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Predictors Of Long-term TMD Pain Intensity: An 8-Year Cohort Study

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Abstract

Aim: To investigate, in participants with pain-related temporomandibular disorders (TMD), the association of long-term TMD pain intensity with baseline Health-Related Quality of Life (HRQoL) and jaw functional limitation.

Methods: Of 513 cases with baseline pain-related TMD (masticatory muscle and/or temporomandibular joint pain), 273 were reevaluated after 8 years and 258 of these had follow-up Characteristic Pain Intensity (CPI) and complete baseline data for Jaw Functional Limitation Scale (JFLS) and HRQoL measured by Short Form-12's Physical Component Summary (PCS) and Mental Component Summary (MCS). Secondary analyses of existing data quantified effects of primary (PCS, MCS) and secondary (JFLS) predictors on follow-up CPI using multivariable linear regression. Sensitivity analyses considered differences between participants included (n=258) and not included (n=255) using inverse probability weighting. Interactions of baseline predictors with age, sex and baseline CPI were evaluated using multivariable linear regression.

Results: Baseline PCS, but not MCS or JFLS, was associated with follow-up CPI ($p=.012$). One standard deviation (SD=9.0) higher baseline PCS predicted an overall 3.2-point lower follow-up CPI (95%CI: -5.8, -0.7), adjusting for age, sex, MCS, JFLS, and baseline CPI. However, the effect of PCS wasn't uniform: the association between PCS and follow-up CPI was statistically

significant for participants with baseline CPI 51.3/100, and clinically significant for participants with baseline CPI 68.7/100. Adjustment for TMD treatments and sensitivity analyses had negligible effect.

Conclusions: In participants with moderate-to-severe baseline TMD pain intensity, higher baseline physical HRQoL predicted lower TMD pain intensity at 8 years' follow-up. PCS could contribute to a multifactorial long-term TMD pain prediction model.

Keywords

Temporomandibular Disorders; Facial Pain; Chronic Pain; Quality of Life; Epidemiology

Introduction

Temporomandibular disorders (TMD) affect the masticatory muscles, temporomandibular joints (TMJ), and associated structures¹ Pain, the most frequent reason patients seek TMD treatment, affects approximately 10% of adults² It been reported that most TMD cases tend to remit or present as recurrent pain episodes. Approximately 15% of patients who seek care progress to chronic TMD pain³, often defined as having pain for at least 3⁴ to 6 months.⁵ Causal factors for persistent TMD pain are not clear, though psychosocial factors differ significantly in TMD cases compared to pain-free controls⁶⁻⁹ and are associated with chronic TMD pain.¹⁰⁻¹² Previous studies suggest that biopsychosocial factors including poor general health can predict onset of chronic pain conditions such as widespread pain¹³ and musculoskeletal disorders¹⁴⁻¹⁸ including TMD.¹⁹⁻²²

Health related quality of life (HRQoL) measures have been used to assess an individual's functioning and disease burden for many chronic physical conditions including headaches,²³ arthritis,^{24,25} back pain,^{16,24,25} and TMD.^{7,26,27} The 12-item Short Form Health Survey (SF-12),^{28,29} is a commonly used HRQoL questionnaire, derived from the 36-item version, SF-36.³⁰ The SF-12 and SF-36 evaluate 8 health domains (physical functioning, role physical, bodily pain, general health, mental health, role emotional, social functioning, and vitality), yielding 2 summary scores: the Physical Component Summary (PCS) and the Mental Component Summary (MCS). SF-12 and SF-36 scores have been shown to differ significantly between healthy controls and patients with migraine,^{31,32} fibromyalgia,³² and TMD.²⁶ The SF-12 score has been found to have a dose-response relationship with severity of various chronic health conditions.³³ In a multivariable model, the SF-12 bodily pain and general health sub-scales were among the 11 best predictors for new-onset TMD out of 202 putative risk factors evaluated in a large cohort.³⁴ To date, no studies have evaluated the capacity of the SF-12 scores to predict long-term pain intensity in TMD participants.

According to the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT),³⁵ there are 2 broad areas of assessment for physical functioning and HRQoL: generic measures such as the SF-12, and disease-specific physical functioning measures such as the Jaw Functional Limitation Scale (JFLS)³⁶. In a large case-control study, the JFLS score was significantly worse in TMD cases compared to pain-free controls.³⁷

Although some factors have been identified as having cross-sectional and retrospective associations with TMD pain or as longitudinal risk factors for new-onset TMD, factors that can identify existing TMD cases who are at risk for long-term TMD pain are largely unknown. The present study addresses this gap and elucidates the effects of a few potential predictors of TMD pain intensity. A unique opportunity to address this hiatus was available in conducting secondary data analyses of a well-defined cohort of TMD pain cases from the multicenter Validation Project³⁸ and its 8-year follow-up, the TMJ Impact Project.³⁹ The present study's aim was to investigate, in participants with pain-related TMD, the association of long-term TMD pain intensity with baseline HRQoL and jaw functional limitation. This aim was addressed by quantifying the effect of the baseline PCS, MCS and JFLS on follow-up TMD pain intensity measured by the Characteristic Pain Intensity (CPI).⁵ The authors hypothesized that baseline PCS and MCS would be negatively associated with long-term TMD pain intensity while baseline JFLS would be positively associated.

Methods

Study sample

At baseline, participants in the Validation Project were recruited at the University of Minnesota, University of Washington, and University at Buffalo between 2003 and 2006. Participants were either referred from local health care providers to each university-based TMD clinic, or responded to community advertisements. Institutional review board approval was obtained at each study site before study initiation; all participants provided informed consent. Enrollment was consecutive until two-thirds of the Validation Project's target recruitment³⁸ was achieved and thereafter participants with less common TMD diagnoses and of older age were selectively enrolled. Thus, the Validation Project participant population was a convenience sample of individuals 18 to 70 years old, consisting of healthy controls and clinical and community TMD cases with the full spectrum of TMD signs and symptoms but without significant non-TMD pain co-morbidities.

Figure 1 shows the flow of study participants from the baseline Validation Project to the follow-up TMJ Impact project and, ultimately, the subset of participants eligible for the present study's secondary data analyses. The Validation Project included 513 potentially eligible participants who had a pain-related gold-standard TMD diagnosis (masticatory muscle and/or TMJ pain) at baseline. Approximately 8 years later, funding was approved for the TMJ Impact Project to follow-up 400 of the 705 Validation Project's participants, the sampling frame being limited to those who had previously agreed to be contacted. Actual follow-up included 401 participants of whom 273 had pain-related TMD diagnoses at baseline and 128 had non-painful TMD diagnosis or were pain-free controls. Among the 304 Validation Project participants not followed-up in the TMJ Impact Project, 240 had pain-related TMD diagnoses and 64 had non-painful TMD diagnoses or were pain-free controls.

Inclusion in the present study required complete data for: (1) at least one baseline gold-standard pain-related TMD diagnosis (masticatory muscle and/or TMJ pain), (2) baseline CPI score greater than 0, (3) baseline SF-12 (PCS and MCS) scores, and (4) follow-up CPI score. Those with pain-related TMD diagnoses who were not included in this study (n=255) consisted of those not followed-up in the TMJ Impact Project (n=240) and those excluded

from the present analysis (n=15) for the following reasons: missing data for baseline SF-12 (n=8), missing data for follow-up CPI (n=1), and those who had baseline pain-related TMD diagnoses with a concurrent CPI of 0 (n=6). Thus, the present study included 258 participants with TMD pain at baseline.

For the present study's purpose, TMD pain at baseline was defined as the presence of at least one pain-related TMD diagnosis and a CPI score greater than 0. Long-term TMD pain was defined by its presence at both baseline and at follow-up, i.e., by evidence that conditions causing the TMD pain had remained unresolved for a longer time than would normally be expected.^{3,4} TMD pain between baseline and follow-up visits was not assessed; whether it was continuous or episodic was not known.

Clinical assessment and TMD diagnoses

Baseline pain-related TMD diagnoses were established by consensus between two clinical examiners at each study site after each independently assessed the participants using a comprehensive history and clinical examination protocol.³⁸ The Validation Project's complete methods and eligibility criteria have been previously reported.³⁸ At follow-up, each participant was seen at the same study site by only one of the examiners. Pain-related TMD diagnoses at follow-up were algorithmically derived from history and exam data collected using the Axis I Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) diagnostic protocol.⁴⁰ At all three study sites the examiners at baseline and at follow-up were the same TMD experts. Inter-rater reliability of examiners, assessed with kappa, was 0.83 for masticatory muscle pain and 0.85 for TMJ pain at baseline⁴¹ and 0.84 for masticatory muscle pain and 0.76 for TMJ pain at follow-up (unpublished data).

Outcome measure

This study's primary outcome measure was a participant's follow-up TMD pain intensity, measured by the CPI score from the Graded Chronic Pain Scale (GCPS).⁵ The CPI score ranges from 0 to 100 and is calculated from three items of self-reported TMD pain intensity: (a) pain at present time, (b) worst pain in the last 6 months and (c) average pain in the last 6 months. Each item consists of a 0–10 numerical rating scale (NRS) where 0 indicates “no pain” and 10 indicates “pain as bad as it could be”. The 3 scores are averaged and multiplied by 10 to obtain the CPI score.

Baseline predictors

Baseline questionnaires included the SF-12 version 2²⁸ and the JFLS-20 (JFLS).^{36,42} The SF-12 is a reliable and valid HRQoL questionnaire^{29,33,43} used in both clinical and research settings. The SF-12's concurrent validity with the SF-36 has been established for PCS and MCS,^{29,33} and with the EuroQol EQ-5D, another HRQoL questionnaire.⁴⁴ MCS and PCS summary scores range from 0 to 100 with a higher score indicating better quality of life. The JFLS consists of 20 items, each with a 0–10 NRS, where 0 indicates “no jaw limitation” and 10 “severe jaw limitation” for each specified activity. The JFLS has three subscales: mastication, vertical jaw mobility, and verbal and emotional expression; their average yields a global jaw functional limitation score on a 0–10 scale. The JFLS has been validated in TMD patients with reliability coefficients of 0.82 for persons and 0.99 for items.⁴²

Participant self-report of TMD treatments during the follow-up period consisted of a questionnaire with 39 Yes/No items, which were clustered into three groups for analyses: A) Medical Management/Physical Rehabilitation, B) Mind-body/Complementary and Alternative Medicine, and C) Occlusal Treatments/Surgery. A fourth grouping, D) Standard Multidisciplinary Treatments, was formed from a subset of 10 of these items (Figure 2). Three definitions for TMD treatments received were considered as adjusters in the analyses: 1) any treatment (Yes/No); 2) any Group-A (Yes/No), any Group-B (Yes/No), any Group-C (Yes/No) treatments; and 3) any Group-D (Yes/No).

Statistical analyses

Linear regression was used to investigate baseline PCS, MCS, and JFLS scores as predictors of follow-up CPI in multivariable models adjusted for baseline characteristics: age, sex, TMD treatments received and baseline CPI. Linear regression coefficient estimates are often reported as the difference in outcome associated with a one-unit increase in a given predictor. Since the present study's multiple study predictors were measured on different scales, the respective effects of one-unit increases were not directly comparable. Thus, for each predictor, the difference in the outcome associated with a one standard deviation (SD) increase in the predictor was computed. SD-standardization of coefficient estimates is often employed in epidemiology to facilitate direct comparison of the effect sizes of study predictors.

Additional analyses were implemented:

1. Since the analyzed subset of cases differed from excluded cases on average age and global JFLS score, the analyzed sample was differentially weighted to adjust for these differences using the inverse of each person's probability of being an included case.⁴⁵ These probabilities were estimated in a secondary logistic-regression analysis with the outcome "Yes" (included case) versus "No" (excluded case). Covariates for the weighting analysis were age and baseline JFLS.
2. Given that about one-half of TMD pain participants from the Validation Project were not included in the analysis in the interest of generalizing the present study's findings to all 513 TMD pain cases in the Validation Project, the authors did a series of variant analyses adding to the main analysis interactions of the main effects with selected population characteristics: sex, age (continuous), or age (categorical).
3. To determine whether the association between baseline predictors and follow-up CPI differed according to baseline CPI, the authors also estimated and tested their interaction with baseline CPI.

Statistical significance was set at $p < .05/2 = .025$ for each of the two primary analyses, baseline PCS and MCS predicting follow-up CPI (i.e., Bonferroni correction). For all other tests, considered exploratory, statistical significance was defined as $p < .05$. All analyses were done using SAS (v. 9.3; SAS Institute, Cary, NC, USA). Graphs were plotted in R (<http://www.r-project.org>).

Results

Elapsed time between the baseline and follow-up examinations averaged 8.0 years (SD 0.7, range 6.3–10.0). Of the 258 participants with TMD pain at baseline who were included in the analysis, 186 (72%) were diagnosed with TMD pain at follow-up. Of these 258 participants, 88% were women, with a mean age of 38 years (SD 13, range 18–67). Table 1 presents characteristics of participants with and without follow-up pain-related TMD diagnoses. Considering all 258 participants, follow-up TMD pain intensity (CPI score) had an overall mean of 28.1 points (SD 19.9, range 0–86.7) on a 0–100 scale, an average of 22.1 points (43.8%) lower compared to baseline CPI scores (mean 50.2, SD 20.0 points). For the subset of participants with pain-related TMD diagnoses at follow-up, the mean follow-up CPI was 34.5 points (SD 18.0, range 6.7–86.7), that is, lower than baseline by an average of 15.7 points (31.3%). At follow-up some participants reported a CPI score greater than 0 for a 6-month reference time frame but were classified as not having a pain-related TMD diagnosis. This situation was clinically possible because the diagnostic criteria were based on pain in the last month; hence, Table 1 includes some participants with follow-up CPI>0 in the group without follow-up pain-related TMD diagnoses.

Multivariable linear regression

The multivariable linear regression model included all three baseline study predictors (PCS, MCS, and JFLS), as well as potential confounders: age, sex and baseline CPI (Table 2). One SD (9.0) higher baseline PCS predicted a 3.2-point (6.4%) lower follow-up CPI (95% Confidence Interval [CI] –5.8 to –0.7; $p=.012$), adjusting for age, sex, MCS, JFLS, and baseline CPI (Figure 3). One SD (9.1) increase in baseline MCS predicted a 1.2-point (2.4%) lower mean follow-up CPI score (95%CI –3.6 to 1.1, $p=.30$), adjusting for age, sex, PCS, JFLS and baseline CPI (Figure 4). One SD (1.4) higher baseline JFLS score predicted a 0.37-point (0.74%) higher mean follow-up CPI score (95%CI –2.2 to 3.0; $p=.78$), adjusting for age, sex, PCS, MCS, and baseline CPI (Figure 5). After adjusting further for treatments received, using each of the three ways of summarizing treatments received, each predictor maintained similar statistical significance and overall magnitude of its effect (Table 3).

Sensitivity analysis: potential bias due to partial follow-up

Compared to those cases who were not followed-up or who were excluded from the analysis, cases included in the analysis were on average 2.6 years older (included=37.8 years, 95%CI: 36.2 to 39.4; SD 13.0; not included=35.2, 95%CI: 33.6 to 36.8; SD 13.1, $p=.028$). Included cases had a 0.39-point lower average JFLS score at baseline (included=1.8 points, 95%CI: 1.7 to 2.0; SD 1.4; not included=2.2, 95%CI: 2.0 to 2.4; SD 1.5, $p=.004$). Although this baseline difference in JFLS was less than 5% of the range for JFLS (0.00 – 7.98), the statistical influence of this difference was investigated to rule out a systematic difference between cases included and not included in the analysis. A sensitivity analysis compared the unweighted linear regression estimates above with suitably weighted analyses in a series of variant regression models with and without adjusters (Table 4). Weighting created slight differences in the SD-standardized coefficient estimates for predicting follow-up CPI but the p -values for these estimates were similar. No other baseline characteristics

(sex, CPI, PCS, MCS, or pain location) differed significantly between included and excluded cases.

Generalization of results to population subgroups

To assess the generalizability of the present study's findings to population subgroups, the authors investigated potential interactions between baseline predictors and three principal population characteristics. Interactions of sex with the three predictors showed p-values ranging from .23 to .86. For age treated as a continuous measure, the range of p-values was .25 to .81. For the age category of 18 – 35 years, the p-value range was .11 to .48. Interactions by the category of 36 – 50 years showed p-values ranging from .29 to .91.

Differences in the association between baseline predictors and follow-up TMD pain intensity according to baseline TMD pain intensity

The multivariable linear regression estimate for the overall PCS effect size associated with follow-up CPI was an average 3.2-point lower follow-up CPI score for every one SD increase in baseline PCS. Although this estimate was statistically significant ($p=.012$), an analysis including an interaction of *baseline* CPI score with baseline PCS found that interaction statistically significant ($p=.008$), implying that the PCS effect size associated with follow-up CPI depended on baseline CPI. In particular, PCS predicted significantly larger differences in follow-up CPI in participants who had higher baseline CPI. For every SD (20.0) higher baseline CPI, the follow-up CPI predicted by one SD higher baseline PCS was 3.14 points lower (95%CI: 0.82 to 5.47). Using this analysis, Table 5 presents examples of the estimated effect of baseline PCS on follow-up CPI for four values of baseline CPI: (a) minimum observed; (b) maximum observed; (c) minimum baseline CPI for which the association between baseline PCS and follow-up CPI was statistically significant; and (d) minimum baseline CPI for which the association between baseline PCS and follow-up CPI was clinically significant (at least 10% change from mean baseline CPI, or 5.0 points; Figure 6). This table shows that the effect of PCS was statistically significant only for participants with baseline $CPI>51.3$, and was clinically significant only for participants with baseline $CPI>68.7$. Conversely, baseline PCS had no significant effect on follow-up CPI for about half of the participants, those with baseline $CPI<51$. The association of baseline MCS and JFLS with follow-up CPI did not depend on baseline CPI ($p=.24$ and $p=.81$ for the interactions, respectively).

Discussion

To the authors' knowledge, this is the first study to report the effect size and clinical significance PCS, MCS, and JFLS as predictors of long-term TMD pain intensity in individuals with baseline TMD pain. The present study found that PCS had a statistically significant association with follow-up CPI, and this association was also clinically significant for participants with higher baseline TMD pain intensity. The differences in outcome predicted by MCS and JFLS were not statistically significant.

Clinical significance of differences in pain intensity

Statistically significant outcomes may not attain clinical significance. IMMPACT recommended that a decrease of 10–20% in self-reported pain intensity is minimally important, 30% or greater is moderately important, and 50% is substantially important improvement.⁴⁷ Also, a difference of 2 points on a 0–10 NRS or a 30% change from baseline was considered clinically important to patients with osteoarthritis, fibromyalgia, chronic low-back pain, diabetic neuropathy, or post-herpetic neuralgia.⁴⁸ In the present study, accepting the threshold of a 10–20% improvement for minimum clinical importance, PCS was a clinically significant predictor of follow-up CPI in the subset of participants reporting moderate-to-severe baseline TMD pain intensity (i.e., CPI>68.7).

After taking into consideration effect modification by baseline CPI, PCS could contribute to a multifactorial model for predicting long-term pain, along with other factors not considered in this study's focused analyses. Such a comprehensive model could then be used to inform treatment and secondary prevention of long-term TMD pain.

Power and Sample Size

As a secondary data analysis, the present study had a fixed sample of 258 cases, determined by applying the inclusion and exclusion criteria to the existing cohort of the Validation³⁸ and TMJ Impact projects.³⁹ With statistically significant results for PCS, the statistical power was necessarily adequate. For JFLS and MCS, which did not have statistically significant associations with follow-up CPI, the respective confidence intervals did not include clinically significant changes (at least 10% change from mean baseline CPI, or 5.0 points).

Factors that may have reduced observed clinical significance of predictors

The long interval between baseline and follow-up data may partially account for the limited clinical significance of PCS and the absence of statistical significance of MCS and JFLS as predictors of long-term TMD pain intensity. The validated 6-month reference^{43,55} for the CPI questions was used because this was the period used in the original GCPS questionnaire⁵ and in the Validation Project.³⁸ Also, considering the fluctuating nature of TMD pain, it is possible that pain status at follow-up may differ from other times between assessments. However, a 6-month reference period, compared to shorter intervals, is thought to provide a better estimate of pain in the long interval between baseline and follow-up.

Potential bias associated with partial follow-up

Of the 513 eligible participants with baseline TMD pain at the Validation Project, 273 participants were recalled for the TMJ Impact Project and 240 that were not followed-up. Another 15 participants were excluded due to inconsistent or missing data, yielding the sample of 258 participants. Comparing included (n=258) versus not included (n=255) participants, the statistically significant 2.6-year difference in average age was unlikely to have caused a clinically significant difference for the risk of long-term TMD pain, and the 0.39-point difference in JFLS score represented less than 5% of the baseline JFLS range of scores. Finally, the unchanged statistical significance of the study predictors in the sensitivity analysis gave the most compelling evidence that selective follow-up most likely did not introduce noteworthy bias.

Generalizability of study results

Participants in the Validation Project were enrolled according to the Standards for Reporting Diagnostic Accuracy (STARD)⁵³ guidelines, which recommend using a sample of individuals with the target condition who are free of relevant co-morbidities when first validating diagnostic criteria. Thus, it is possible that results could have differed in samples with other medical and pain co-morbidities.

The Validation Project was designed to generalize its findings to TMD cases with the most common pain-related TMD diagnoses, TMJ soft tissue disorders (disc displacement) and TMJ hard tissue disorders (degenerative joint disease). With a large number of subjects recruited across the USA (NY, MN, WA), the generalizability of the Validation Project results has been demonstrated.⁴¹ No significant interactions ($p>.1$) were found between the three study predictors and three selected population characteristics, sex, age as a continuous measure, and age when the population was split into two categories. The authors conclude that these study results are generalizable to individuals having one or more pain-related TMD diagnoses, whether male or female, for ages in the range of this study.

Conclusions

In participants with moderate-to-severe baseline TMD pain intensity, higher baseline physical Health-Related Quality of Life, but not baseline mental Health-Related Quality of Life or baseline jaw functioning, was a statistically and clinically significant predictor of lower TMD pain intensity at 8-years' follow-up. This secondary data analysis suggests PCS could contribute to a future multifactorial prediction model for long-term TMD pain for the purpose of improving clinical management and secondary prevention of ongoing TMD pain. Further research is needed to validate these findings.

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Figure 1:
CPI: Characteristic Pain Intensity

**A) Medical Management/
Physical Rehabilitation**

- Evaluation only, no treatment
- Counseling by dentist or staff
- Heat/Ice
- Soft Diet
- Rest/Relax jaw
- Jaw exercise
- Muscle relaxant
- Strong analgesics
- Prescription anti-inflammatories
- Over-the-counter anti-inflammatories
- Acetaminophen
- Antidepressants
- Antibiotics
- Physical Therapy: Heat, cold, ultrasound
- Physical Therapy: TENS
- Physical Therapy: Soft tissue manipulation
- Physical Therapy: TMJ manipulation
- Mouth appliance

**B) Mind-body/
Complementary and/or Alternative
Medicine (CAM)**

- Yoga
- Herbs/Nutrition
- Homeopathy
- Craniosacral treatment
- Massage
- Chiropractic treatment
- Acupuncture
- Biofeedback
- Relaxation (whole body)
- Stress management
- Psychotherapy
- Hypnosis

**C) Occlusal
Treatments/Surgery**

- Extensive treatment to change bite
- Grinding on teeth
- Dental reconstruction to improve bite
- Orthodontic treatment
- TMJ surgery
- TMJ arthrocentesis
- Jaw surgery to realign the bite
- Treatment for broken jaw
- Major jaw surgery for any other reason

**D) Standard
Multidisciplinary
Treatments**

- Jaw exercise
- Physical Therapy: Heat, cold, ultrasound
- Physical Therapy: TENS
- Physical Therapy: Soft tissue manipulation
- Physical Therapy: TMJ manipulation
- Mouth appliance
- Biofeedback
- Relaxation (whole body)
- Stress management
- Psychotherapy

Figure 2:

Survey of Treatments Received - Items and Treatment Categories Used for Multivariable Analyses Adjustments

Figure 3:

1 SD (9.0) higher baseline PCS was associated with a 3.2-point lower follow-up CPI score (95%CI -5.5 to -0.6 ; $p=.012$), adjusting for age, sex, MCS, JFLS and baseline CPI. PCS: Physical Component Summary, CPI: Characteristic Pain Intensity, SD: Standard Deviation, CI: Confidence Interval.

Figure 4:

There was not a significant linear association between baseline MCS and follow-up CPI (-1.2 , 95%CI -3.6 to 1.1 ; $p=.30$), adjusting for age, sex, PCS, JFLS and baseline CPI. MCS: Mental Component Summary, CPI: Characteristic Pain Intensity, SD: Standard Deviation, CI: Confidence Interval.

Figure 5:

There was not a significant linear association between baseline JFLS and follow-up CPI (-0.37 , 95%CI -2.2 to 3.0 ; $p=.78$), adjusting for age, sex, PCS, MCS and baseline CPI. JFLS: Jaw Functional Limitation Scale, CPI: Characteristic Pain Intensity, SD: Standard Deviation, CI: Confidence Interval.

Figure 6:

Linear association between baseline PCS and follow-up CPI, adjusting for age, sex, MCS and JFLS at 4 values of baseline CPI (in ascending order of depicted lines): (a) minimum baseline CPI observed; (b) minimum baseline CPI for statistical significance of the association between baseline PCS and follow-up CPI; (c) minimum baseline CPI for clinical significance (at least 10% of mean baseline CPI, or 5.0 points) of the association between baseline PCS and follow-up CPI; and (d) maximum baseline CPI observed

Table 1:

CPI: Characteristic Pain Intensity, PCS: Physical Component Summary, MCS: Mental Component Summary, JFLS: Jaw Functional Limitation Scale, SD: Standard Deviation.

Variable	Category	Overall n=258	Follow-up Pain-Related TMD Diagnoses	
			Yes n=186	No n=72
Sex n(%)	Male	31 (12.0)	18 (9.7)	13 (18.1)
	Female	227 (88.0)	168 (90.3)	59 (81.9)
Age(years)	Mean (SD)	37.8 (13.0)	38.4 (13.2)	36.2 (12.7)
	(Min, Max)	(18.0, 67.0)	(18.0, 67.0)	(18.0, 65.0)
Baseline CPI 0–100	Mean (SD)	50.2 (20.0)	51.0 (19.5)	48.1 (21.4)
	(Min, Max)	(6.7, 100.0)	(10.0, 93.3)	(6.7, 100.0)
Baseline SF-12 PCS 0–100	Mean (SD)	50.6 (9.0)	49.8 (9.5)	52.6 (7.0)
	(Min, Max)	(15.7, 65.4)	(24.1, 65.4)	(15.7, 64.5)
Baseline SF-12 MCS 0–100	Mean (SD)	49.6 (9.1)	49.1 (9.21)	50.8 (8.7)
	(Min, Max)	(22.8, 67.3)	(22.8, 65.2)	(23.3, 67.3)
Baseline TMD Pain Location n(%)	TMJ Pain only	35 (13.6)	26 (14.0)	9 (12.5)
	Muscle pain only	3 (1.2)	1 (0.5)	2 (2.8)
	Both	220 (85.3)	159 (85.5)	61 (84.7)
Baseline JFLS Global Score 0–10	Mean (SD)	1.8 (1.4)	1.9 (1.4)	1.6 (1.5)
	(Min, Max)	(0.0, 8.0)	(0.0, 6.5)	(0.00, 8.0)
Follow-up CPI 0–100	Mean (SD)	28.1 (19.9)	34.5 (18.0)	11.6 (14.2)
	(Min, Max)	(0.0, 86.7)	(6.7, 86.7)	(0.0, 66.7)
Follow-up TMD Pain Location n(%)	None	72 (27.9)	0	72 (100.0)
	TMJ Pain Only	35 (13.6)	35 (18.8)	0
	Muscle Pain Only	5 (1.9)	5 (2.7)	0
	Both	146 (56.6)	146 (78.5)	0

Table 2:

SD-coefficient estimates represent β (regression line slope), interpreted as the difference in follow-up CPI associated with 1 SD higher baseline predictors when controlling for age and sex, the other baseline predictors in the model and baseline CPI. Please compare to Table 5 since the SF-12 PCS estimate was not uniform for all levels of baseline CPI.

CPI: Characteristic Pain Intensity, PCS: Physical Component Summary, MCS: Mental Component Summary, JFLS: Jaw Functional Limitation Scale, SD: Standard Deviation, CI: Confidence Interval.

Baseline Predictor	SD-Coefficient Estimates	95%CI	p-value
SF-12 PCS (SD 9.0)	-3.2	(-5.8, -0.7)	.012
SF-12 MCS (SD 9.1)	-1.2	(-3.6, 1.1)	.30
JFLS (SD 1.4)	0.4	(-2.2, 3.0)	.78

Table 3:

SD-coefficient estimates represent β (regression line slope), interpreted as the difference in follow-up CPI associated with 1 SD higher baseline predictors when controlling for age, sex, the other predictors in the model, baseline CPI, as well as for treatments received, with the latter defined in three different ways: 1) Any Treatment, 2) Any Group A, B or C Treatments, and 3) Any Group D Treatment. Group A: Medical Management/Physical Rehabilitation, Group B: Mind-body/Complementary and/or Alternative Medicine (CAM), Group C: Occlusal Treatments/Surgery, and Group D: Standard Multidisciplinary Treatments. CPI: Characteristic Pain Intensity, PCS: Physical Component Summary, MCS: Mental Component Summary, JFLS: Jaw Functional Limitation Scale, SD: Standard Deviation, CI: Confidence Interval.

Baseline Predictor	Any Treatment		Any Group A, B, C		Any Group D	
	SD-Coefficient Estimates (95% CI)	p-value	SD-Coefficient Estimates (95%CI)	p-value	SD-Coefficient Estimates (95%CI)	p-value
SF-12 PCS(SD 9.0)	-3.0 (-5.5, -0.6)	.014	-3.6 (-6.0, -1.2)	.004	-3.2 (-5.8, -0.7)	.012
SF-12 MCS(SD 9.1)	-1.2 (-3.4, 1.1)	.31	-0.81 (-3.0, 1.4)	.48	-1.2 (-3.5, 1.2)	.34
JFLS(SD 1.4)	0.47 (-3.0, 2.1)	.72	-0.31 (-2.8, 2.2)	.81	0.26 (-2.3, 2.9)	.84

Table 4:

SD-coefficient estimates represent β (regression line slope), interpreted as the difference in follow-up CPI associated with 1 SD higher baseline predictors. Weighted analyses were based on the inverse probability weighting method to address bias associated with loss to follow-up.

Type of Analysis	Baseline Predictors	Unweighted SD-Coefficient Estimates (95%CI)	p-value	Weighted SD-Coefficient Estimates (95%CI)	p-value
Bivariate	SF-12 PCS (SD 9.0)	-6.0 (-8.3, -3.6)	<.001	-6.1 (-8.5, -3.7)	<.001
	SF-12 MCS (SD 9.1)	-0.8 (-3.3, 1.6)	.51	-0.5 (-3.0, 2.0)	.72
	JFLS (SD 1.4)	5.7 (3.3, 8.1)	<.001	5.1 (2.7, 7.4)	<.001
Adjusted for sex and age	SF-12 PCS (SD 9.0)	-4.9 (-7.3, -2.4)	<.001	-5.2 (-7.8, -2.7)	<.001
	SF-12 MCS (SD 9.1)	-1.4 (-3.7, 1.0)	.26	-1.0 (-3.4, 1.5)	.44
	JFLS (SD 1.4)	5.0 (2.6, 7.3)	<.001	4.5 (2.2, 6.8)	<.001
Adjusted for baseline PCS, MCS, JFLS, sex, age, baseline CPI and any treatment	SF-12 PCS (SD 9.0)	-3.0 (-5.5, -0.6)	.014	-3.4 (-6.0, -0.9)	.009
	SF-12 MCS (SD 9.1)	-1.2 (-3.4, 1.1)	.31	-1.1 (-3.4, 1.2)	.34
	JFLS (SD 1.4)	0.5 (-3.0, 2.1)	.72	-0.7 (-3.2, 1.8)	.59

Table 5:

SD-coefficient estimates represent β (regression line slope), interpreted as the difference in follow-up CPI associated with 1 SD (9.0) higher baseline PCS at different values of baseline CPI, controlling for age, sex, MCS and JFLS. CPI: Characteristic Pain Intensity, PCS: Physical Component Summary, MCS: Mental Component Summary, JFLS: Jaw Functional Limitation Scale, SD: Standard Deviation, CI: Confidence Interval.

Baseline CPI	SD-Coefficient Estimates	95%CI	p-value
Minimum(6.7)	3.7	(-2.6, 10.1)	.25
Maximum(100)	-9.4	(-15.2, -3.7)	.001
StatisticallySignificance (51.3)	-2.6	(-5.1, 0.0)	.050
ClinicallySignificance(68.7)	-5.0	(-7.9, -2.1)	.001