and 15% in the U.S.A according to the National Institute of Dental and Craniofacial Research (NIDCR), one of the faculties of the National Institutes of Health (NIH).

The prevalence rates of TMD disorders are well distributed throughout a broad spectrum age range of 20-60 and peaking between 20-40 years. Nationally speaking, some states have a much higher incidence than others raising the question of whether it's geography or the larger population of these states that reflect that higher incidence rate.

TMD disorders are at least twice as prevalent in women as men, while only 1.4 -7% seeks treatment (4 times more females); Progression to severe and/or chronic pain is associated with greater psychosocial distress, sleep disturbances, and comorbidities. TMD-related can affect daily activities, physical, psychosocial functioning, and quality of life. And women using either supplemental estrogen or oral contraceptives are more likely to seek treatment for these conditions so researchers are exploring a possible link between female hormones and TMJ disorders.

Pathophysiology

Many aspects of the etiology of TMD are unclear. But there is definite support for a biopsychosocial and multifactorial background, illustrating the complex interaction between biological mechanisms, psychological states and traits, environmental conditions, and macro- and microtrauma.

In masticatory muscle pain (MMP), experts propose a complex interaction between environmental, emotional, behavioral, and physical factors, including overloading parafunctions such as clenching during waking hours and bruxism during sleep, micro-trauma, and release of inflammatory mediators and neuropeptides in muscles, which can sensitize the peripheral and central nervous systems. In conjunction with altered pain-regulating mechanisms (also influenced by female hormones), such factors may lead to localized or more generalized muscle pain, which is associated with comorbidities (6-15)

Recent articles have highlighted the cultural effects of persistent TMD pain on patient behavior, as well as genetic factors (*COMT* gene haplotypes) (14).

Much co-morbidity are present in TMD in-patients studied and the numbers don't necessarily correlate, which warrants further study with more depth to investigate any underlying relationship between these conditions. Many conditions may mask and co-exist with TMJ Disorders.

Meanwhile, a variety of symptoms may be linked to TMJ disorders. Pain, particularly in the chewing muscles and/or jaw joint, is the most common symptom.

Other likely symptoms include:

- Radiating pain in the face, jaw, or neck.
- Jaw muscle stiffness.
- Limited movement or locking of the jaw.
- A change in the way the upper and lower teeth fit together
- painful clicking, popping or grating in the jaw joint opening/closing the mouth.

For many people, symptoms seem to start without obvious reason.

Naturally, trauma to the jaw or temporomandibular joint plays a role in some TMJ disorders. But for most jaw joint and muscle problems, scientists don't know the causes.

Having said that, some perceived causes are;

- Autoimmune disease
- Infection
- Injury
- Dental procedures
- Arthritis
- Stretching the jaw for breathing tube
- A gene variant
- Hormonal e.g. women of child bearing age and premenopausal.
- Environmental e.g. habitual gum chewing or sustained jaw position

For most people, pain in the area of the jaw joint or muscles does not signal a serious problem. Generally, discomfort from these conditions is occasional and temporary, often occurring in cycles. The pain eventually goes away with little or no treatment.

Patients can therefore misinterpret and assign the pain to sinuses or migraine headaches. Some people, however, develop significant, long-term symptoms that affect their quality of life.

Complex cases are often marked by prolonged, persistent and severe pain; jaw dysfunction; co-existing conditions; and diminished quality of life. Such cases require a team of experts from various fields, such as dentist, orofacial pain specialist, oral surgeon, neurology, rheumatology, pain management and others, to diagnose and treat this condition.

Researchers from the National Institute of Dental and Craniofacial Research (NIDCR), generally agree that TMD conditions fall into three main categories:

1. Myofascial pain involves discomfort or pain in the muscles that control jaw function.
2. Internal derangement of the joint involves a displaced disc, dislocated jaw, or injury to the condyle.
3. Arthritis refers to a group of degenerative/inflammatory joint disorders that can affect the temporomandibular joint.

A person may have one or more of these conditions at the same time.

Types of Temporomandibular Disorders

A clear differential diagnosis for TMD is necessary, especially when a surgical consideration is possible.

TMJ joints disorder include disc displacement disorders, arthritic or degenerative changes and neoplasm. Other conditions affecting the temporomandibular joints include congenital disorders, inflammatory conditions and systemic disease.

There are three signs of a temporomandibular disorder;

1. Pain of lower jaw function
2. Limitation of lower jaw movements
3. Joint sounds.

Can be one, two, or all three conditions when present, may indicate either signs of a chronic adaptation of the anatomy structure of the joint. Mostly no need for treatment interventions, or symptoms of dysfunction which may limit the activities of daily life due to pain or a limited ability to masticate muscle.

While pain of the masticatory system can arise from the muscles of mastication or can be referred to the craniofacial region from musculoskeletal structures (3).

Examination of the masticatory muscles will detect myofacial trigger points and muscle tenderness, which can also produce referral patterns to the region of the temporomandibular joints. Also myositis or muscle inflammation, often result from local trauma or infection. Myospasm describes an involuntary muscle contraction. The patient with myospasm may present with a restricted mandibular range of motion that must be differentiated from an internal derangement of the joint, as this condition can also restrict mandibular movement (19-20).

By time, masticatory muscles experiencing chronic contraction or other local myopathies may develop myfibrotic contracture. This may not be a painful condition, but will also limit the mandibular range of motion. For this reason, a differential diagnosis requires a very detailed history and evaluation (18).

Anatomy of temporomandibular Joint

The temporomandibular articulation is among the most complex in the body. It is a synovial joint that has two joint compartments, four articular surfaces, contains vascularized tissue within the joint capsule and has articular surfaces of fibro.

The temporomandibular joint functions within the glenoid or temporomandibular fossa of the skull. The fossa is located in the temporal bone bilaterally, just anterior to

the external auditory meatus. The TMJ fossa is not so much of a precise socket, but more of a depression in the base of the skull within the mandibular condyle functions.

The mandibular condyle is a spheroidal structure capable of a wide range of anterior, posterior and lateral movements. The fibrocartilagenous articular surfaces of the condyle and fossa function against the fibrous interarticular disc that is interposed between these two structures.

The disc is attached to the mandibular condyle by lateral and medial collateral ligaments and blends into the capsule anteriorly. Posteriorly, the disc attaches to the complex retrodiscal tissues. While the disc is avascular and non-innervated, the retrodiscal tissue is highly vascularized and richly innervated.

The temporomandibular joint is a synovial join; by definition, it is encapsulated and stress bearing. The disc and its circumferential attachments separate the joint into an upper and lower joint space. The disc-condyle complex and mandibular fossa are enclosed within the capsular ligament that is lined by synovial tissue with collateral ligaments blending into the capsule. The Temporomandibular joint lateral ligament complex arises from the articular eminence and attaches to the posterior aspect of the nest of the condyle (21-24).

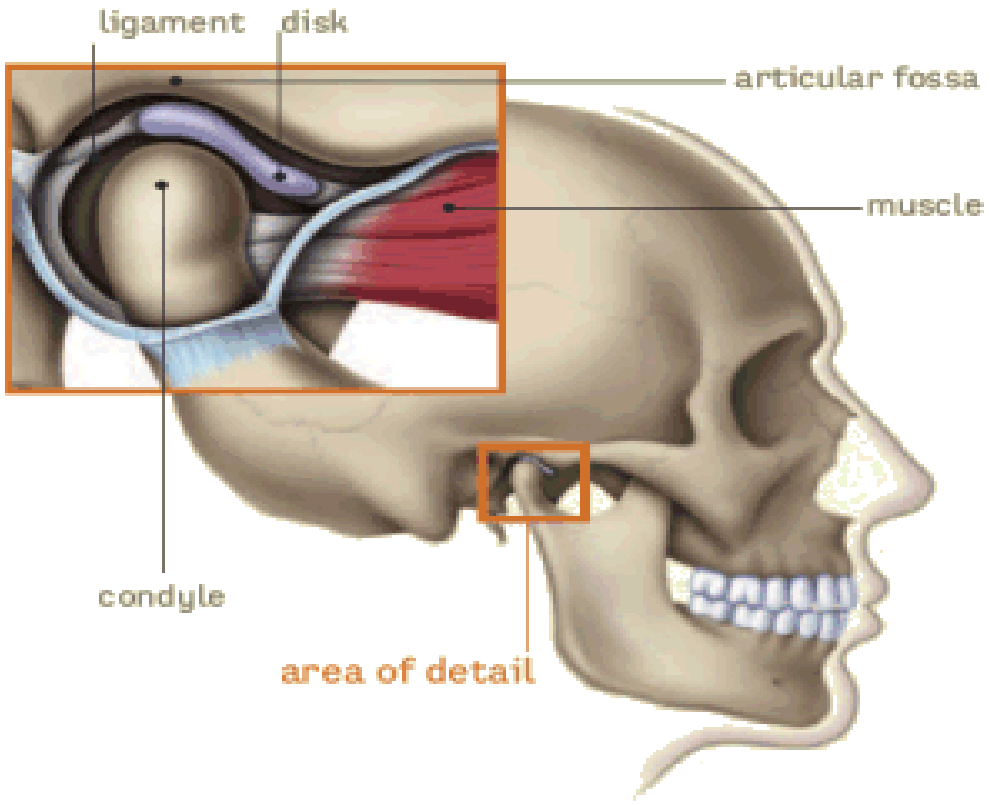

Figure.2. Basic anatomy of Temporomandibular Joint (source: TMJ association)

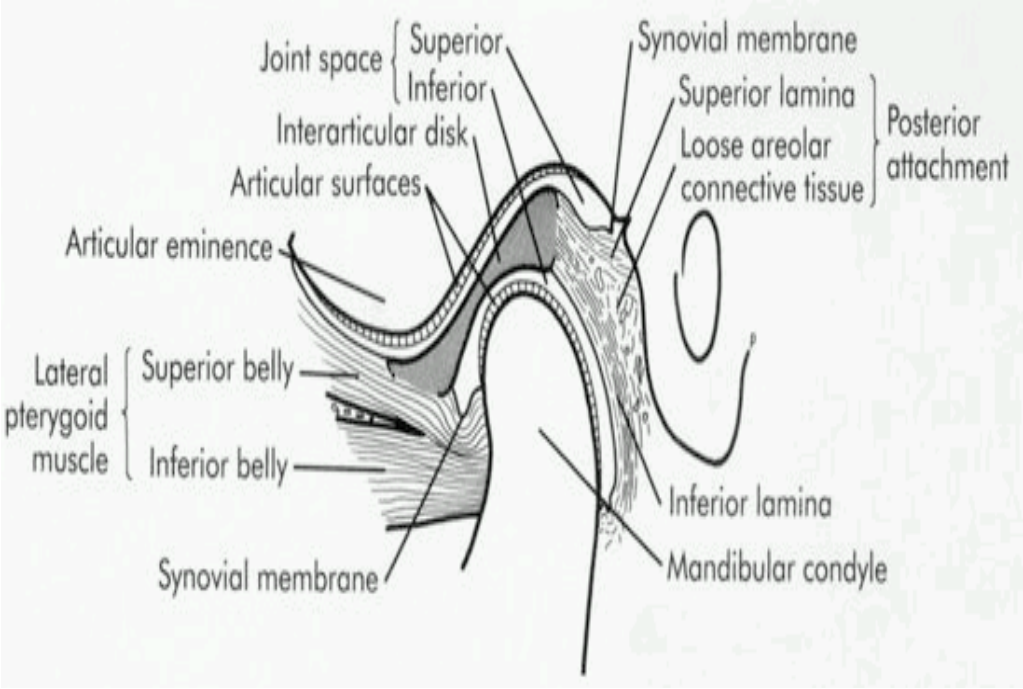

Figure.3. Components of Temporomandibular Joint (source: clinical outline)

Evaluation of temporomandibular joint

Evaluation is very important to diagnose the temporomandibular joint disorders properly. The goal of any treatment regimen regarding injury to, or dysfunction of, a joint is the restoration of function and decrease in pain.

The approach to management of a temporomandibular joint injury or dysfunction is no different from any other joint. Regardless of the etiology, pain, dysfunctional movements and sounds during function characterize a temporomandibular disorder.

Trauma may have been the precipitating event leading to the onset of the patient's complaints, there may be perpetuating factors, which result in lengthier and less productive treatment if not recognized and eliminated.

Therefore; the first goal in implementing a well-defined management on the identification of contributing factors. This should include addressing physical, emotional and psychological factors.

A comprehensive evaluation must include a detailed history which reviews:

- The chief complaint
- The history of the present illness
- The patient's medical and dental histories
- The findings of the clinical examination
    - An evaluation of the muscles of mastication and the supporting muscles of the neck and shoulders
    - The conditions found within the oral cavity which might be contributing to the patient's pain complaints
    - Myofunctional and/or parafunctional habits
    - Mandibular range of motion measurements
    - Auscultation of the temporomandibular joints during movement
    - Radiologic findings

Examination of temporomandibular joint

As musculoskeletal disorders are the most common sources of craniofacial pain, All patients should be screened for TMD and other craniofacial pain disorders during a general examination.

Examination of the temporomandibular joints includes:

- Measurement of mandibular range of motion
- Evaluation of mandibular gait
- Auscultation
- Palpation

Diagnosis of temporomandibular joint

Many TMD and facial Pain specialists say that temporomandibular joint “related” disorders can and must be differentially diagnosed, with highly specialized evaluations to specify diagnoses that might include the following:

- Myalgia
- Myofascitis
- Articular disc disorder (Disc dislocation)
- Inflammatory arthritis
- Muscle spasm
- Hyoid Bone Syndrome
- Posterior capsulitis
- Omohyoid Syndrome
- Temporal tendonitis (short head and long head)
- Rheumatoid arthritis
- Hemarthrosis
- Stylomandibular Ligament Sprain
- Reflex sympathetic dystrophy
- Degenerative arthritis
- Anterior displacement of TMJ disc without reduction
- Anterior displacement of TMJ disc with reduction
- Osteocavitational Necrosis
- Osteochondritis
- And numerous other conditions.

Treatment of temporomandibular joint

Management aims at providing the optimal circumstances for healing and adaptation to take place. Noninvasive, reversible therapies that fit in the biopsychosocial approach include:

- Education of the patient, active self-care, follow-up

- Physical therapy, physical self-regulation programs

- Intraoral occlusal appliances

- Medication (analgesics, nonsteroidal anti-inflammatory drugs)

In patients with chronic TMD, these therapies must be accompanied by:

- Psychological support, e.g., cognitive-behavioral therapy, relaxation therapy

- Surgery, But before doing surgery, must have:

1. Documented TMJ internal derangement that is
2. The result of a structural disorder
3. Pain and/or dysfunction are a disability
4. Prior unsuccessful nonsurgical treatment
5. Prior management of habits, concurrent active medical or dental problems
6. Informed consent

Diagnostic Criteria of TMD

The Guidelines of the American Academy of Orofacial Pain (2013) and the Diagnostic Criteria (DC-TMD, 2013-2014) suggest the following criteria:

MMP: A complaint of muscle pain in the jaw, in the temple, in the ear, or in front of the ear that is affected by jaw movement, function, or parafunction. Replication of this

familiar pain occurs with provocation testing of the masticatory muscles (i.e., palpation of the temporalis or masseter muscle(s); OR with maximum unassisted or assisted opening. Limitation of mandibular movement(s) secondary to pain may be present.

TMJ arthralgia: A complaint of joint pain that is affected by jaw movement, function, or parafunction. Replication of this familiar pain occurs with provocation testing of the TMJ (i.e., palpation of the lateral pole or around the lateral pole) OR with maximum unassisted or assisted opening, right or left lateral movements, or protrusive movements.

Psychosocial factors are rated by means of a pain drawing for pain locations and comorbidities, the Graded Chronic Pain Scale (GCPS) for pain intensity and physical function, the Jaw Function Limitation Scale (JFLS) short-form for limited function, the Patient History Questionnaire-4 (PHQ-4) for depression and anxiety, and the Oral Behavior Checklist for parafunction (9).

Research Significance, goal and Hypothesis of the study

Study Significance

The growing prevalence of TMD and the significant direct and indirect costs associated with this condition need more attention especially at emergency department and In-patient. Because TMJ disorders causation is complex and multifactorial, understanding the dynamics of other conditions, interactions and manifestation of a disease is essential to enhance the ability to diagnose and treat the condition.

Hence, there is an urgent need to address these issues via a retrospective analysis of existing data from HCUP in-patients to identify high risk populations throughout the United States.

There is a need to investigate the likely causes and recognize common co-morbidities in order to develop an optimal treatment plan that is safe and effective with a preventative approach to reduce prevalence and long term damage from chronic recurring pain which may become debilitating and accumulate direct and indirect costs including but not limited to recurring hospital stays.

Research Goal

Evaluate associations of socio-demographic and co-morbidity characteristics for TMD In-patient using NIS-HCUP data

Our hypothesis:

1. Socio-demographic factors (age, gender, median income, ethnicity) affect incidence of TMD and hospital stays
2. Co-morbidities exist that are significantly related to TMD incidence and hospitalization costs
3. Hospitalization trend of TMD

If we study and analyze TMD statistics and demographics in the USA we can understand and appreciate its prevalence in order to;

A. Investigate and establish optimum treatment for patients and develop measures and guidelines for healthcare providers at in-patient settings.
B. Strategize for long term preventative care and reduce direct and indirect costs associated with TMD including hospital stay and loss of productivity
C. Improve the quality of life for those affected and reduce oral health disparities

Objective

The study aims to:

1. Examines 8 years hospitalization patterns and changes in TMJD in united states
2. look at national statistics of patients with TMD from populations of United states that participate with HCUP and in light of better understanding the significant predictors for TMJD from selected demographics, prevalence, comorbidities disease, genetics risk factors and preventive strategies of in-patient temporomandibular joint disorders

Limitations

- There is no recent data from 2010-2014 so that more samples can be collected or studied.
- There is no data on recurrence to establish how effective treatments are such that patients do not have to be readmitted. If patients keep coming back then their condition is not controlled and a more appropriate treatment for long term effects is necessary.
- Number of missing data specially in 2006 Data
- Different CPT Code used for TMD by clinician
- Patients are lost to follow up once they are discharged and therefore are not continued to be monitored for chronic TMD.
- the numbers for recurrence rates are not known which makes it difficult to know the success of the treatments offered
- Patients are lost to follow up once they are discharged and therefore are not continued to be monitored for chronic TMD.
- The examining physician specialty is also unknown and may therefore cause a very high probability of misdiagnosis depending on whether the physician is a Neurologist, ENT Specialist etc.
- During their hospital visit, those inpatients are unlikely to be seen by a TMD Specialist since these physicians are not stationed at ER or in ward
- guidelines for TMD not available at the ER and in-patients
- There are no follow up visits to prevent further deterioration and improve preventative care.

Chapter II

REVIEW OF RELATED LITERATURE

Temporomandibular joint disorders (TMD)

Etiology, Risk factors, Epidemiology and Economics for TMD

TMJ is often a unique joint and complex nature and affected by many factors. It is a general belief that the etiology of TMD is multicausal although it is still many aspects of the etiology of TMD are unclear. But they are related to different etiologic factors and comorbid conditions (25).these factors can be (Anatomic, Physiologic, Neurologic, Psychologic, Behavioral, and Genetic). A certain etiologic cause, under different circumstances, can play the major role of either one or all mentioned factors (26). Every patient has some unique characteristics which are typical of their body.

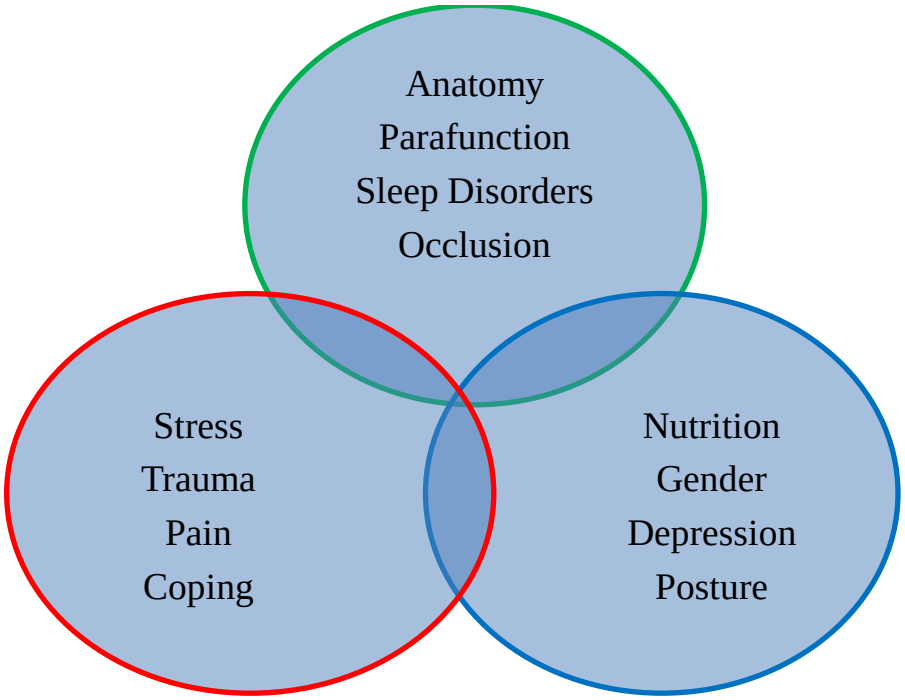

Figure.4. Etiologic Variables of TMD

Age and gender differences:

Age and gender differences play a role in the TMD epidemic. In a study that examined the age and sex distribution of 3,428 TMD patients presenting at a Seattle based HMO of 360,000enrollees, results showed that a mean ages of the women and men were 34.2 years and 33.8 years, respectively of those seeking treatment, 85.4% were women.

Anxiety and stress:

There is strong evidence that female effects of anxiety more than male, because of Gender Differences, Decreased pain threshold, Decreased pain tolerance, Disrupted self-control strategies, Increased EMG, and Increased pain behavior. Links have been identified between guilt, grief, emotional and depressive stress syndromes and immunologic status. (27, 33, 34)

Hormones:

Hormonal Influences on pain modulation which Greater pain sensitivity during menstrual cycle, at ovulation, and following menses. In addition, functional estrogen receptors have been identified in the female TM joint but not been found in the male TMJ. It is likely that sex hormones profoundly influence several cell activities associated with remodeling or degenerative processes in the temporomandibular joint (28-32)

Occlusion:

Occlusion is the relationship between dental arches in a bite. In the past, there was a belief that occlusal factors are among the most causes which contribute to the pathological condition of temporomandibular joint and masticatory muscles but there is insufficient evidence to support this claim. An association has been reported in literature between open bite, posterior crossbite, and deep bite and the occurrence of TMD. occlusion not an exclusive etiologic factor of TMD but generally it contributes to them (35,36)

Trauma:

Trauma (microtrauma and macrotrauma) considered among the important factors in development of TMD. Caused by a traffic accident, sport injury and other types of trauma. Macrotrauma is often mentioned by patients while microtrauma usually unnoticed so that the patient does not mention it, which can be missing fact in diagnostics. The most common sources of microtrauma are hypoxic-reperfusion injuries, bruxism and orthopedic instability (3,37)

Economics:

Studies proved that TMDs are affects 10-36 million adults in the U.S., with 17.8 million working days lost per year due to head pain for every 150 million working adults and 50% of this head pain is related to orofacial pain disorders Which resulting in billions of dollars in financial loss (38-41). Prevalence of TMD is between 5% and 15% in the U.S.A according to the National Institute of Dental and Craniofacial Research (NIDCR), one of the faculties of the National Institutes of Health (NIH). The serious personal consequences of sever, constant facial, head and neck pain from temporomandibular disorders make these problems a major social issue. If recognition and treatment of these disorders are inadequate or inappropriate, the patient impact can be tragic and the costs are great (42,43).

Pain and TMD:

Recent studies showed that TMD 76% impacted by pain. 57% suffered from chronic or recurrent pain, Small variation between age groups 4 of 10 chronic pain sufferers reported significant life adjustments (Research America! September 4, 2003)

22% Of Population suffered from craniofacial pain more than once in the previous 6 months, and 6% of the populations suffer from TMD and or face pain in a 6 month period (44), also Study done by UNC Pain center shows Primary Pain Complaints by Body Region:

- 43%Head, Face, and Neck region
- 23% back and lower extremities
- and 34% Other

75% of the general populations have at least one sign of TMJ dysfunction. (Joint noise, joint tenderness, etc.), and 33% have at least one symptom (face pain, joint pain, etc.), also Epidemiologic studies show that 60-65 of the U.S. population have some degree of malocclusion. (Henry A. Gremillion)

Table.1.This table below shows prevalence rate of TMD and pain for 45,711 Households Interviewed per 100,000 (source: Lipton, ship, Larch-Robinson JADA 1993)

Toothache	**12,361**
Oral Ulcer	8,392
TMD	**5,289**
Facial Pain	1,415
Burning Mouth	707

Chapter III

METHODOLOGY

Study Design, Methodology and Limitations

Description of database

The data for this project is taken from The Nationwide Inpatient Sample (NIS), which is part of the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ), formerly the Agency for Health Care Policy and Research. The Healthcare Cost and Utilization Project (HCUP) is developed through a Federal-state-industry partnership.

HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. HCUP database is collective effort of state data organizations, hospital associates, private data organizations and federal government. These databases allow researchers to study health policy issues ranging from cost and quality of health services, medical practice patterns, and access to health care programs, and outcome of treatments at the national, state or local market levels to improve health care delivery.

The NIS is largest hospital inpatient stay publicly available database. This database are used by researchers and policymakers to identify, track and analyze national trends in health care utilization, access, charges, quality, and outcomes.

This database includes 5 to 8 million hospital stays from about 1,000 hospitals sampled to approximate a 20-percent stratified sample of U.S. community hospitals defined by the AHA to be “all non-Federal, short-term, general, and other specialty hospitals, excluding hospital units of institutions.”

The NIS database is available yearly, beginning with 1988. The NIS is a stratified probability sample of hospitals in the frame, with sampling probabilities proportional to the number of U.S. community hospitals in each stratum. The sample is limited by availability of inpatient data from the states participating in HCUP and all the discharge from sampled hospitals is included in database.

The NIS includes Inpatient stay records and charge information for all patients including payer information from discharge abstracts. For Medicare, the NIS includes Medicare Advantage patients, a population that is missing from Medicare claims data. The NIS can be linked directly to hospital-level data from the American Hospital Association (AHA) Annual Survey Database (Health Forum, LLC © 2007) and to county-level data from the Health Resources and Services Administration Bureau of Health Professions' Area Resource File (ARF), except in those States that do not allow the release of hospital identifiers.

The large sample size and nationally representative sample of NIS database gives opportunity to analyze data for rare conditions, such as specific types of cancer; uncommon treatments, such as organ transplantation; and special patient populations, such as the uninsured.

To maintain the representative of the target universe sample, the stratification strategy is changed over time. The main base strata for the samples are geographic region, hospital ownership, urban/rural location, and teaching status. The strata for sample are reduced from 108 to 60 in span of years as the sampling states numbers are changed over time. The NIS sample was comprised of eight states when started while the latest NIS sample is drawn from 22 states. In these years some data elements were dropped, some were added, for some data elements, the coding was changed .NIS data is open to user after signing data user agreement.

These yearly databases contain more than 100 clinical and nonclinical data

elements for each hospital stay, including:

- Primary and secondary diagnoses and procedures
- Admission and discharge status
- Patient demographic characteristics (e.g., sex, age, race, median household income for ZIP Code)
- Hospital characteristics (e.g., ownership, size, teaching status)
- Expected payment source
- Total charges
- Discharge status
- Length of stay
- Severity and comorbidity measures.

For this analysis purpose we used data from 2003 to 2010. The NIS is nationally representative of all hospitalizations of the years that were examined: 2003 through 2010.

We asked for data related to temporomandibular disorders, TMD musculoskeletal and neurovascular disease data for the research purpose. In the HCUP inpatient databases, the first listed diagnosis (DX1) is the principal diagnosis. Diagnoses are compared to a list of ICD-9-CM codes valid for the discharge date. We combined received eight years data from 2003 to 2010.

All ICD-9-CM and CPT Code with a primary diagnosis of temporomandibular joint disorders (*International Classification of Diseases, 9th Revision,4th edition, clinical modifications, volumes 1 and 2, practice management information corporation, LA, 2005.)*

Clinical Modification (*ICD-9-CM*) codes, TMJ disorder (524.69), Muscle spasm(728.85), Other disorder-muscle, leg, fascia(728.9), Myofascitis(729.1), Dislocation(830.1), Cervical strain injury(847.0), Cervicalgia(723.1), Capsulities of TMJ(726.90), Ligament lax, and Hypermobility(728.4), Interstitial Myositis(728.81), Rupture of Muscle-non-traumatic(728.83), Tension type headache(307.81), Migraine with aura(346.00), Migraine without aura(346.10), Cluster headache(346.20), Ankylosis(524.61), Rheumatoid arthritis(714.0), Degenerative arthritis(715.98), Traumatic arthropathy(716.18), Recurrent dislocation(718.38), Internal derangement(718.98)

Data user agreement

We received data for secondary data analysis for this project from NIS in on DVD drive after signing a copy of this data use agreement and completing the online Data Use Agreement Training Course.

Outcome variables

The main outcome variables were length of stay, hospital charges, in-hospital mortality, and disposition at discharge.

Independent variables

The primary independent variable of interest was year of hospitalization (2003-2010) in examining the trends in discharge patterns. included socio-demographic characteristics (age, gender, and race or ethnicity), type of temporomandibular disorders (Muscle spasm, Myofascitis, Dislocation, Cervical strain injury, Cervicalgia, etc…), insurance status (Medicare, Medicaid, private insurance, uninsured, and other insurance plans including other government programs), disposition at discharge (routine, transfer to another hospital, transfer to other facilities including skilled nursing facility, intermediate care facility, another type of facility, home health care, discharged against advice, died, and unknown destination), and the presence of comorbid conditions. Hospital-level factors hospital location (urban and rural), and hospital region (Northeast, Midwest, South, and West).

Analytical approach - Descriptive statistics

Descriptive statistics were used to summarize the characteristics of hospitalizations attributed to temporomandibular disorders in 2003-20010 in the United States

- Length of stay
- Age in years at admission
- Hospital charge
- Disposition at discharge, mortality, comorbidity diseases and TMD

Table 1 shows the numbers of observation for each datasets received for each year. Table 2 shows the data for each year by primary diagnosis**.**

Table.2. Observations per year

Year	Numbers of observations
2003	9479
2004	9781
2005	8842
2006	8638
2007	8172
2008	7816
2009	7108
2010	7191

Table.3. Data by TMD and Related Diagnosis for each year

Table of DX1 by current year									
DX1(Principal diagnosis)	Current year								
Frequency Percent Row Pct Col Pct	2003	2004	2005	2006	2007	2008	2009	2010	Total
Tension type headache	473 0.71 13.53 4.99	482 0.72 13.79 4.93	486 0.73 13.90 5.50	471 0.70 13.47 5.45	442 0.66 12.64 5.41	397 0.59 11.36 5.08	356 0.53 10.18 5.01	389 0.58 11.13 5.41	3496 5.22
Migraine with aura	287 0.43 10.06 3.03	309 0.46 10.83 3.16	304 0.45 10.65 3.44	326 0.49 11.42 3.77	289 0.43 10.13 3.54	312 0.47 10.93 3.99	547 0.82 19.17 7.70	480 0.72 16.82 6.68	2854 4.26
Migraine without aura	351 0.52 15.38 3.70	368 0.55 16.13 3.76	313 0.47 13.72 3.54	339 0.51 14.86 3.92	329 0.49 14.42 4.03	327 0.49 14.33 4.18	133 0.20 5.83 1.87	122 0.18 5.35 1.70	2282 3.40
Cluster headache	461 0.69 13.74 4.86	427 0.64 12.73 4.37	479 0.71 14.28 5.42	475 0.71 14.16 5.50	524 0.78 15.62 6.41	404 0.60 12.04 5.17	291 0.43 8.67 4.09	294 0.44 8.76 4.09	3355 5.01

Table of DX1 by current year									
DX1(Principal diagnosis)	Current year								
Frequency Percent Row Pct Col Pct	2003	2004	2005	2006	2007	2008	2009	2010	Total
Ankylosis	69 0.10 16.39 0.73	51 0.08 12.11 0.52	80 0.12 19.00 0.90	38 0.06 9.03 0.44	30 0.04 7.13 0.37	56 0.08 13.30 0.72	51 0.08 12.11 0.72	46 0.07 10.93 0.64	421 0.63
TMJ disorder	221 0.33 14.69 2.33	231 0.34 15.36 2.36	225 0.34 14.96 2.54	234 0.35 15.56 2.71	135 0.20 8.98 1.65	175 0.26 11.64 2.24	118 0.18 7.85 1.66	165 0.25 10.97 2.29	1504 2.24
Rheumatoid arthritis	3012 4.49 13.73 31.78	3257 4.86 14.84 33.30	3079 4.59 14.03 34.82	2862 4.27 13.04 33.13	2712 4.05 12.36 33.19	2581 3.85 11.76 33.02	2239 3.34 10.20 31.50	2199 3.28 10.02 30.58	2194 1 32.73
Degenerative arthritis	142 0.21 21.65 1.50	89 0.13 13.57 0.91	112 0.17 17.07 1.27	96 0.14 14.63 1.11	60 0.09 9.15 0.73	61 0.09 9.30 0.78	41 0.06 6.25 0.58	55 0.08 8.38 0.76	656 0.98

Table of DX1 by current year									
DX1(Principal diagnosis)	Current year								
Frequency Percent Row Pct Col Pct	2003	2004	2005	2006	2007	2008	2009	2010	Total
Traumatic arthropathy	3 0.00 6.52 0.03	7 0.01 15.22 0.07	7 0.01 15.22 0.08	8 0.01 17.39 0.09	5 0.01 10.87 0.06	5 0.01 10.87 0.06	3 0.00 6.52 0.04	8 0.01 17.39 0.11	46 0.07
Recurrent dislocation	3 0.00 10.00 0.03	4 0.01 13.33 0.04	5 0.01 16.67 0.06	6 0.01 20.00 0.07	3 0.00 10.00 0.04	5 0.01 16.67 0.06	1 0.00 3.33 0.01	3 0.00 10.00 0.04	30 0.04
Internal derangement	2 0.00 10.53 0.02	1 0.00 5.26 0.01	3 0.00 15.79 0.03	2 0.00 10.53 0.02	5 0.01 26.32 0.06	2 0.00 10.53 0.03	1 0.00 5.26 0.01	3 0.00 15.79 0.04	19 0.03
Cervicalgia	1140 1.70 12.58 12.03	1184 1.77 13.07 12.11	1165 1.74 12.86 13.18	1179 1.76 13.01 13.65	1134 1.69 12.52 13.88	1124 1.68 12.40 14.38	1031 1.54 11.38 14.50	1104 1.65 12.18 15.35	9061 13.52
Capsulities of TMJ	22 0.03 17.19 0.23	20 0.03 15.63 0.20	19 0.03 14.84 0.21	14 0.02 10.94 0.16	15 0.02 11.72 0.18	13 0.02 10.16 0.17	10 0.01 7.81 0.14	15 0.02 11.72 0.21	128 0.19

Table of DX1 by current year									
DX1(Principal diagnosis)	Current year								
Frequency Percent Row Pct Col Pct	2003	2004	2005	2006	2007	2008	2009	2010	Total
Ligament lax, Hypermobility	17 0.03 15.04 0.18	13 0.02 11.50 0.13	15 0.02 13.27 0.17	20 0.03 17.70 0.23	9 0.01 7.96 0.11	15 0.02 13.27 0.19	11 0.02 9.73 0.15	13 0.02 11.50 0.18	113 0.17
Interstitial Myositis	1 0.00 9.09 0.01	3 0.00 27.27 0.03	1 0.00 9.09 0.01	4 0.01 36.36 0.05	1 0.00 9.09 0.01	1 0.00 9.09 0.01	0 0.00 0.00 0.00	0 0.00 0.00 0.00	11 0.02
Rupture of Muscle-non-traumatic	31 0.05 21.68 0.33	22 0.03 15.38 0.22	17 0.03 11.89 0.19	12 0.02 8.39 0.14	18 0.03 12.59 0.22	14 0.02 9.79 0.18	16 0.02 11.19 0.23	13 0.02 9.09 0.18	143 0.21
Muscle spasm	397 0.59 13.49 4.19	418 0.62 14.20 4.27	371 0.55 12.61 4.20	353 0.53 11.99 4.09	327 0.49 11.11 4.00	361 0.54 12.27 4.62	333 0.50 11.31 4.68	383 0.57 13.01 5.33	2943 4.39
Other disorder-muscle, leg, fascia	225 0.34 44.55 2.37	35 0.05 6.93 0.36	41 0.06 8.12 0.46	38 0.06 7.52 0.44	38 0.06 7.52 0.47	41 0.06 8.12 0.52	44 0.07 8.71 0.62	43 0.06 8.51 0.60	505 0.75

Table of DX1 by current year									
DX1(Principal diagnosis)	Current year								
Frequency Percent Row Pct Col Pct	2003	2004	2005	2006	2007	2008	2009	2010	Total
Myofascitis	1638 2.44 14.95 17.28	1528 2.28 13.95 15.62	1376 2.05 12.56 15.56	1338 2.00 12.21 15.49	1361 2.03 12.42 16.65	1265 1.89 11.55 16.18	1261 1.88 11.51 17.74	1187 1.77 10.84 16.51	10954 16.34
Dislocation	0 0.00 0.00 0.00	1 0.00 14.29 0.01	0 0.00 0.00 0.00	2 0.00 28.57 0.02	0 0.00 0.00 0.00	0 0.00 0.00 0.00	3 0.00 42.86 0.04	1 0.00 14.29 0.01	7 0.01
Cervical strain injury	984 1.47 15.00 10.38	1331 1.99 20.30 13.61	744 1.11 11.34 8.41	821 1.22 12.52 9.50	735 1.10 11.21 8.99	657 0.98 10.02 8.41	618 0.92 9.42 8.69	668 1.00 10.19 9.29	6558 9.78
Total	9479 14.14	9781 14.59	8842 13.19	8638 12.89	8172 12.19	7816 11.66	7108 10.60	7191 10.73	67027 100.00

Outcomes of the Study

As our main goal was to find demographic predictors for the TMJ disorder, we select our sample for the patients whose primary diagnosis was TMJ disorder. Our final analytic sample size for this research purpose is 1504 of temporomandibular disorder, and 67027 total of TMD including the disease associated with TMD. This sample size would be enough to study demographic variables that are related to TMJ disorders. As this database also includes the information for up-to 25 disease codes, we will be able to study other prevalent disease with TMJ disorders. This database also allows us to study present any comorbidity measures related to TMJ disorder.

We are planning to use SAS9.3 to do all our analysis. The large, nationally representative data will help us to get insight depth to understand factors that play major role for TMJ disorder and ultimately will facilitate the treatment part of disease. This data also includes the information regarding numbers of days of admission and total charges we will be able to study the financial burden related to disease.

Chapter IV

RESULT

Description of all years from 2003 to 2010

Characteristics of hospitalizations for Temporomandibular disorders of all years combined are summarized in table. The total number of hospitalizations was 67,027 over the eight year period. The majority of all hospitalizations were female (68.9%), and the overall mean age was 41.05 years (standard deviation of the mean 18.48). Data on race or ethnicity were missing in 23.0% of all hospitalizations since some states did not provide information on race. Among those for which race information was available, whites accounted for the most of the hospitalizations (51.6%), followed by blacks (12.1%), Hispanic (9.0%), other (2.4%), Asian/Pacific Islanders (1.4%), and Native Americans (0.5%). Primary diagnoses or the temporomandibular disorders type at hospitalization, in the order of most frequently occurring location, involved Rheumatoid arthritis (32.73%), Myofascitis (16.34%), Cervicalgia (13.52%), cervical strain injury (9.78%), Tension type Headache (5.22%), Cluster headache (5.1%), Muscle spasm (4.39%), Migraine with aura (4.26), Migraine without aura (3.40), and the primary temporomandibular joint disorder (2.24). The two largest payers were Medicare (37.8%) and private insurance (39.2%), and the remaining hospitalizations were covered by Medicaid (11.7%) and other insurance plans (4.1%). About 6.4% of hospitalizations were uninsured or self-pay. The majority of hospitalizations were routinely discharged (74.4%), while others were followed by transferred to other facilities (13.3%), home health care (10.1%), transferred to another short-term hospital (0.9%), and discharged against advice (0.9%). In-hospital mortality occurred in 101 hospitalizations (0.2% of all hospitalizations) over the eight-year period. The majority of the hospitalizations occurred in large metropolitan hospitals (26.7%),

small metropolitan hospitals, (12.6%), micropolitan hospitals (4.9%), and mostly lesser in an urban location (3.9%). Many of the hospitals were in the South region 43.11% (SE 32.28% and SW 10.83%), followed by the Northeast (23.97%), West (17.47%), and Midwest (15.43) regions.

Table.4. Characteristics of hospitalizations for temporomandibular disorders– all years from 2003 to 2010 (N = 67027)

Characteristic	***n***	**%**
Mean age	**41.05 years (std Dev 18.48)**	
Mean length of stay	**48.67 (std Dev 34.85)**	
Mean Total charges	**25723 (std Dev 27714.9)**	
Gender		
Female	40,210	68.9
Male	17,870	30.6
Missing	309	0.5
Total	58,080	
Race		
White	30,115	51.6
Black	7,074	12.1
Hispanic	5,272	9.0
Asian/Pacific Islander	797	1.4
Native American	270	0.5
Other races	1,427	2.4
Missing	13,434	23.0
Total	44,955	
Type of TMJ Disorders		
Tension type headache	3,496	5.22
Migraine w/ aura	2,854	4.26

Migraine w/o aura	2,282	3.40
Cluster headache	3,355	5.01
Ankyloses	421	0.63
TMJ disorders	1,504	2.24
Rheumatoid arthritis	2,1941	32.73
Degenerative arthritis	656	0.98
Traumatic arthropathy	46	0.07
Recurrent Dislocation	30	0.04
Internal derangement	19	0.03
Cervicalgia	9,061	13.52
Capsulitis of TMJ	128	0.19
Ligament lax, Hypermobility	113	0.17
Myositis	11	0.02
Rupture muscle-non traumatic	143	0.21
Muscle spasm	2943	4.39
Other disorder(muscle,leg,fasci)	505	0.75
Myofascitis	10,954	16.34
Dislocation	7	0.01
Cervical strain injury	6,558	9.78
Total	67,027	
Insurance		
Medicare	22,080	37.8
Medicaid	6,843	11.7
Private insurance	22,877	39.2
Other insurance	2,389	4.1
Uninsured or self-pay	3,747	6.4
No charges	326	0.6
Missing	127	0.2
Total	58,262	

Disposition at discharge		
Routine	43,434	74.4
Transfer to short-term hospital	516	0.9
Transfer to other facility	7,792	13.3
Home health care	5,888	10.1
Discharged against advice	532	0.9
Died	101	0.2
Unknown destination	14	0.0
Missing	111	0.2
Total	58,278	
Hospital location: Urban-rural 4 categories		
Large metropolitan	15,561	26.7
Small metropolitan	7,334	12.6
Micropolitan	2,851	4.9
None metropolitan or micro	2,255	3.9
Missing	30,388	52.0
Total	28,001	
Hospital region of primary diagnosis		
South	577	43.11
Northeast	321	23.97
West	234	17.47
Midwest	207	15.43
Total	1339	
Year		

2003	9,479	
2004	9,781	
2005	8,842	
2006	8,638	
2007	8,172	
2008	7,816	
2009	7,108	
2010	7,191	
Total	67,027	

Eight-year trends

The trends of hospitalization-level factors are shown in Figures below. The number of hospitalizations decreased in general and ranged from 9,479 in 2003 to 7,191 in 2010. The female to male ratio 2:1steadily from 2003 to 2010. Whites accounted for the majority of the hospitalizations 51.6% overall the years.

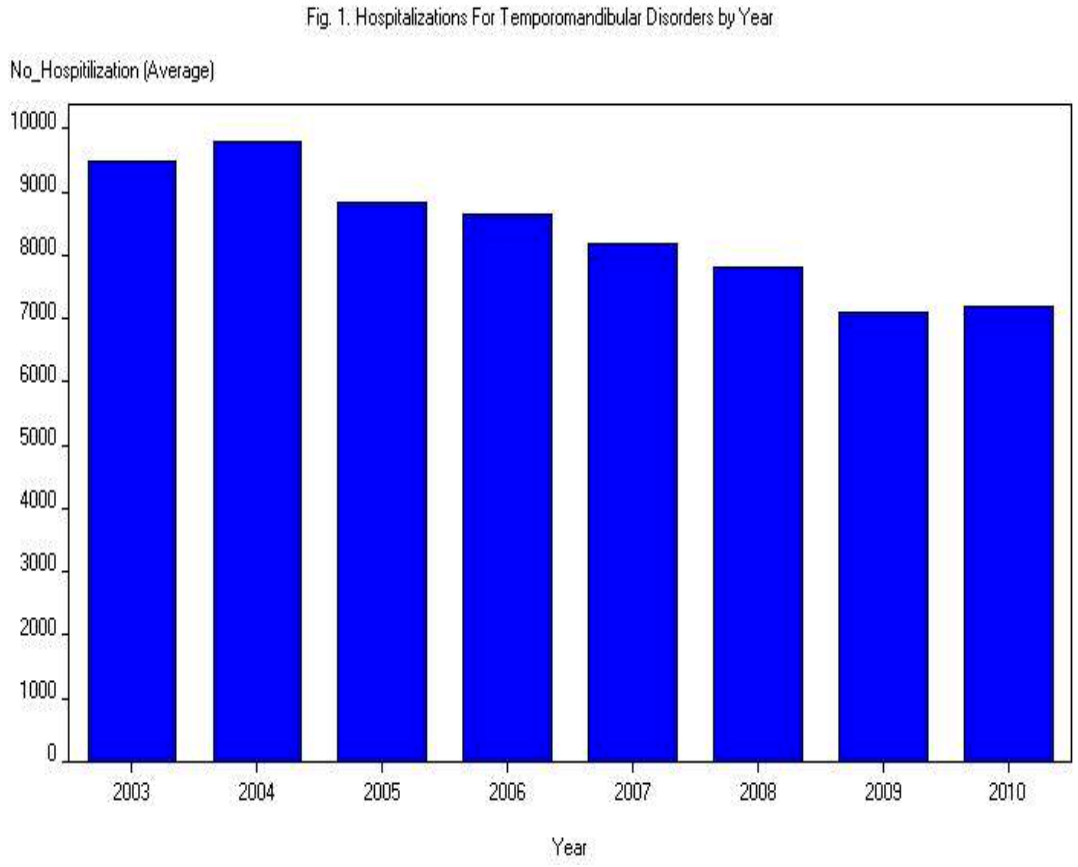

Figure.5. Hospitalizations for Temporomandibular Disorders by year.

Eight-year trends

The trends of hospitalization-level factors are shown on Figures. The number of hospitalizations decreased in general and ranged from 9,479 in 2003 to 7,191 in 2010. The female to male ratio 2:1steadily from 2003 to 2010. Whites accounted for the majority of the hospitalizations 51.6% overall the years.

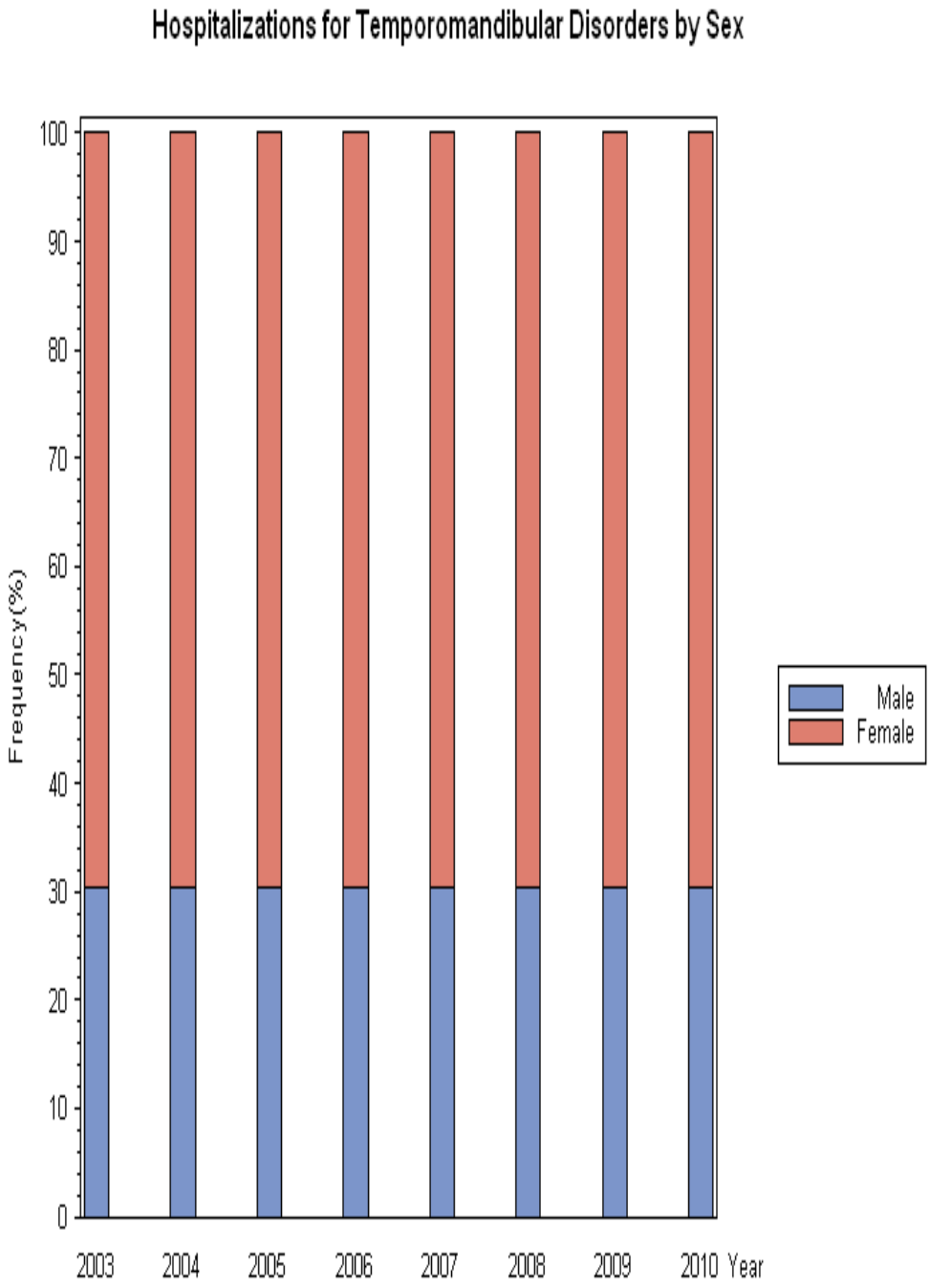

Figure.6. Hospitalizations for Temporomandibular disorders by sex.

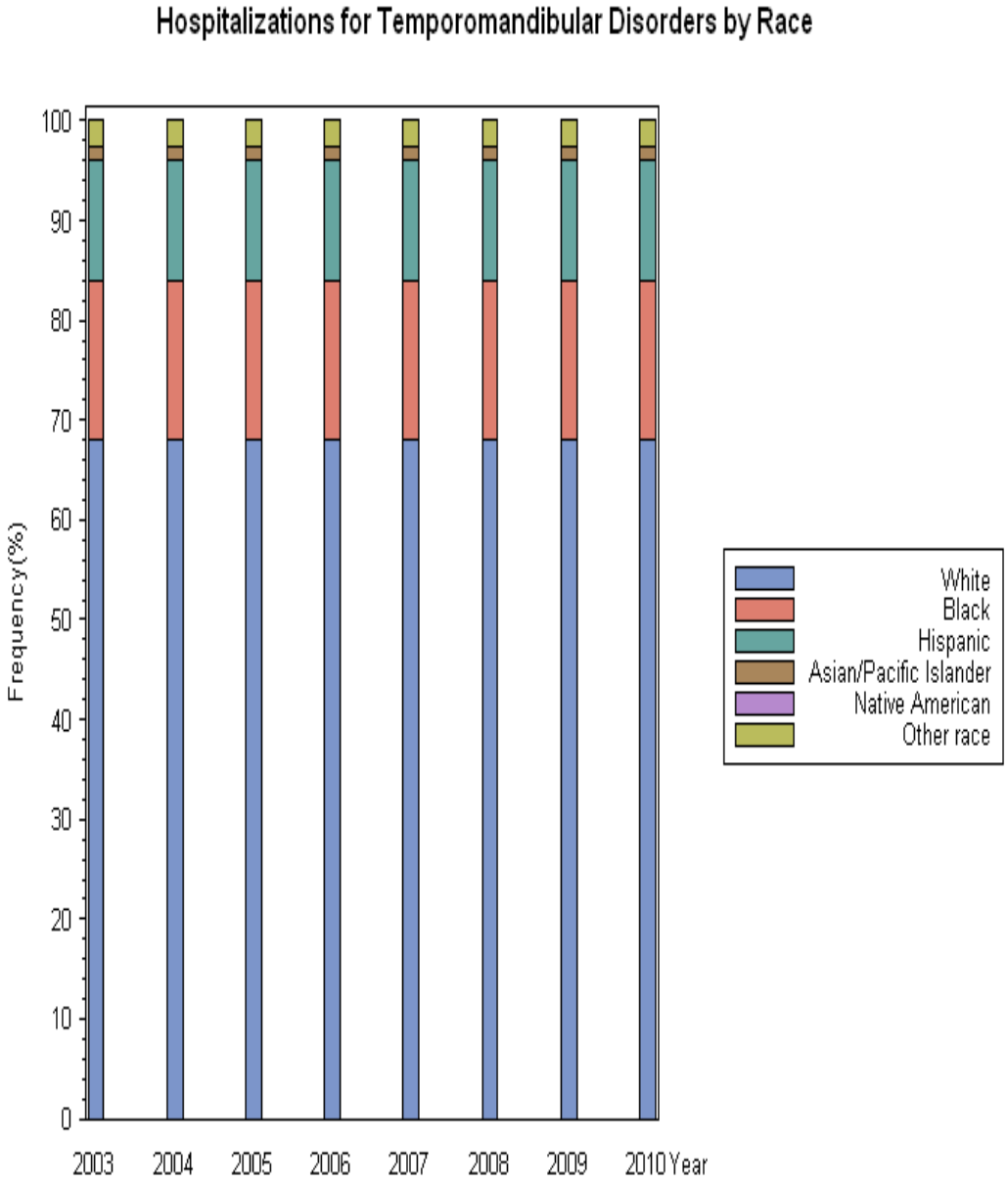

Figure.7. Hospitalizations for Temporomandibular disorders by race.

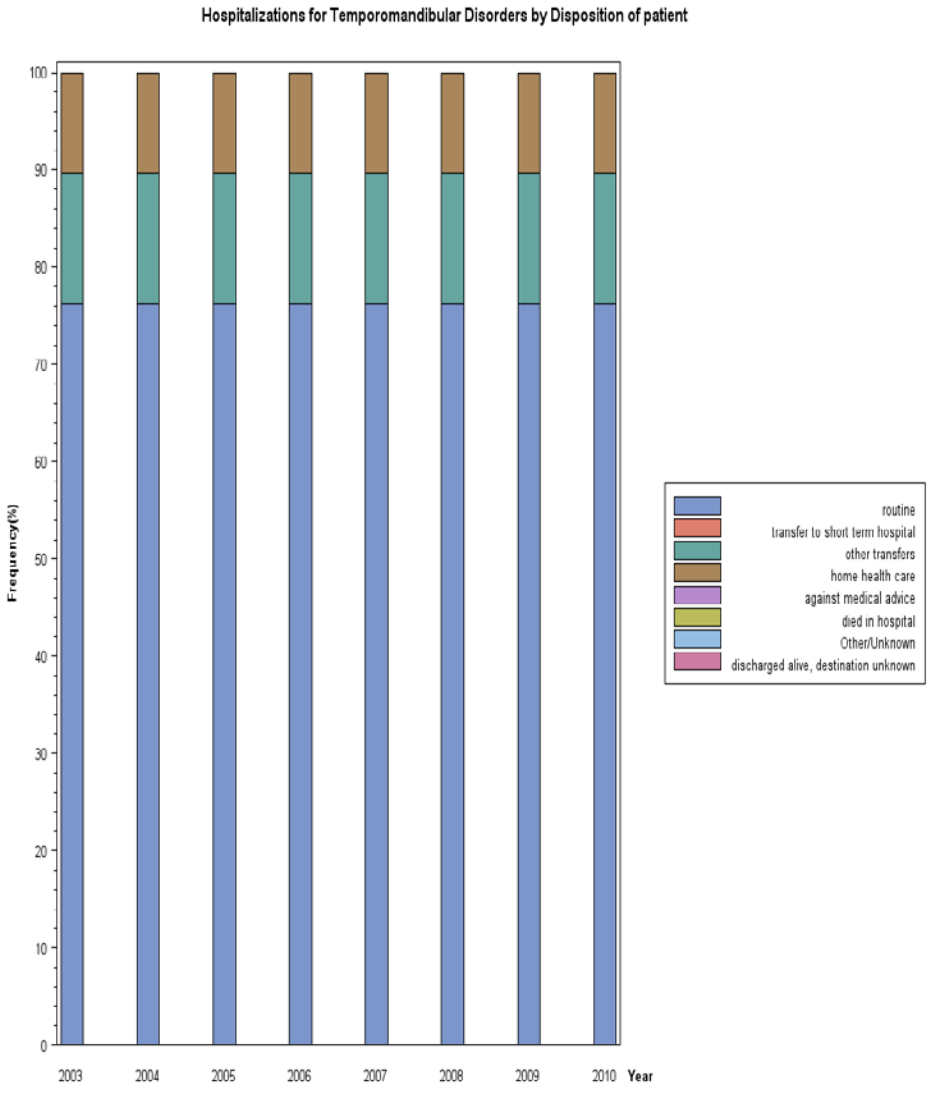

Figure.8. Hospitalizations for Temporomandibular disorders by disposition at discharge.

More than 75% of patients are discharged to routine, about 10% to home health care and the rest are other transfers. This very high majority 75% may be lost to follow up if they are discharged to routine so their patient charts/records need to be flagged to alert them with future notifications for follow up and to remind their healthcare providers to check on them too.

Home health care and other transfer patients need counselling and patient education material for future reference in order to reduce recurrence and provide them with a better quality of life.

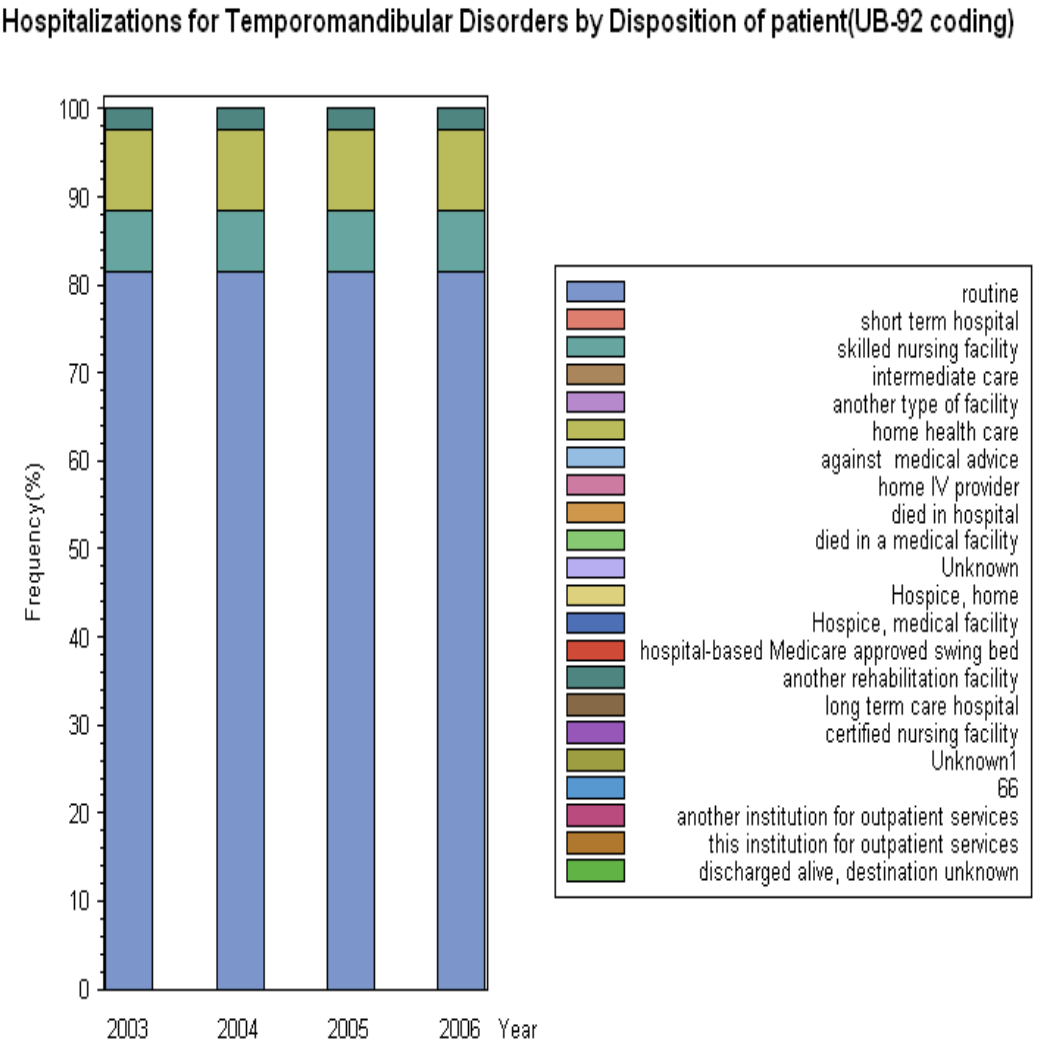

Figure.9. Hospitalizations for Temporomandibular disorders by disposition at discharge.

The majority of patients are discharged to routine, about 10% to home health care, a small proportion to skilled nursing facilities and the rest are other rehabilitation facilities or other transfers. This very high majority discharged to routine may be lost to follow up so their patient charts/records need to be flagged to alert them with future notifications for follow up and to remind their healthcare providers to check on them too.

Skilled nursing facilities and home health care providers all need TMD educational material too because TMD is a complex disorder with many variables and it needs diligent attention by healthcare providers as well as patients in order to avoid future episodes, reduce chronic pain and improve patients quality of life.

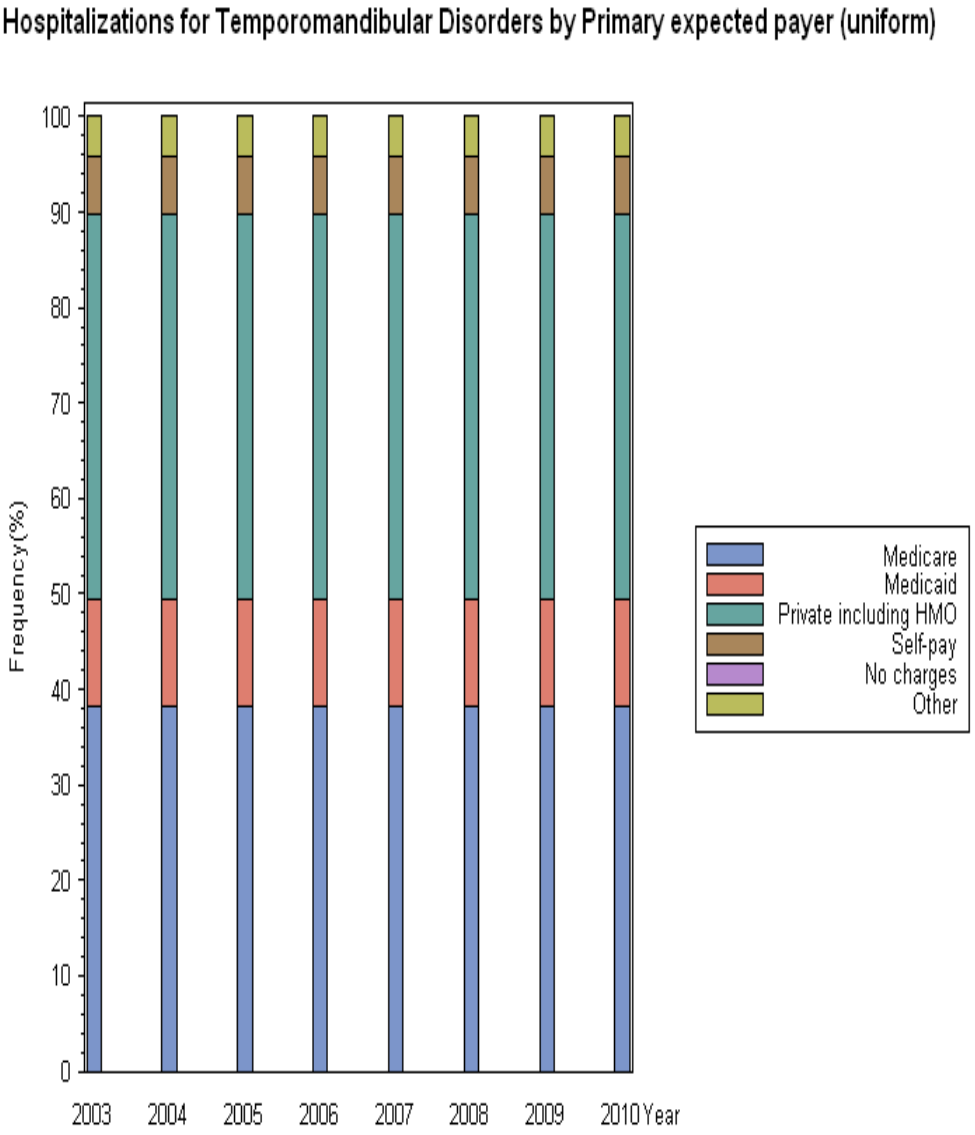

Figure.10. Hospitalizations for Temporomandibular disorders by primary expected payer.

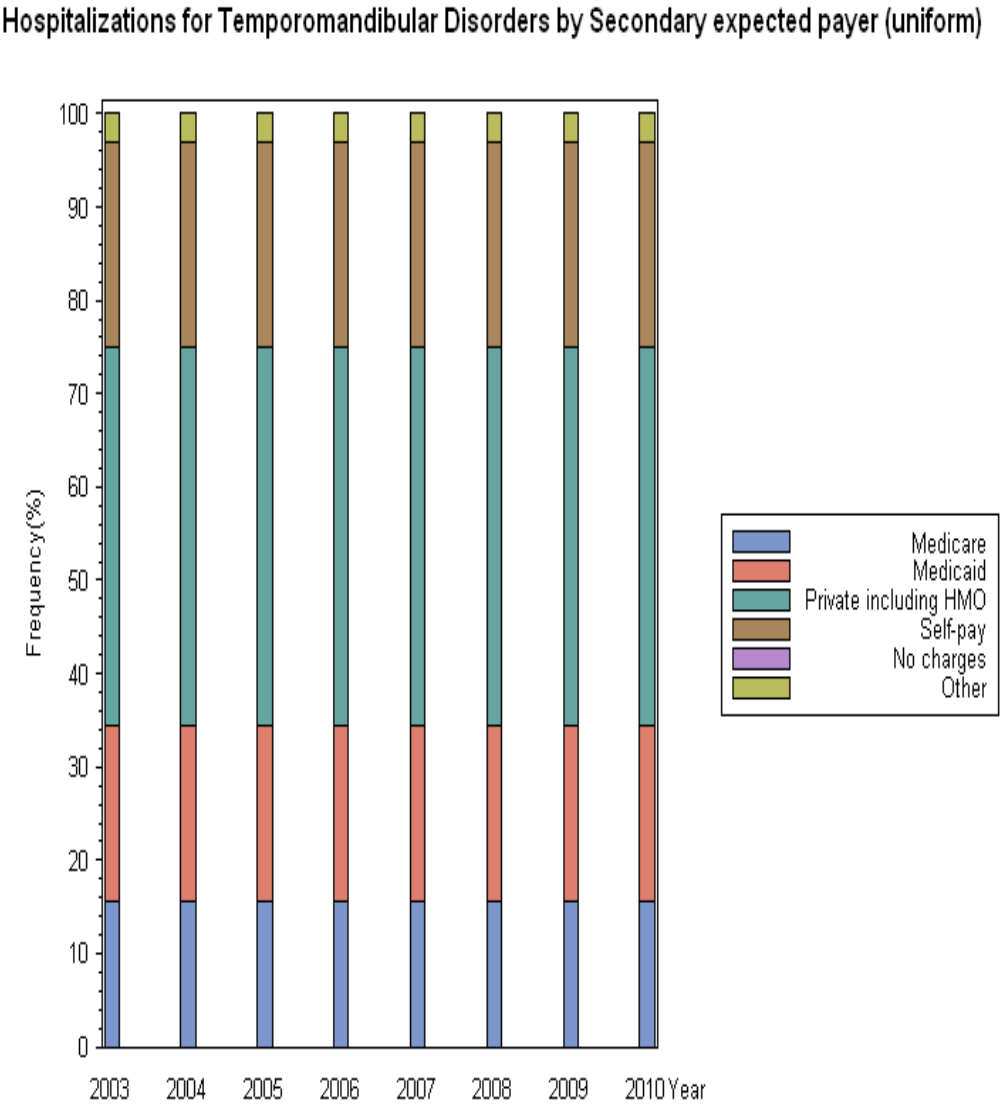

Figure.11. Hospitalizations for Temporomandibular disorders by secondary expected payer.

Privately insured patients form the majority of TMD inpatients even as secondary expected payers, more than self-paying inpatients. This indicates that these patients are unaware of their condition early on and are left to wander until an acute event leads them into ER. This also shows the misdiagnosis and or confused diagnosis masked by related disorders and the lack of TMD Specialists at ER and Inpatient settings. It further confirms the need to have TMD guidelines available at ER and inpatient settings and with multidisciplinary Specialists who handle pain management and other TMD related disorders.

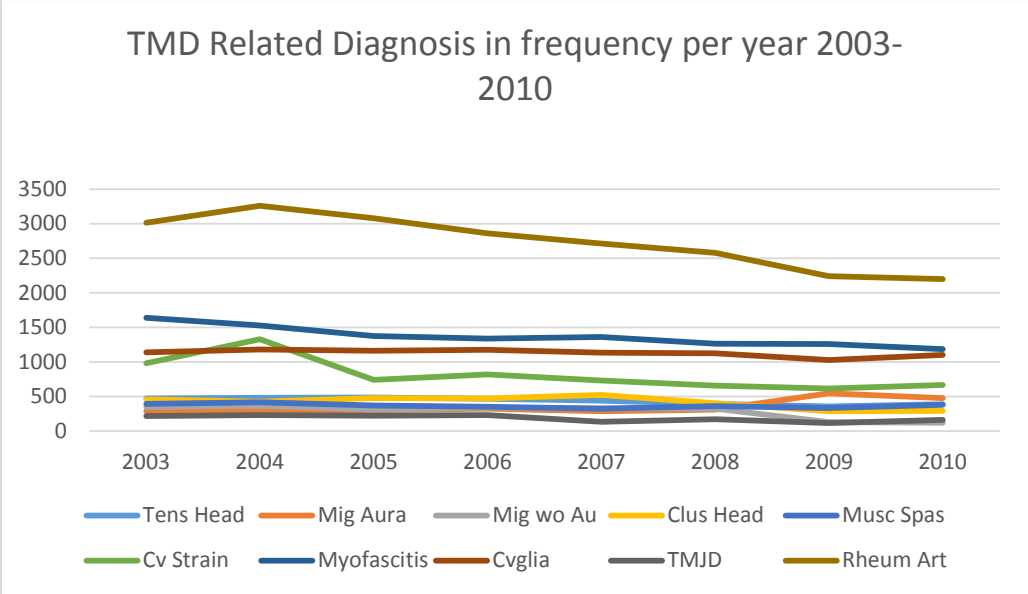

Figure.12. Hospitalizations for Temporomandibular disorders by TMD related diagnosis.

Diagnosis	Tens Hea	Mig Aura	Mig w o A	Clus Head	Musc Spas	Cv Strain	Myofascit	Cvgia	TMJD	Rheum Ar
2003	473	287	351	461	397	984	1438	1140	771	3017
2004	482	309	368	427	418	1331	1528	1184	231	3257
2005	486	304	313	479	371	744	1376	1165	225	3079
2006	471	328	339	475	353	821	1338	1179	234	2852
2007	442	289	329	524	327	735	1361	1134	135	2712
2008	397	312	327	404	361	657	1265	1124	175	2581
2009	356	547	133	291	333	618	1261	1031	118	2289
2010	389	420	122	294	383	668	1187	1104	165	2193

Table.5. Hospitalizations for Temporomandibular disorders by TMD related diagnosis.

As seen on the chart above pain is one of the main disorders related to temporomandibular disorder; Tension Type Headache, Migraine with and without aura, and Cluster Headaches are prominently associated with TMD. Since causes of headaches are more difficult to distinguish their frequency of occurrence remains on somewhat the same level slightly increasing or decreasing over the years. A more specifically related type of pain such as Cervical Strain Injury, Cervicalgia, and Myofascitis occurs in higher frequency in relation to TMD as is expected. Cervical Strain Injury was highest in 2004 but tapered down lower than Cervicalgia and Myofascitis, perhaps with better control of all three conditions.

However, the highest frequency of occurrence is of Rheumatoid Arthritis, which is only expected of late phase RA from clinical experience. Since AR patients are more aware of their condition and its related disorders they are more likely to seek medical care for TMD.

TMD is the lowest frequency on the chart above which could be attributed to its misdiagnosis or that it is so masked by other disorders it is difficult to spot or treat. This could also be considered the result of the lack of TMD Specialists at inpatient settings.

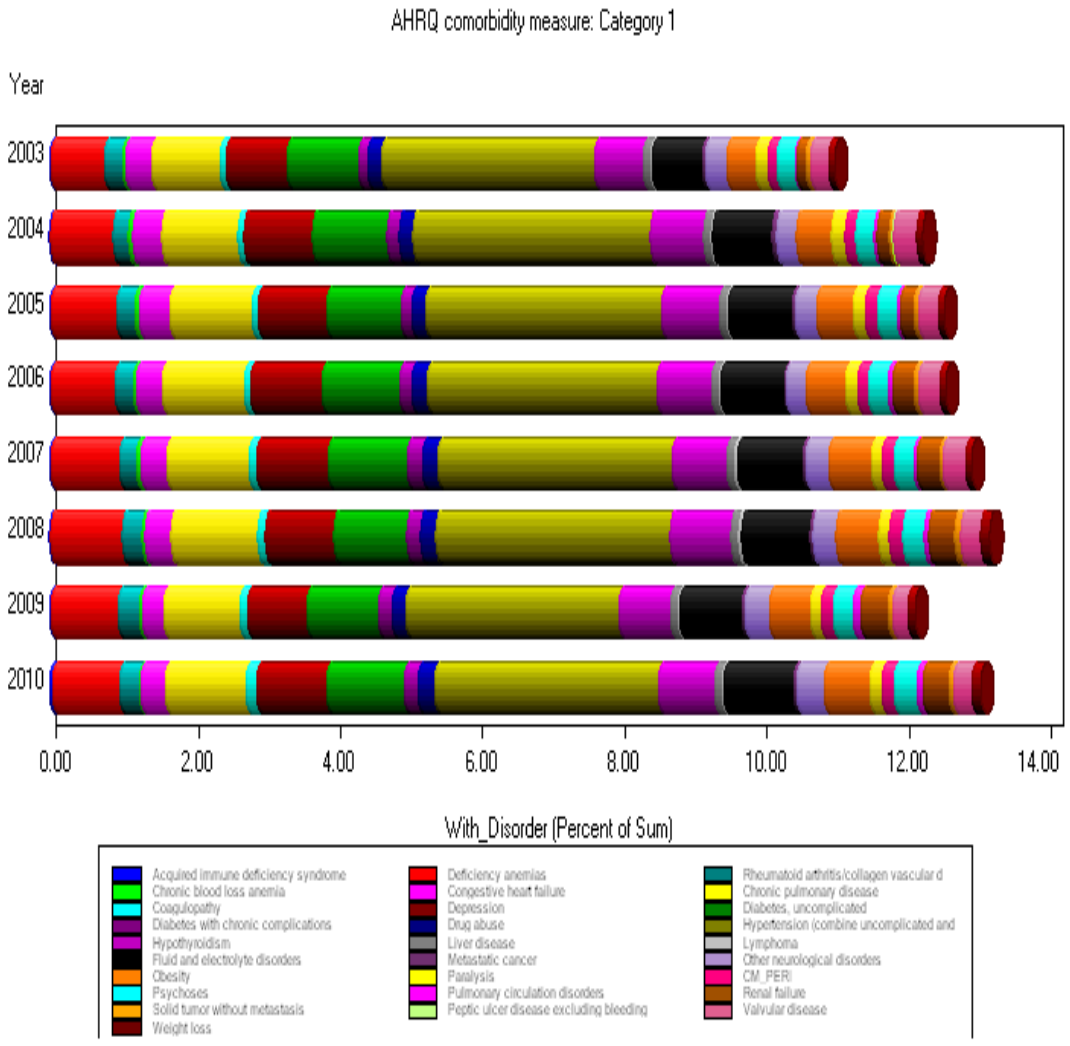

Figure.13. Comorbidity Measure with Temporomandibular Disorders- all Years hospitalizations from 2003 to 2010

This chart shows comorbidities with TMD versus the next chart which shows comorbidities without TMD. Hypertension represented by the olive green part of the pipe is the major comorbidity consistently from 2003-2010. The yellow section demonstrates Chronic Pulmonary Disease, the maroon pipe section is Depression and the leaf green is uncomplicated Diabetes and the bright red on the left is deficiency Anemias.

This clearly indicates that hypertension plays a major role in TMD, in contrast to previous literature which states no correlation between hypertension and TMD. Hypertension and stress are directly related and stress is one of the main factors associated with TMD patients.

Chronic Pulmonary Disease patients tend to use their mouth to breathe in compensation for their difficulty in breathing through their regular airways. This compensation could in long terms affect their TMJ.

Depression is also associated with stress which could contribute to TMD. Weight loss, Uncomplicated Diabetes and deficiency Anemias seem to also play a role in TMD. Further investigation is warranted to understand how all these conditions are related and what could be done to alleviate further suffering leading to TMD.

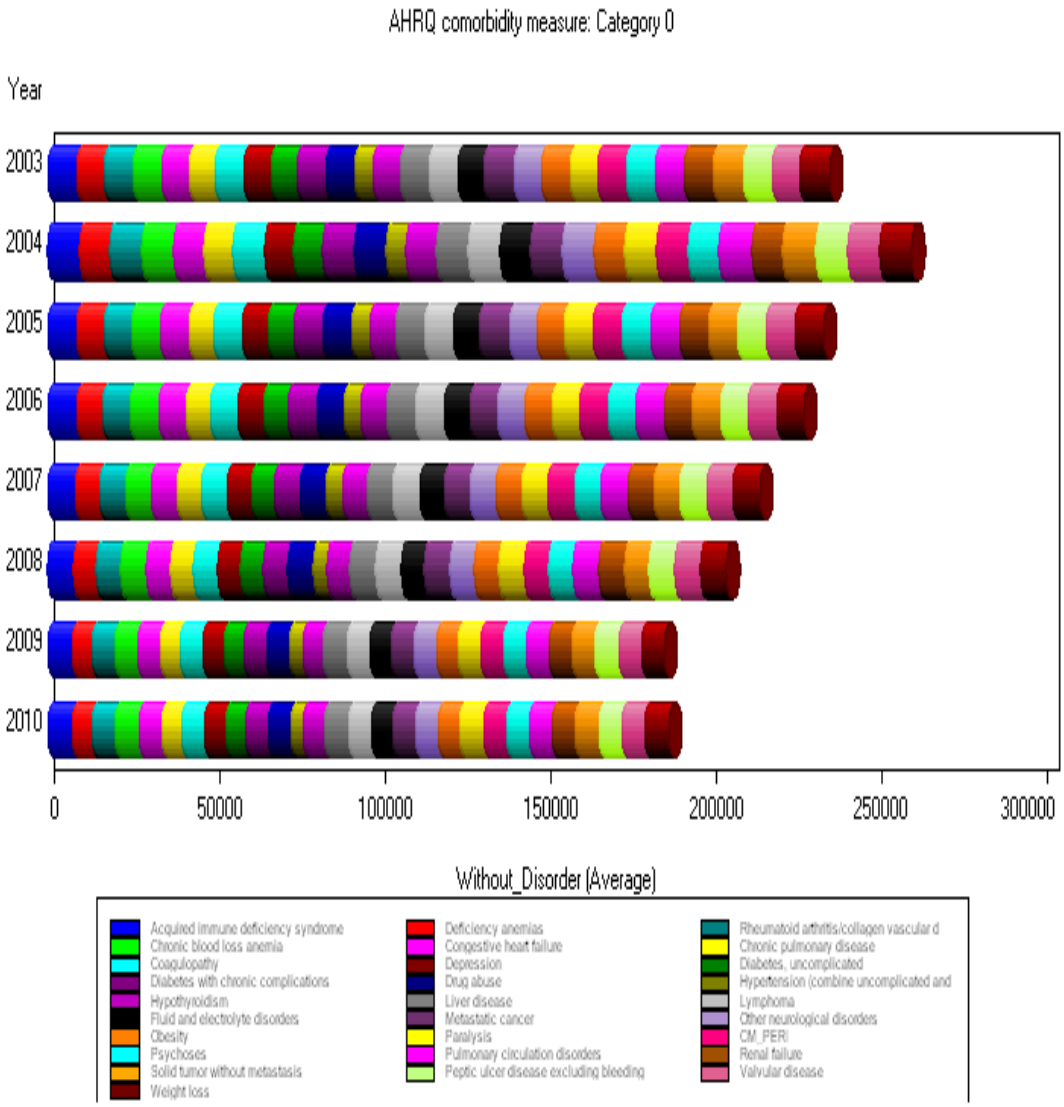

Figure.14. Comorbidity Measure without Temporomandibular Disorders – all Years hospitalizations from 2003 to 2010

Table. 6,7. Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without_Disorder (Zero)	With_Disorder (One)
2003	Acquired immune deficiency syndrome	8830	18
2004	Acquired immune deficiency syndrome	9755	26
2005	Acquired immune deficiency syndrome	8820	22
2006	Acquired immune deficiency syndrome	8620	18
2007	Acquired immune deficiency syndrome	8151	21
2008	Acquired immune deficiency syndrome	7790	26
2009	Acquired immune deficiency syndrome	7088	20
2010	Acquired immune deficiency syndrome	7160	31

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Deficiency anemias	8057	791
2004	Deficiency anemias	8869	912
2005	Deficiency anemias	7880	962
2006	Deficiency anemias	7682	956
2007	Deficiency anemias	7152	1020
2008	Deficiency anemias	6752	1064
2009	Deficiency anemias	6112	996
2010	Deficiency anemias	6186	1005

Table.8,9. Continued comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Rheumatoid arthritis/collagen vascular diseases	8573	275
2004	Rheumatoid arthritis/collagen vascular diseases	9534	247
2005	Rheumatoid arthritis/collagen vascular diseases	8552	290
2006	Rheumatoid arthritis/collagen vascular diseases	8379	259
2007	Rheumatoid arthritis/collagen vascular diseases	7925	247
2008	Rheumatoid arthritis/collagen vascular diseases	7531	285
2009	Rheumatoid arthritis/collagen vascular diseases	6800	308
2010	Rheumatoid arthritis/collagen vascular diseases	6904	287

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Chronic blood loss anemia	8803	45
2004	Chronic blood loss anemia	9724	57
2005	Chronic blood loss anemia	8788	54
2006	Chronic blood loss anemia	8581	57
2007	Chronic blood loss anemia	8093	79
2008	Chronic blood loss anemia	7769	47
2009	Chronic blood loss anemia	7064	44
2010	Chronic blood loss anemia	7152	39

Table.10,11 . Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Congestive heart failure	8459	389
2004	Congestive heart failure	9354	427
2005	Congestive heart failure	8389	453
2006	Congestive heart failure	8255	383
2007	Congestive heart failure	7793	379
2008	Congestive heart failure	7426	390
2009	Congestive heart failure	6783	325
2010	Congestive heart failure	6841	350

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Chronic pulmonary disease	7828	1020
2004	Chronic pulmonary disease	8634	1147
2005	Chronic pulmonary disease	7619	1223
2006	Chronic pulmonary disease	7406	1232
2007	Chronic pulmonary disease	6944	1228
2008	Chronic pulmonary disease	6532	1284
2009	Chronic pulmonary disease	5975	1133
2010	Chronic pulmonary disease	5978	1213

Table.12,13. Continued comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Coagulopathy	8761	87
2004	Coagulopathy	9694	87
2005	Coagulopathy	8746	96
2006	Coagulopathy	8548	90
2007	Coagulopathy	8073	99
2008	Coagulopathy	7696	120
2009	Coagulopathy	6986	122
2010	Coagulopathy	7047	144

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Depression	7935	913
2004	Depression	8765	1016
2005	Depression	7822	1020
2006	Depression	7567	1071
2007	Depression	7106	1066
2008	Depression	6792	1024
2009	Depression	6225	883
2010	Depression	6138	1053

Table.14,15. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Diabetes, uncomplicated	7785	1063
2004	Diabetes, uncomplicated	8662	1119
2005	Diabetes, uncomplicated	7730	1112
2006	Diabetes, uncomplicated	7491	1147
2007	Diabetes, uncomplicated	6989	1183
2008	Diabetes, uncomplicated	6738	1078
2009	Diabetes, uncomplicated	6046	1062
2010	Diabetes, uncomplicated	6028	1163
2003	Diabetes with chronic complications	8702	146
2004	Diabetes with chronic complications	9605	176
2005	Diabetes with chronic complications	8670	172
2006	Diabetes with chronic complications	8464	174
2007	Diabetes with chronic complications	7948	224
2008	Diabetes with chronic complications	7610	206
2009	Diabetes with chronic complications	6907	201
2010	Diabetes with chronic complications	6988	203

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Drug abuse	8656	192
2004	Drug abuse	9587	194
2005	Drug abuse	8638	204
2006	Drug abuse	8401	237
2007	Drug abuse	7927	245
2008	Drug abuse	7581	235
2009	Drug abuse	6896	212
2010	Drug abuse	6938	253

Table.16,17. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Hypertension (combine uncomplicated and complicated)	5672	3176
2004	Hypertension (combine uncomplicated and complicated)	6234	3547
2005	Hypertension (combine uncomplicated and complicated)	5333	3509
2006	Hypertension (combine uncomplicated and complicated)	5224	3414
2007	Hypertension (combine uncomplicated and complicated)	4697	3475
2008	Hypertension (combine uncomplicated and complicated)	4318	3498
2009	Hypertension (combine uncomplicated and complicated)	3935	3173
2010	Hypertension (combine uncomplicated and complicated)	3869	3322

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Hypothyroidism	8116	732
2004	Hypothyroidism	8976	805
2005	Hypothyroidism	7976	866
2006	Hypothyroidism	7804	834
2007	Hypothyroidism	7344	828
2008	Hypothyroidism	6909	907
2009	Hypothyroidism	6332	776
2010	Hypothyroidism	6353	838

Table.18,19. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Liver disease	8739	109
2004	Liver disease	9670	111
2005	Liver disease	8733	109
2006	Liver disease	8528	110
2007	Liver disease	8054	118
2008	Liver disease	7707	109
2009	Liver disease	6997	111
2010	Liver disease	7073	118

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Lymphoma	8818	30
2004	Lymphoma	9757	24
2005	Lymphoma	8812	30
2006	Lymphoma	8611	27
2007	Lymphoma	8144	28
2008	Lymphoma	7778	38
2009	Lymphoma	7089	19
2010	Lymphoma	7158	33

Table.20,21. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Fluid and electrolyte disorders	8096	752
2004	Fluid and electrolyte disorders	8895	886
2005	Fluid and electrolyte disorders	7897	945
2006	Fluid and electrolyte disorders	7701	937
2007	Fluid and electrolyte disorders	7189	983
2008	Fluid and electrolyte disorders	6799	1017
2009	Fluid and electrolyte disorders	6179	929
2010	Fluid and electrolyte disorders	6154	1037

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Metastatic cancer	8808	40
2004	Metastatic cancer	9729	52
2005	Metastatic cancer	8809	33
2006	Metastatic cancer	8603	35
2007	Metastatic cancer	8124	48
2008	Metastatic cancer	7769	47
2009	Metastatic cancer	7068	40
2010	Metastatic cancer	7139	52

Table.22,23. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Other neurological disorders	8540	308
2004	Other neurological disorders	9478	303
2005	Other neurological disorders	8520	322
2006	Other neurological disorders	8341	297
2007	Other neurological disorders	7826	346
2008	Other neurological disorders	7469	347
2009	Other neurological disorders	6738	370
2010	Other neurological disorders	6793	398

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Obesity	8414	434
2004	Obesity	9258	523
2005	Obesity	8300	542
2006	Obesity	8060	578
2007	Obesity	7547	625
2008	Obesity	7186	630
2009	Obesity	6497	611
2010	Obesity	6504	687

Table.24,25. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Paralysis	8656	192
2004	Paralysis	9575	206
2005	Paralysis	8645	197
2006	Paralysis	8457	181
2007	Paralysis	8013	159
2008	Paralysis	7654	162
2009	Paralysis	6956	152
2010	Paralysis	7017	174

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Psychoses	8593	255
2004	Psychoses	9518	263
2005	Psychoses	8557	285
2006	Psychoses	8332	306
2007	Psychoses	7885	287
2008	Psychoses	7488	328
2009	Psychoses	6808	300
2010	Psychoses	6850	341

Table.26,27. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Pulmonary circulation disorders	8809	39
2004	Pulmonary circulation disorders	9736	45
2005	Pulmonary circulation disorders	8798	44
2006	Pulmonary circulation disorders	8577	61
2007	Pulmonary circulation disorders	8116	56
2008	Pulmonary circulation disorders	7741	75
2009	Pulmonary circulation disorders	7005	103

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Renal failure	8716	132
2004	Renal failure	9600	181
2005	Renal failure	8634	208
2006	Renal failure	8316	322
2007	Renal failure	7851	321
2008	Renal failure	7441	375
2009	Renal failure	6690	418
2010	Renal failure	6804	387

Table. 28,29. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Solid tumor without metastasis	8786	62
2004	Solid tumor without metastasis	9725	56
2005	Solid tumor without metastasis	8772	70
2006	Solid tumor without metastasis	8575	63
2007	Solid tumor without metastasis	8107	65
2008	Solid tumor without metastasis	7731	85
2009	Solid tumor without metastasis	7054	54
2010	Solid tumor without metastasis	7117	74

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Peptic ulcer disease excluding bleeding	8839	9
2004	Peptic ulcer disease excluding bleeding	9774	7
2005	Peptic ulcer disease excluding bleeding	8837	5
2006	Peptic ulcer disease excluding bleeding	8635	3
2007	Peptic ulcer disease excluding bleeding	8171	1
2008	Peptic ulcer disease excluding bleeding	7810	6
2009	Peptic ulcer disease excluding bleeding	7106	2
2010	Peptic ulcer disease excluding bleeding	7189	2

Table.30,31. Continued Comorbidity measure with and without temporomandibular disorders – all Years from 2003 to 2010

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Valvular disease	8587	261
2004	Valvular disease	9428	353
2005	Valvular disease	8567	275
2006	Valvular disease	8332	306
2007	Valvular disease	7850	322
2008	Valvular disease	7517	299
2009	Valvular disease	6871	237
2010	Valvular disease	6934	257

Year	AHRQ comorbidity measure	Without Disorder (Zero)	With Disorder (One)
2003	Weight loss	8762	86
2004	Weight loss	9689	92
2005	Weight loss	8745	97
2006	Weight loss	8543	95
2007	Weight loss	8069	103
2008	Weight loss	7685	131
2009	Weight loss	7006	102
2010	Weight loss	7047	144

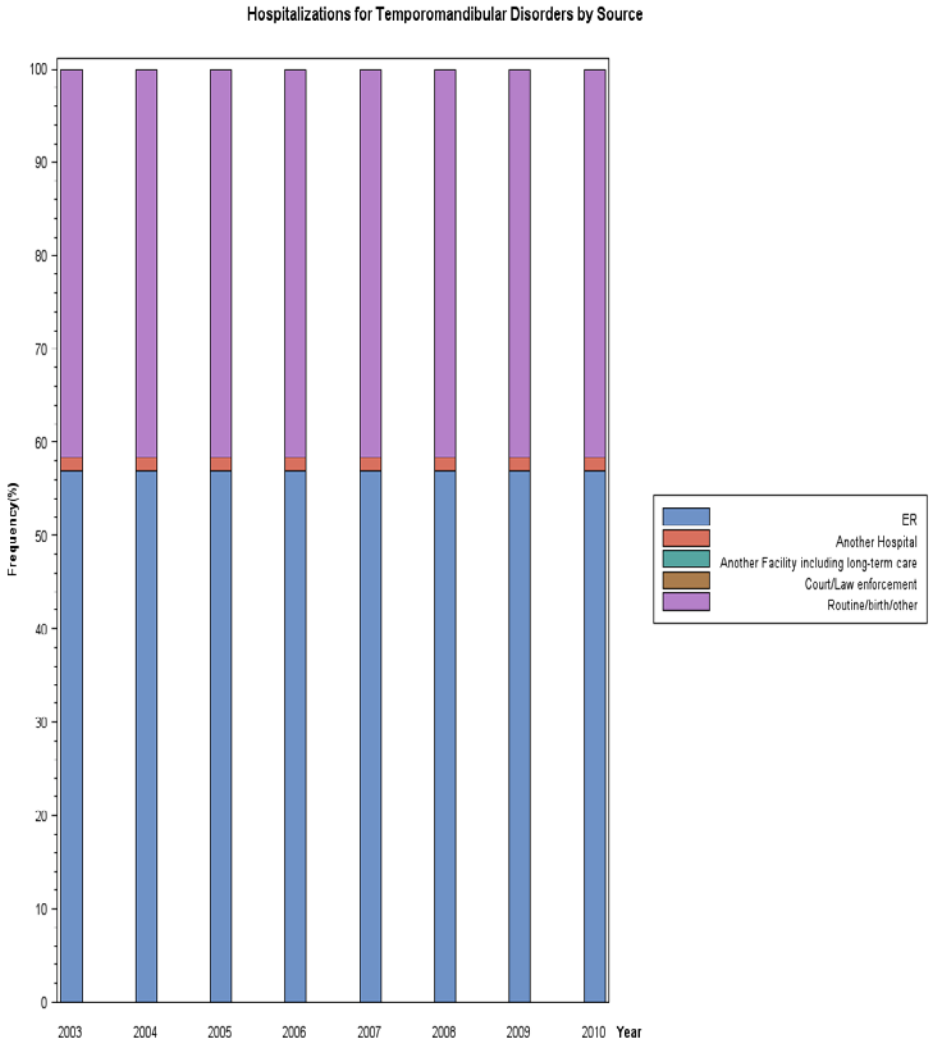

Figure.15. Hospitalizations for Temporomandibular disorders by source

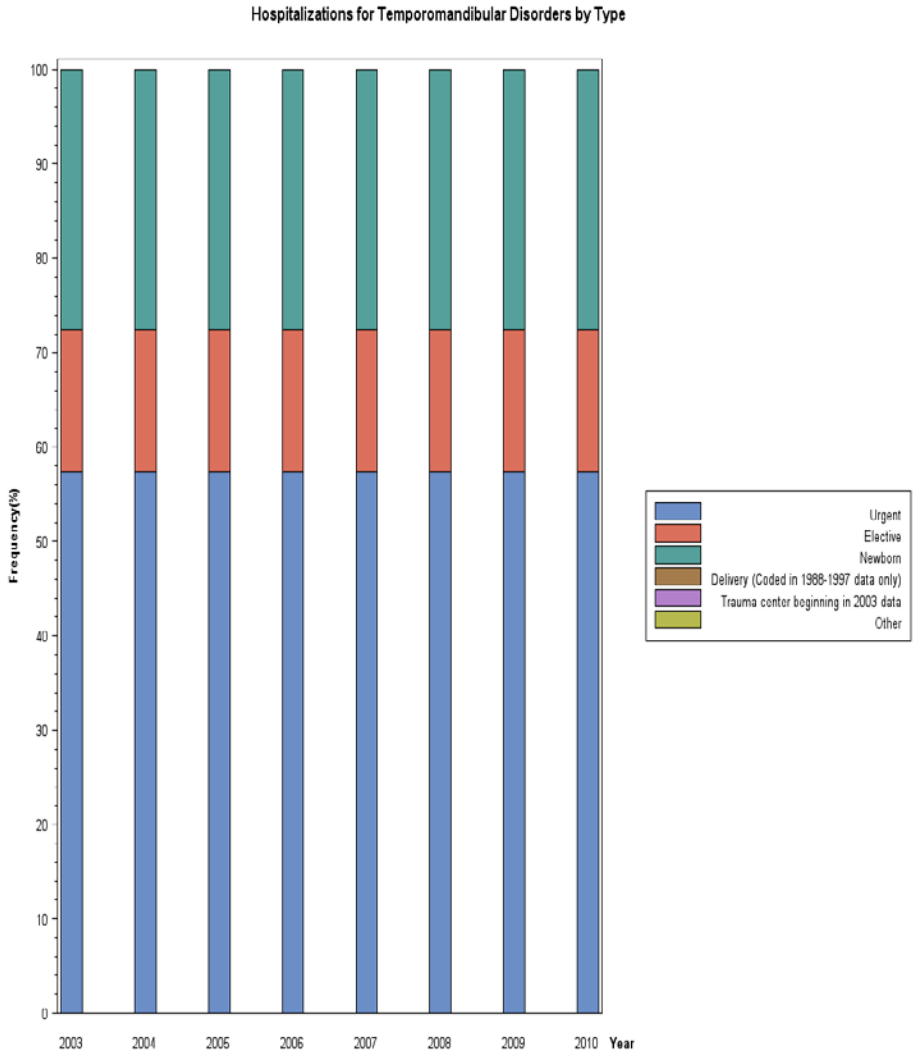

Figure.16. Hospitalizations for Temporomandibular disorders by Type

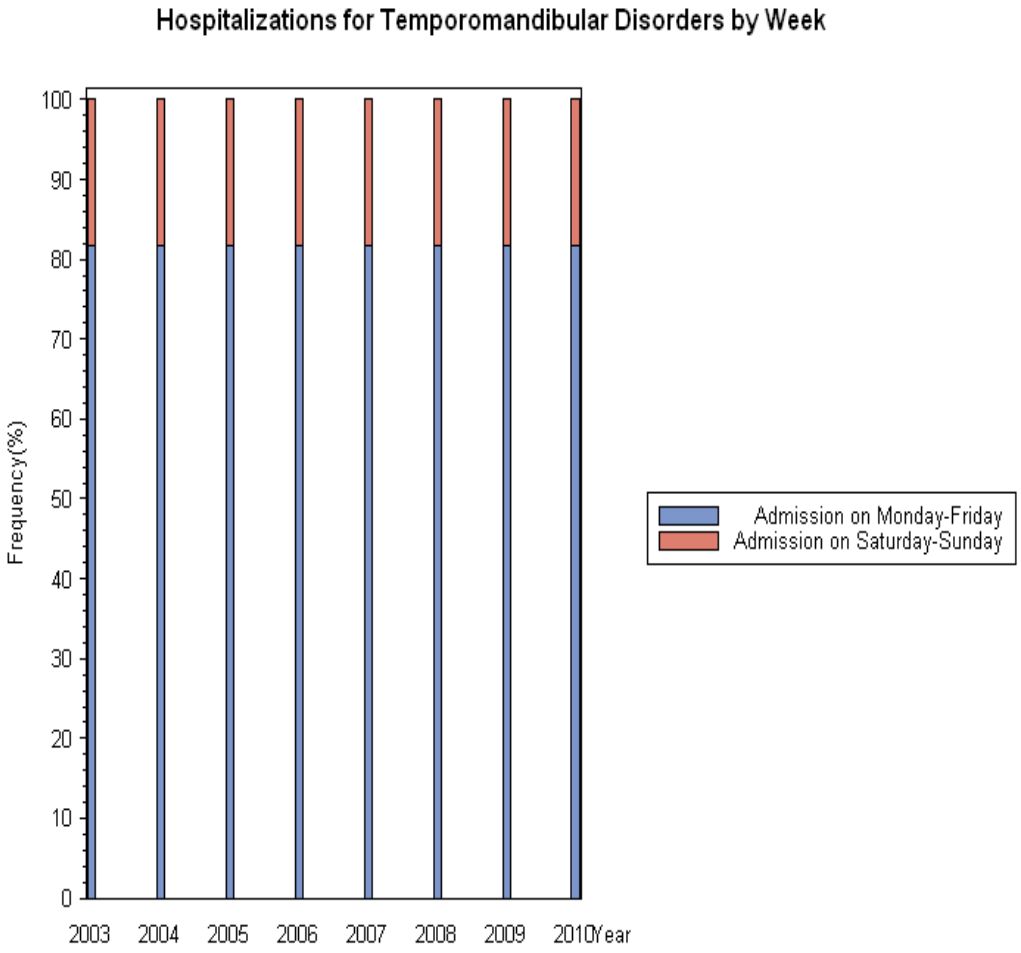

Figure.17. Hospitalizations for Temporomandibular disorders by week

Over 80% of patients are getting admitted during weekdays versus weekends when ER seems the only available option. This reflects that those inpatients coming into the ER in weekdays may not know where to go and are not aware of what they may be experiencing; hence they are not seeking TMD Specialists. These numbers have been consistent from 2003-2010, which means no modifications have taken place on our outlook toward TMD.

There is an urgent need to raise awareness about TMD among health care providers so they may better assist and refer patients as well as counsel them on general treatments such as stress management, relaxation techniques, physiotherapies and nutritional advice and if need be more serious interventions such as occlusal adjustments and oral appliance therapies.

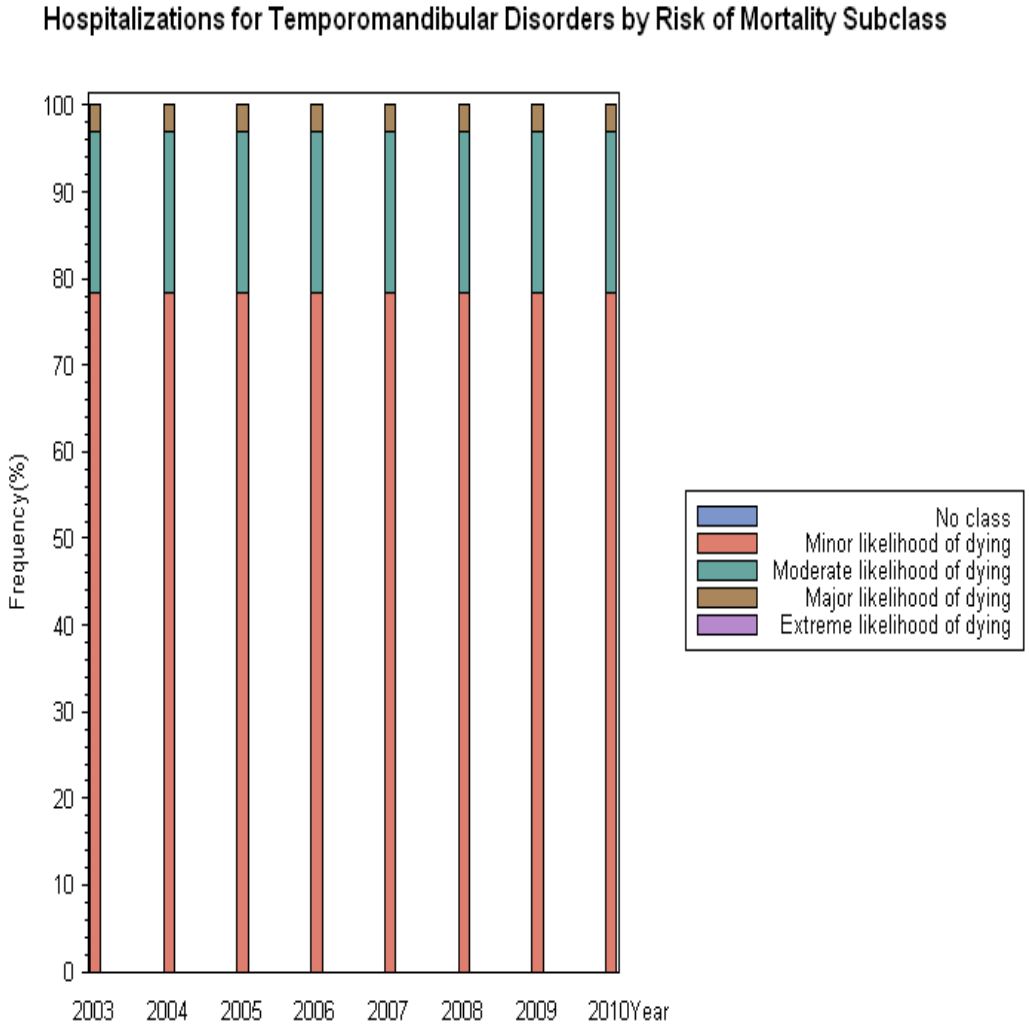

Figure.18. Hospitalizations for Temporomandibular disorders by Risk of Mortality subclass

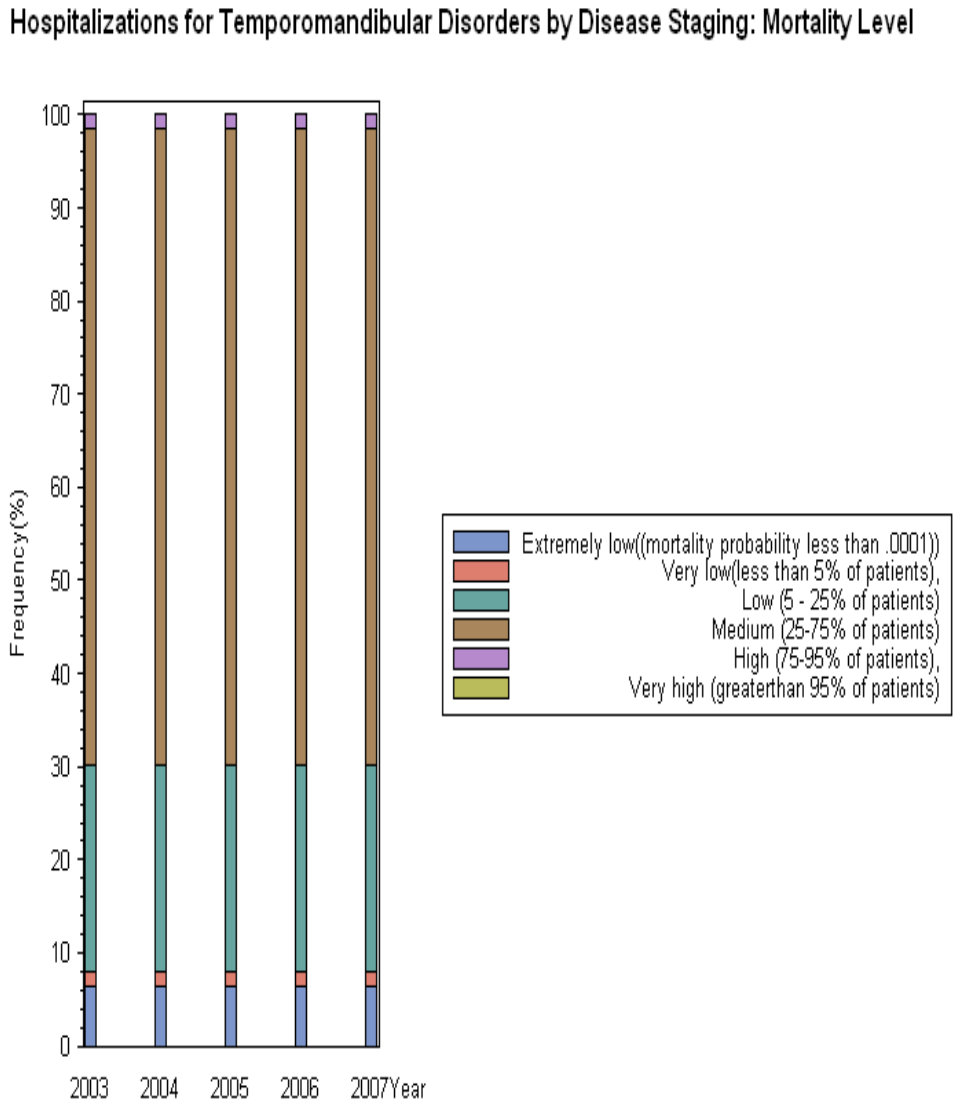

Figure.19. Hospitalizations for Temporomandibular Disorders by Disease staging: Mortality level

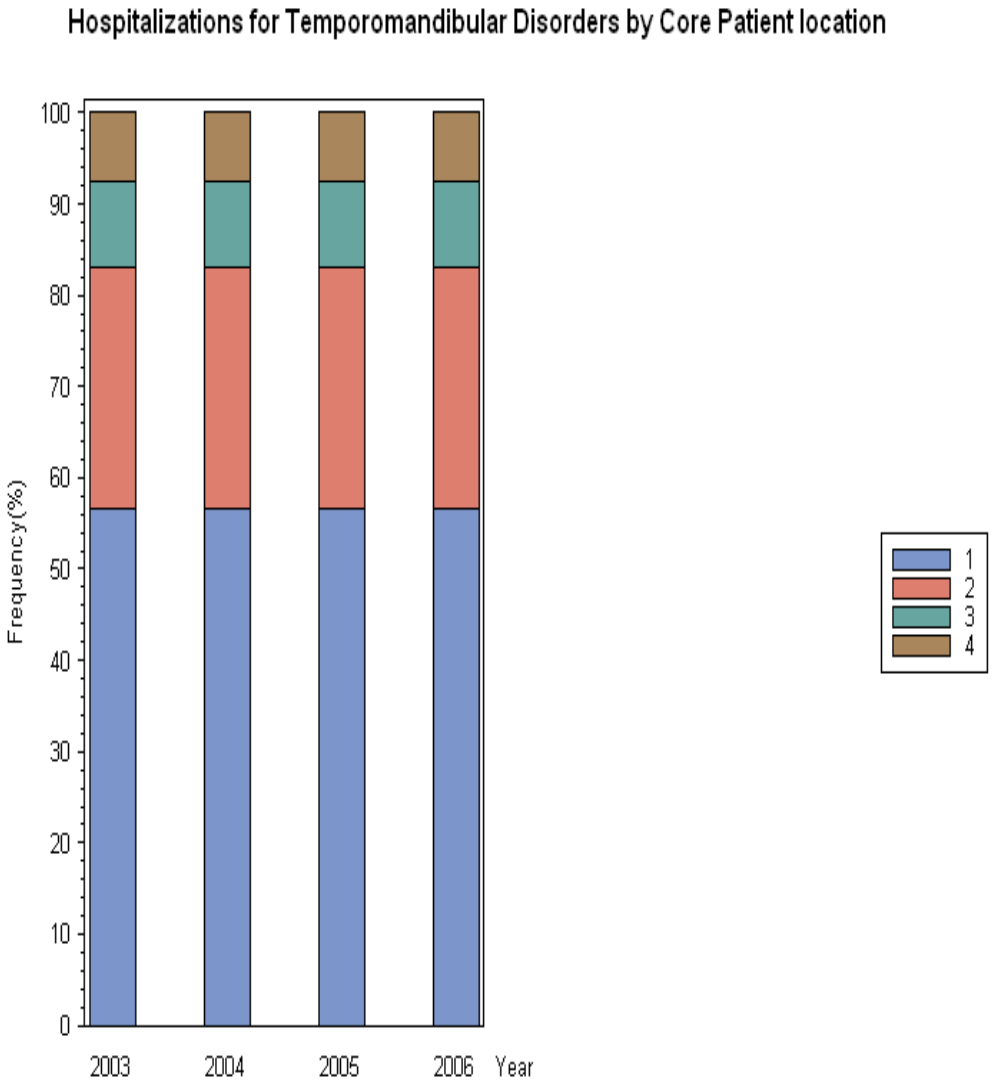

Figure.20. Hospitalizations for Temporomandibular disorders by hospital location

The majority of patients are located in large metropolitan areas, then small metropolitan areas, micropolitan and other locations. Big cities attract a lot of stress factors and other variables which may contribute to TMD.

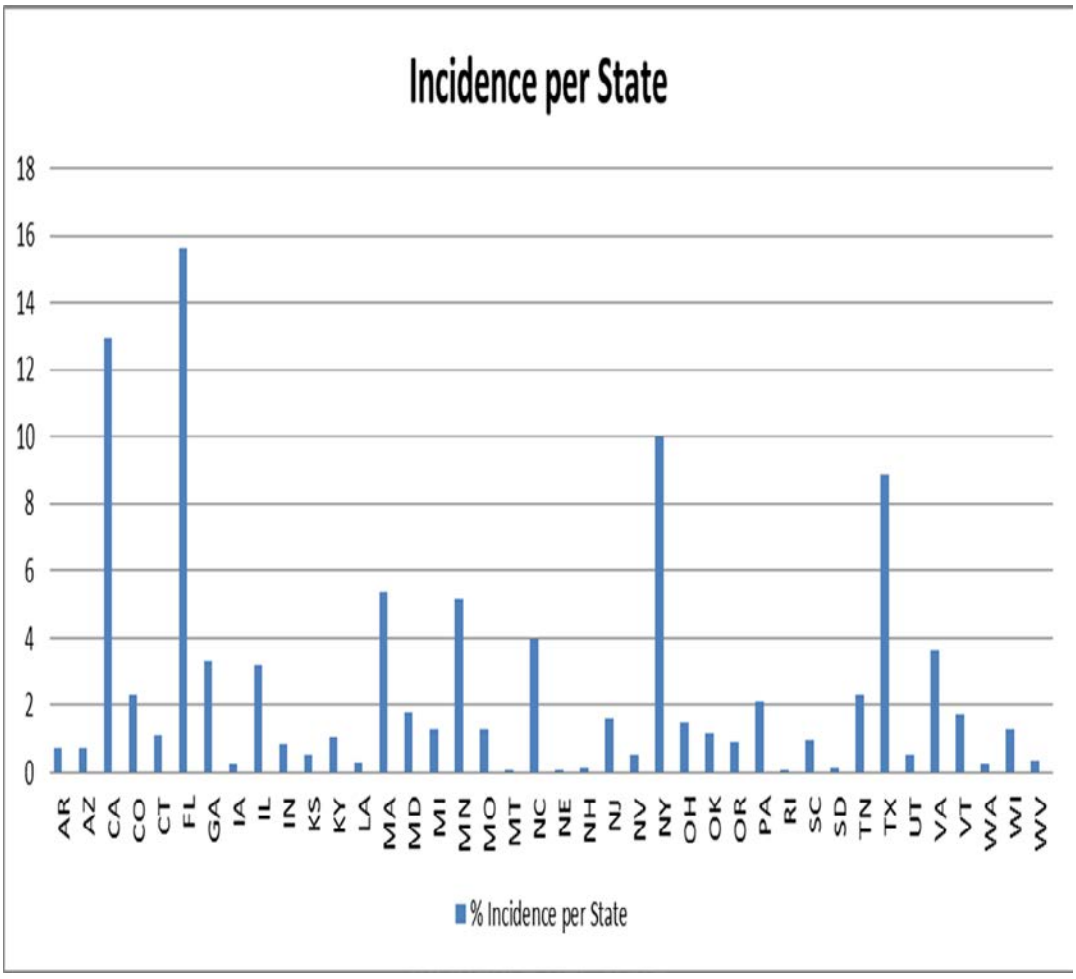

Figure.21. Hospitalizations for Temporomandibular disorders by state

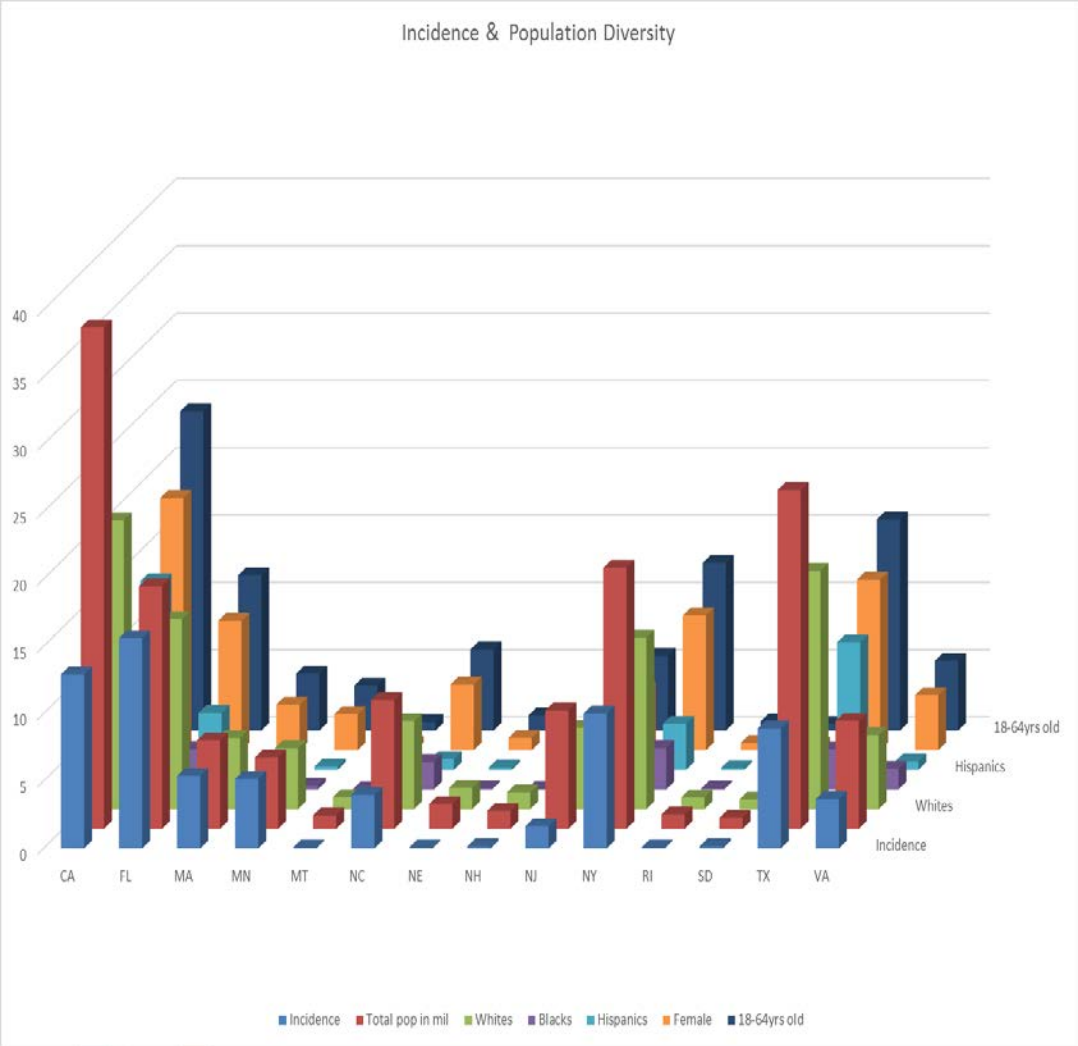

Figure.23. Incidence and population diversity

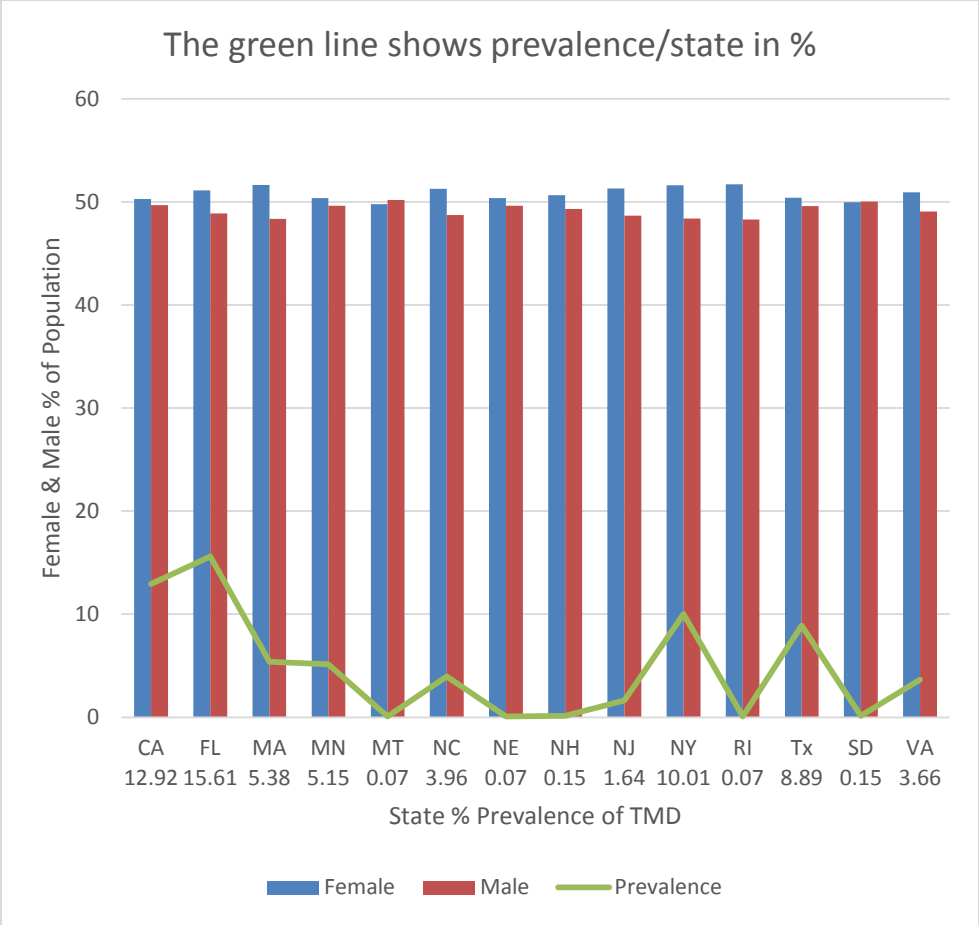

Figure.24. Hospitalizations for Temporomandibular disorders by state/Prevalence.

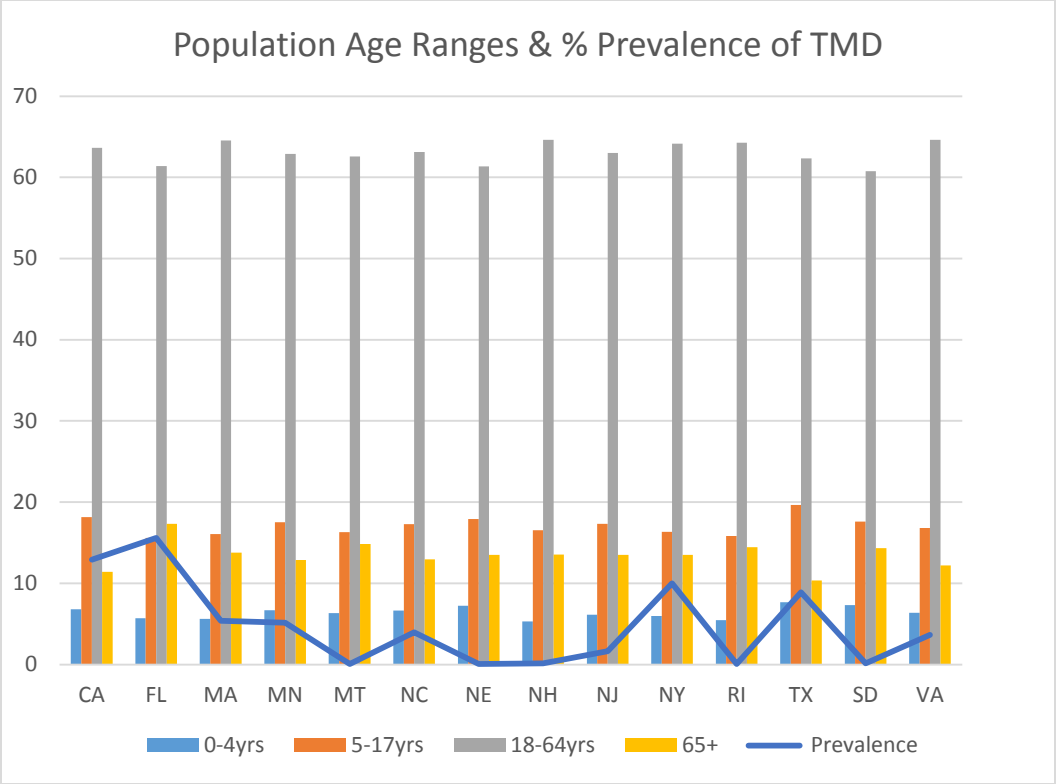

Figure.25. Population Age Ranges and % prevalence of TMD

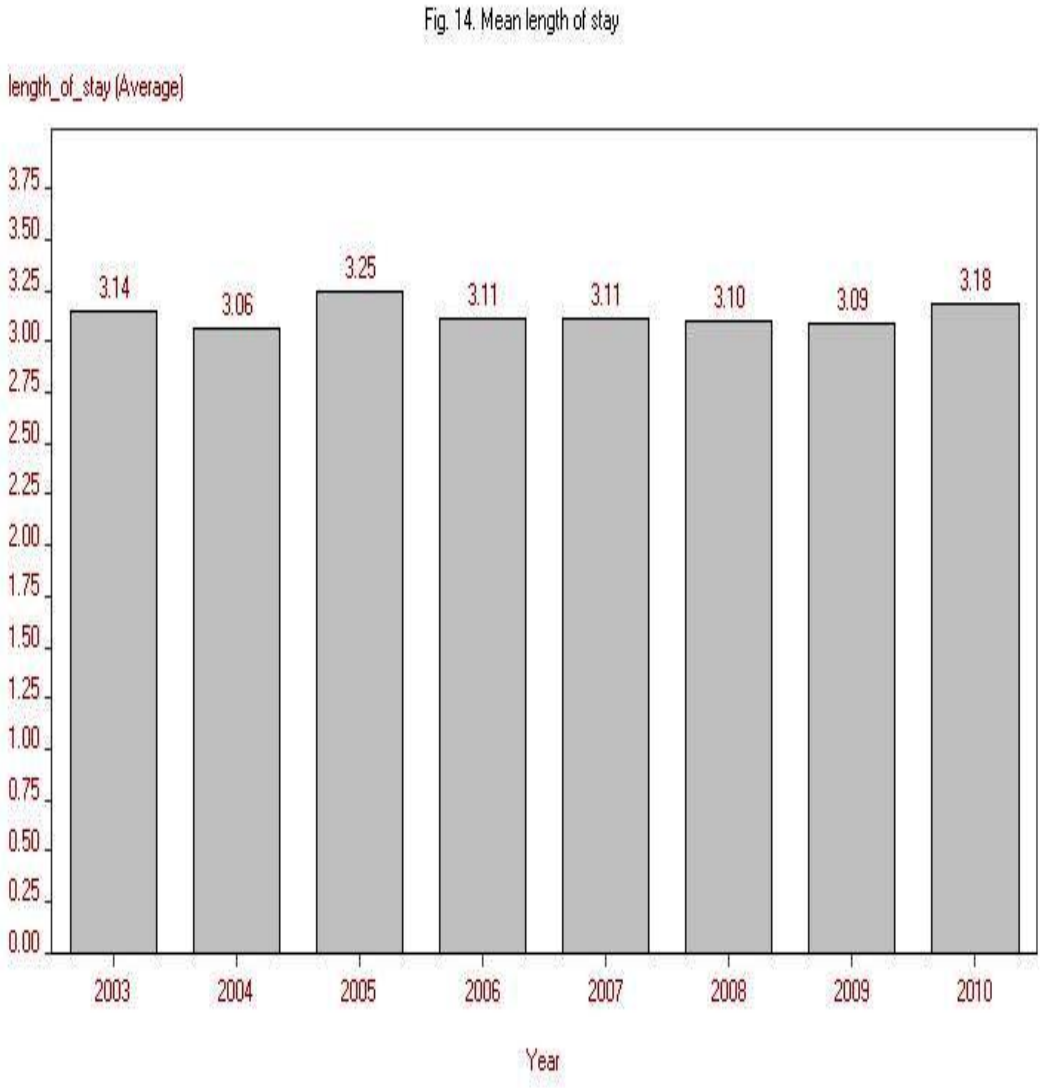

Figure.26. Mean length of stay

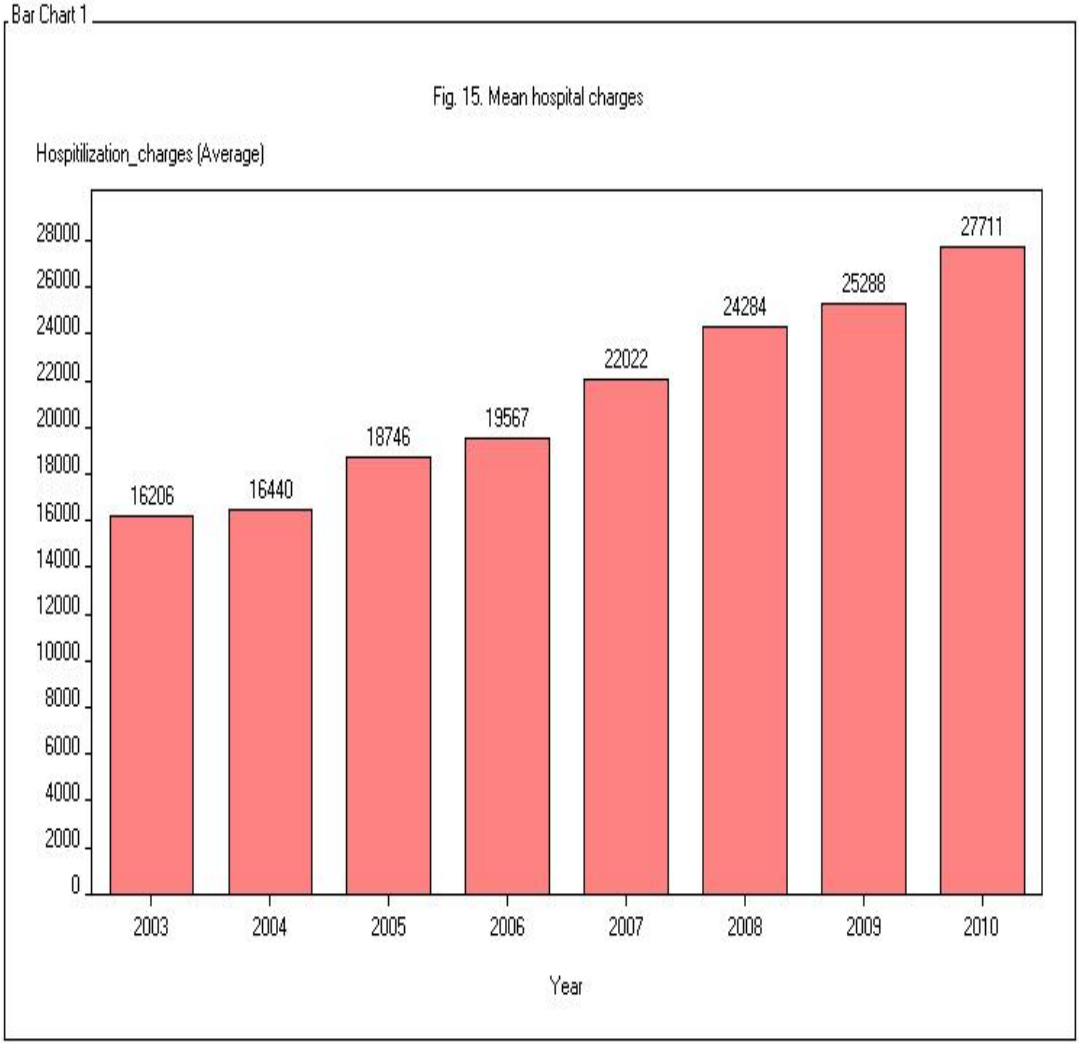

Figure.27. Mean hospital charges

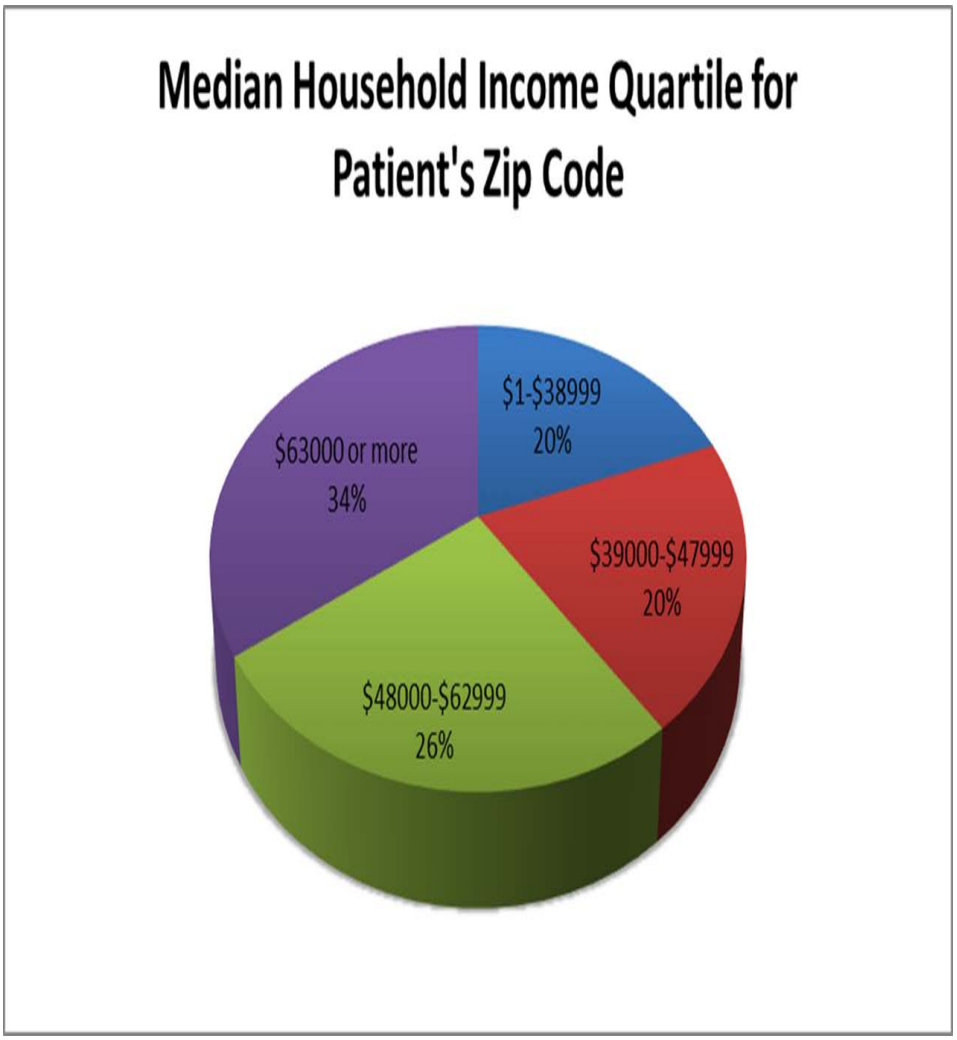

Figure.28 . Median Household income by patient Zip code

Chapter V

DISCUSSION

DISCUSSION

Geography;

The high incidence of TMJ in geographic locations may be attributed to the originally high populations of these large states especially FL, Ca, NY, Tx. It may also relate to the metropolitan fast pace lifestyle and stress disorders or the different diets in diverse and densely populated urban areas. Alternatively, there may be an underlying cause for spikes of incidence at certain geographies and further investigation is thus required.

Florida with a total population 18,801,310 showed the highest incidence of 15.61% of TMD inpatients, although it has a high elderly population of 3,259,602 persons over 65 years old and 11,539,617 persons 18-64 years who are not the main culprit for TMD. Florida also showed a higher incidence of 15.61% than California of 12.92% incidence even though its population is less than half that of California which has a total population of 37,253,956 with 4,246,514

elderly over 65 years old and 23,712,402 persons 18-64 years old. Also the west coast is known for its laid back lifestyle yet California had a higher prevalence than New York. TMD is highest at age range 18-64.

New York with a total population of 19,378,102 out of which 12,435,943 persons are 18-64 years has a prevalence of 10.01% versus Texas with a total population of 25,145,561 including 15,677,851 persons 18-64 years and a prevalence of 8.89%

Texas has a dry atmosphere versus the humid Florida weather, and the geographic distribution of TMJ shows no direct co-relation and a more in depth analysis is necessary.

Massachusetts with a total population of 6,547,629 and 4,225,982 persons 18-64 years had a prevalence of 5.38% is similar to Minnesota with total population 5,303,925 and 3,336,741 persons 18-64 years and prevalence 5.15% yet these incidence rates are much higher in comparison to two other states. The two other states are North Carolina with a total population of 9,535,483 and 6,019,769 persons 18-64 years and prevalence of 3.96% and the state of Virginia with total population 8,001,024 and 5,170,410 persons 18-64 years and a prevalence of 3.66%. Although North Carolina and Virginia have almost double the populations of Massachusetts and Minnesota their incidence rates are significantly lower.

New Jersey on the other hand has a total population of 8,791,894 and 5,540,687 persons 18-64 years and a prevalence of only 1.64%. So although the population of NJ is closer to MA and MN its incidence rate is almost half that of NC and VA.

Fortunately some states have a very low incidence rate such as; Montana with a total population of 989,415 out of which 619,110 persons are 18-64 years and a prevalence of 0.07%. Nebraska has a total population of 1,826,341 and 1,120,443 persons 18-64 years with a prevalence of 0.07%. Rhode Island has a total population of 1,052,567 with 676,730 persons 18-64 years and a prevalence of 0.07%. Meanwhile New Hampshire has a total population of 1,316,470 with 850,968 persons 18-64 years and a prevalence of 0.15%. South Dakota has a total population of 814,180 with 494,802 persons of 18-64 years and a prevalence of 0.15%.

The prevalence of TMD in the female population far outweighs that of the male by almost five folds with an incidence rate of 81.54% female to 18.46% male.

Women in general may have a softer bone structure and they are more likely to report symptoms and more likely to seek medical attention sooner and more frequent than men. The female anatomy may also play a role of weaker jaws for example with osteoporosis & rheumatoid arthritis which are more common with women.

Women of child bearing age are more subject to risk since the common age range for TMD is 20-60 years old, peaking at 30-40years old. However, the percentages of prevalence above still do not explain why some states have a higher incidence than others. Further investigation is required at a more local level.

Race;

The Caucasian population shows a high incidence compared to minorities such as African American, Hispanic, Native American, Asian & others. This might be due to better access to healthcare or more educated diagnosis or more inclusive insurance coverage. Perhaps genetic biomarkers can help us understand why occurrence is higher in this population.

Income;

Higher income population shows more prevalence which could be attributed to higher education & hence diagnosis, better access to healthcare & broader insurance coverage. It may also reflect a different diet or lifestyle that encourages TMJ and is thus interesting to further investigate.

Hypertension;

Contrary to existing literature(46-50), inpatients with hypertension showed significantly higher incidence of TMJ. This may be attributed to higher stress levels being a cause for TMJ. Further investigation is necessary to assess the relation between these conditions. the relationship between chronic pain and blood pressure is much less well understood. It has been reported in a number of studies that there may be a deficiency of endogenous opioids in chronic pain patients. The blood pressure-pain relationship was studied by Bruehl et al. in 118 patients with chronic lower back pain. The main finding was that in patients in whom the duration of the pain was relatively short (less than a year) there was a weak inverse correlation between the symptoms of pain and blood pressure, but in those who had been suffering from pain for more than 2 years the correlation was positive -- those who reported more frequent or intense pain had higher blood pressures. Maixner et al. found no relationship between blood pressure and sensitivity to acute pain in patients with temporomandibular joint disorders. Thus, the normal pain-blood pressure relationship is absent or reversed in these patients, which raises questions about which comes first: Are people who do not show the usual pain-blood pressure relationship more likely to develop chronic pain, or does chronic pain impair the relationship? The effects of the duration of exposure to pain reported by Bruehl et al. favor the latter explanation, leading those authors to propose the following sequence of events: persistent pain leads to generalized arousal and elevation of blood pressure. This in turn leads to baroreceptor stimulation, which acutely lowers pain sensitivity, partly through release of endogenous opioids. However, over the long term progressive opioid dysfunction occurs, resulting in a decrease of endogenous opioids and their painkilling effects, and hence a vicious cycle whereby further pain leads to further arousal and decreased pain tolerance. Additional support for this view comes from a study showing that in women with acute pelvic pain of 2-3 days' duration, endorphin levels are increased.

Diabetes;

Some inpatients showed incidence and more studies are needed to confirm association between diabetes & TMJ.

Ankylosis;

Although a higher occurrence is expected, only a few incidences were reported. It may be due to those patients already being in the appropriate treatment regime.

A retrospective analysis of 1504 patients with primary diagnosis musculoskeletal TMJD from 2003-2010 available from HCUP member states can help us understand which geographies are more affected & why. It can help us understand which patients are high risk & why, whether women experience a higher prevalence or just differ because they

actually report it. We can learn about any other variables that may exist, such as co-morbidities & if any then which ones have a direct relation and what can be done about it.

Although the overall number of incidences declines, the numbers for incidences with comorbidities fluctuate randomly from 2003-2010 which may mean there is no relation or that those patients are not controlled or that there is not enough awareness for patients or providers.

Such rich data will help track and monitor patients & their TMJD progression over the years and provide a productive study of treatments available to compare safety & effectiveness as well as long term effects of these treatment options. This can offer a useful platform to investigate the reasons behind recurrence & a strategy to make educated decisions and establish preventative care that allows patients a healthier life style and is more cost effective. It can help simplify the diagnosis & direct the patients to the appropriate specialist at inpatient as well as outpatient settings.

A more in-depth analysis can provide a comparative study of facial structural damages such as jaw joint wear & tear, teeth wear & breakdown, and long term tissue damage. It can help us study craniofacial development & craniofacial microbiology & immunology. We can learn if there is any relation to oral & pharyngeal cancer or if the salivary glands & any tumors are affected.

We can also compare prevalence in the United States with the rest of the world to study causes & alternative treatment options available if any exist.

Chapter VI

SUMMARY AND CONCLUSIONS

Dysfunction of TMJ and associated structures can be a source of acute and chronic recurrent orofacial pain and masticatory dysfunction. Successful treatment depends on an accurate assessment of these disorders, therefore it must be based on a comprehensive evaluation and accurate diagnosis.

The disorders that may affect the TMJ are similar to those involving other synovial joints; therefore, treatment of TMD will be consistent with any other musculoskeletal disorder. A clear understanding of the anatomy, biomechanics and possible pathologic processes that may afflict the TMJ is necessary in order to determine an acceptable course of treatment.

An organized approach to the assessment of the orofacial pain/TMD patients and an accurate diagnosis is essential.

During hospital visits patients are unlikely to be seen by TMD Specialists as they do not tend to be stationed at ER or in Wards. Therefore optimal care is not provided, nor is there appropriate education and self-care awareness should patients experience repeat episodes. There are no follow up visits upon discharge to prevent further deterioration and improve preventative care and ensure an improved quality of life for the affected individuals.

The complex nature of this condition and the lack of general familiarity with it is confusing to both patients as well as to some health care providers too. After evaluating the association of socio-demographics, comorbidities and related disorders of TMD using the NIS-HCUP data several conclusions have been reached.

This investigation to establish optimal treatment for inpatients reflects the hardship faced by Multidisciplinary Specialists in identifying TMD and distinguishing its symptoms from the related disorders that mask it. Therefore there is a dire need to make available

measures and guidelines for health care providers at ER and inpatients settings as well as at Primary care level and at Specialists offices.

In order to strategize for long term preventative care , improve patients' quality of life and reduce direct and indirect costs of TMD, the following suggestions are made;

- Raising awareness for patients as well as health care providers in the Orofacial pain and associated arenas such as Neurologists, ENT Specialists, Pain Management Specialists, and General Physiscian offices and healthcare clinics
- Making available TMD guidelines and their updates at secondary care level for Multidisciplinary Specialists at the ER and at inpatient settings
- Also making these guidelines and their updates available along with educational information at post discharge facilities like home health care, nursing homes, hospices, outpatient services, rehabilitation facilities etc
- Obtaining appropriate documentation at discharge to ensure patients are not lost to follow up and flagging these patients' charts/medical records to alert both patient and their health care provider for follow up after a specified time whether or not the patient complains of any symptoms
- Setting up measures to monitor long term effects of the different treatments available in order to establish optimal care and device a preventative approach at local and regional levels. These measures should be structured for both conservative treatments like counselling, stress management, physiotherapy and nutritional advice as well as interventional treatments like Occlusal Adjustments and Oral Appliance Therapies
- Continue to investigate and identify the likely causes, recognize socio-demographics, TMD related disorders and comorbidities in order to develop optimal interaction and treatment strategies that are safe, effective and preventative and that would improve patient's quality of life and reduce prevalence and long term costs of TMD
- Continue to investigate in particular why prevalence is much higher in women versus men, in the white population versus all other ethnicities, why it seems to affect high income versus lower income brackets, metropolitan versus

micropolitan locations, and how depression, diabetes, chronic pulmonary disease and especially hypertension may be related to a raised risk for TMD.

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