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Predicting the number of physical therapy visits and patient satisfaction in individuals with temporomandibular disorder: A cohort study

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Abstract

Background: Temporomandibular disorders (TMD) can be challenging to manage for clinicians and patients alike. It is unclear which factors are associated with prolonging conservative care and patient dissatisfaction with treatment outcomes.

Objectives: To examine factors collected during a physical therapy (PT) evaluation in a cohort of individuals with TMD to determine factors associated with an increased number of PT visits and reduced patient satisfaction.

Methods: Records of 511 patients referred to PT over 18 months were reviewed to extract 27 variables to develop a predictive model. Outcomes were patient satisfaction following PT and number of PT visits. Linear and zero inflated negative binomial regressions were used, and a multivariate regression model was built for both outcomes.

Results: Two factors were associated with both lower patient satisfaction and an increased number of PT visits: higher patient rated functional neck disability and a greater number of healthcare professionals seen. Other factors associated with patient satisfaction were duration of symptoms, subluxation, and referral from an oral surgeon. Only patient rated functional neck disability score was a significant predictive factor in the multivariate model. Factors associated with number of PT visits were gender, educational level, time between initial visit and discharge, number of pain areas, bruxism, biopsychosocial factors, dizziness, pain rating, and presence of neck pain. In the multivariate model, gender, number of healthcare professionals seen, and resting pain rating were significant predictors of number of PT visits.

Conclusion: Considering key factors on initial evaluation, specifically functional neck disability and the number of prior healthcare professionals seen before starting PT, can help to predict a higher number of PT visits and reduced patient satisfaction with outcomes.

KEYWORDS

episode of care, interdisciplinary, patient satisfaction, temporomandibular joint disorders, treatment outcome

1 | INTRODUCTION

Temporomandibular disorders (TMD) involve the temporomandibular joints, masticatory muscles, and associated tissues. It is estimated that 4.8 percent of U.S. adults (11.2–12.4 million) have pain in the face that maybe related to TMD.[1] Management of individuals with TMD can be a challenging endeavor for clinicians and patients alike, as well as for third-party payers.[2] Actual costs in the management of TMD are difficult to determine. In 1995, Fricton and Schiffman estimated the annual cost for treating craniofacial pain and TMD to be as high as 32 billion dollars.[3] Twenty-five years later, one can only imagine the annual costs associated with craniofacial pain and TMD management. Higher costs may be driven by factors related to a patient's search for quality care or by factors that differentially affect the typical course of resolution of TMD symptoms. Factors of cost related to a patient's search for quality care may be affected by the number of healthcare professionals seen for TMD-associated services.[3,4] This in turn may be driven by the lack of understanding and experience of various healthcare professionals concerning appropriate evidence based management of TMD, as well as inconsistencies in professional training related to TMD.[5-8] Factors of cost that can differentially affect the course of resolution of TMD symptoms involve comorbidities that can affect the resolution of typical TMD symptoms and factors associated with developing a chronic persistent pain condition.

Over 30 comorbidities have been considered to be associated with TMD.[1] With varying levels of evidential support, several comorbidities considered as contributing to the development of or the persistence of symptoms in individuals with TMD include sleep apnea,[9] headache (migraine),[10,11] bruxism,[12] biopsychosocial distress,[13] and neck pain.[14-16] Whether or not all these comorbidities increase the risk of developing TMD or just co-exist with it is unknown, but the strongest predictor of TMD incidence found thus far is frequency of somatic symptoms.[17] The extent that these comorbidities actually interfere with or prolong achieving satisfactory treatment outcomes in individuals with TMD is unclear.

There are several recommended conservative approaches to the management of TMD including appliance therapy, physical therapy (PT), and pharmacological management.[18] The focus of this paper is on PT management. PT is recognized as an evidence based conservative approach to the management of TMD[19-21] as well as for the treatment of several comorbidities that accompany TMD, including neck pain and headache.[22-25] Successful PT treatment requires clinical decision making to carefully consider the factors that might affect the course of the condition to guide the intervention strategy and to rule out other conditions. Successful PT also requires effective collaboration with other healthcare professionals involved in the care of individuals with TMD, particularly dentists and physicians. The current recommendation for the management of TMD is an interdisciplinary biopsychosocial approach that is focused on the individual and not the condition to promote overall health and wellbeing.[2] To fulfill this recommendation, all members of the interdisciplinary team and the patient should be informed about what factors may interfere with or prolong the attainment of satisfactory treatment outcomes. Thus, while this study focuses on outcomes from PT, other members of the healthcare team that work with TMD, specifically dentists and physicians, will benefit from understanding those factors that drive outcomes in this patient population.

Clinical Implications

- Patients with a variety of TMD diagnostic subsets referred to PT by dental professionals are satisfied with their outcomes following PT.
- Lower patient satisfaction and an increased number of PT visits were associated with a higher initial patient rated functional neck disability and a higher number of healthcare professionals seen before starting PT.
- Several factors were associated with increasing the number of PT visits but female patients who saw a higher number of healthcare professionals prior to starting PT and who had a higher pain rating significantly predicted an increased number of PT visits.
- Earlier access to PT for individuals with acute or chronic TMD may be one route to reducing the significant healthcare costs associated with this condition.

When designing a plan of care for an individual with TMD, physical therapists establish a diagnosis for treatment with consideration of factors that may impact an individual's prognosis, including pain-associated psychological distress. The goal of the examination of an individual with TMD is to classify the subtype of TMD to guide appropriate treatment selection. Physical therapy examination also includes screening for common co-existing conditions that may mimic TMD symptoms (e.g. neck pain, allergies, sinusitis, otalgia, and odontalgia) as well as uncommon systemic comorbidity causes (e.g. RA, gout) affecting the TMJ, which would necessitate patient referral.[26-28] Limited evidence exists to inform all parties of the typical number of PT visits associated with satisfactory resolution of symptoms in different forms of TMD,[29] and there is a general lack of evidence to inform appropriate determination of prognosis during the clinical decision making process. Additionally, understanding the patient perspective including satisfaction in their experience with PT intervention is limited for individuals with TMD.[29] There is some evidence to support that individuals are highly satisfied with PT care aimed at musculoskeletal problems across different outpatient settings.[30] However, satisfaction has been shown to be lower in patients with chronic musculoskeletal conditions compared to patients with acute musculoskeletal conditions.[31] Considering that the duration of symptoms in the majority of individuals with TMD seen in outpatient PT is usually more than 3 months and thus chronic in nature,[4,32] satisfaction with PT may well be lower in individuals with TMD compared to other musculoskeletal conditions.

The purpose of this study is to retrospectively examine intake factors collected during a PT initial evaluation in a large cohort of

individuals with TMD to determine which factors were associated with an increased number of PT visits and with reduced patient satisfaction following treatment. The significance of this study lies in informing all members of the interdisciplinary team, including patients themselves, about expectations from a PT episode of care by identifying those factors that are likely to impact the length of care as well as patient satisfaction with care. Identifying factors that contribute to a higher number of patient care visits will also provide justification to third party payers that cost of care should not be based solely on diagnostic classification. Finally, given the increasing emphasis on understanding and improving patient satisfaction ratings,[33] results from this study will help to inform a universal goal of improving patient-centered healthcare for individuals with TMD.

2 | MATERIALS AND METHODS

2.1 | Subjects

This was an IRB approved, retrospective cohort study. All consecutive new patients referred to one outpatient PT clinic run by one author (SK), a licensed PT with extensive clinical experience examining and treating individuals with TMD, were included in the study if they met the inclusion criteria. Inclusion criteria were referral from a dental professional including general dentists and any subspecialty (e.g. orthodontic, periodontics, prosthodontist, endodontist, oral maxillofacial surgeon), and ability to complete intake forms and follow instructions. The period of observation was approximately 18 months (April 30, 2007, through April 4, 2008, and October 31, 2008, through May 6, 2009), and a total of 579 patients were referred during this timeframe and records reviewed for inclusion. Sixty-three of the 579 patients were omitted because they were referred by a physician. Of the 516 patients referred by dentists, 3 patients were omitted because of active pathology (cancer in nasopharyngeal space, blocked parotid gland duct, and a cracked tooth), 2 were omitted due to an inability to complete the necessary forms (1 mentally challenged and another with Alzheimer's disease). A total of 511 patients met all inclusion criteria, and their records were thus included in the study.

At the initial visit and before being evaluated by the PT, all patients were asked to fill out a medical history questionnaire, symptom questionnaire, a symptom location diagram and to complete the Copenhagen Neck Functional Disability Scale[34] (CNFDS) questionnaire. Patients completed all forms without assistance while in the waiting area. Front-office staff reviewed forms for missing information and brought to the patient's attention any portion of a form not completed to allow a chance to complete if desired. The CNFDS is a patient-rated outcome tool consisting of 15 items, scored from 0 to 30 to indicate the level of functional neck related disability, with a maximum score of 30 indicative of high levels of perceived disability.[34] The CNFDS is a multidimensional scale that captures 3 factors related to participation restriction on psychosocial function, disability in activities of daily living, and cognitive functioning.[35] A 9-point change during treatment would be considered a clinically meaningful change.[36] Patient records were retrospectively reviewed to identify 27 variables for use in developing a predictive model (Table 1). The criteria used to diagnose the subtypes of TMD followed Axis I of the 1992 Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) guidelines.[37] All patient evaluations, patient treatments, and patient discharge were done by the same PT, and thus, bias could not be minimized.

2.2 | Outcomes

Primary outcomes were patient satisfaction and number of PT visits. Number of PT visits for each patient were extracted from the medical record. To evaluate patient satisfaction in response to PT, a mailed questionnaire was used. Approximately 8 weeks after discharge or 8 weeks after the last PT visit, patients were mailed a patient satisfaction questionnaire along with a stamped return envelope. Not all patients completed the recommended number of PT visits. Front-office staff attempted contact with patients by phone to reschedule. All 511 patients, regardless if they completed the recommended PT sessions or not, were sent a questionnaire. If the questionnaire was not returned, a reminder phone call to the patient was made alerting them that another copy of the questionnaire would be mailed to them and requesting them to complete and return it. This was repeated at 4 months post visit. Response rate of the questionnaire was 74%. The questionnaire consisted of one primary question stem "How much did physical therapy help you with the following symptoms/problems?" This question pertained to 12 symptoms/problems: Headache, Jaw pain/tension, Limited mouth opening, Jaw popping, Jaw locking, Pain with chewing, Clenching/grinding of teeth, Neck and shoulder pain/tension, Waking up at night due to headache/jaw/neck pain, Headache/jaw/neck pain while sitting, Ear pain/ringing/fullness/other, and Dizziness. Subjects were asked to circle the number from 0–10 that best indicated their response related to each symptom or problem, where 0 represented "Did not help" and 10 represented "Helped a great deal". Subjects had the option to check a box that indicated they did not have the symptom or problem at the time of therapy if it was not relevant to them. Satisfaction was averaged across all questions to give a general satisfaction rating from 0 to 10. Satisfaction values >6 were defined as satisfied versus not satisfied.[29]

2.3 | Data analysis

Demographic variables were summarized descriptively with mean (SD) and or count (%). Two main outcome variables were considered, overall patient satisfaction and the total number of care visits. Linear regression assessed the relationship between overall patient satisfaction and the variables of interest. Zero-truncated negative binomial regression was used to analyze the relationship between the number of care visits and the variables of interest, reporting the incident

rate ratio (IRR) and respective 95% confidence interval (95% CI). The confidence interval and standard errors were estimated using bootstrapping with 1500 replicates. The zero-truncated negative binomial model is appropriate as the number of visits was highly skewed and every observation had at least one visit to be included in the data set. Missing data were left blank. Variables were considered individually in a univariate model and in a multivariate model with backwar regression for both outcomes. Statistical significance was set at the 0.05 level, and statistical analysis was done in R version 3.6.2.

3 | RESULTS

There were 511 patients included in the sample for analysis. Table 2 contains demographic information on the sample. The average age was 43.9 (range: 8–85) and 89 (17%) were male. Average overall patient satisfaction was 6.7 (SD = 2.5) out of a total possible score of 10 and the median number of visits was 4 (Range = 1–43). Most patients were either college graduates (38%) or post-graduate (24%).

TABLE 1 Predictor variables extracted from the patients' medical records

Variable	Description
Data from patient intake form	
Age	Years
Gender	Male/female
Distance from PT clinic	Miles
Education level completed	1 = Less than high school which includes middle school, in high school, and some high school 2 = High school grad or technical school 3 = Partial college −in college or some college 4 = College graduate 5 = Post-graduate
Number of medications currently prescribed	Total number
History of prior jaw surgery	1 = yes, 2 = no
History of trauma to the jaw	1 = yes, 2 = no
Dental referral source	1 = Dentist 2 = TMJ specialist[a] 3 = Oral surgeon
Number of healthcare professionals seen for this problem	Total Number
Time since onset of symptoms	1 = <4 weeks 2 = 4–12 weeks 3 = 3 months to <6 months 4 = 6 months to <1 year 5 = 1 year to <2 years 6 = 2 years to <5 years 7 = 5 years plus
Time between initial visit and discharge	Total number of days
Resting numeric pain rating score (NPRS) at initial visit	0–10
Total number of areas on pain diagram[b]	1–4
Self-reported history of migraine	1 = yes, 2 = no
Self-reported history of headache (non-migraine)	1 = yes, 2 = no
Self-reported neck pain	1 = yes, 2 = no
Self-reported dizziness	1= yes, 2 = no
Self-reported bruxism	1 = yes, 2 = no
CNFDS score at initial visit[c]	Total score (0–30)
Biopsychosocial factors[d]	Total number (0–15)
Use of antidepressants at initial visit	1 = yes, 2 = no
Prior imaging jaw	1 = yes, 2 = no
Total number of oral appliances prescribed	Total number (including 0)

Continues

TABLE 1 (Continued)

Variable	Description
Diagnosis given on referral[e]	1 = Myofascial 2 = Trismus 3 = TMD 4 = Degenerative joint disease 5 = Disc displacement with reduction 6 = Disc displacement without reduction 7 = Functional disc displacement without reduction 8 = TMJ pain 9 = Jaw pain 10 = Ear symptoms 11 = Status post-arthroplasty 12 = Status post-arthroscopy 13 = Status post-arthrocentesis 14 = Neck pain 15 = Migraine 16 = LBP 17 = Total joint TMJ 18 = Post-orthognathic 19 = Status post-trauma 20 = Headache
Data from physical therapy examination	
Number of diagnostic subsets	Total Number (1–8)[f]
Signs of subluxation[g]	1 = yes, 2 = no
TMD headache[h]	1 = yes, 2 = no

[a]TMD specialist was self-defined by the dentist (including advertising themselves as such) or a Diplomate of the American Board of Orofacial Pain.

[b]Areas of pain = face, sub-occipital, neck, jaw/temple.

[c]CNFDS = Copenhagen Neck Functional Disability Scale where higher scores indicate greater disability.

[d]Total number of positive "Yes" responses based on intake questionnaire: Moodiness, loss of job, depression, forgetfulness, nervousness, grief due recent death, lack of emotional support, unable to participate in activities, significant stress home, significant stress work, significant stress other, difficulty with daily activities, difficulty with self-care, difficulty with housekeeping duties, transportation problems.

[e]Diagnosis given on referral exactly as written by the referring provider.

[f]Consistent with RDC-TMD. 37. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord 1992;6:301–355.

[g]Subluxation is defined here as an excessive condylar translation of one or both condyles where the condylar head(s) move anterior to the eminence associated with aberrant jaw movement and/or clicking, both occurring at the end of wide mouth opening with the mouth being able to close. Condyle catching briefly on closing from a wide-open position may or may not occur. 71. Kummoona R. Surgical managements of subluxation and dislocation of the temporomandibular joint: clinical and experimental studies. J Craniofac Surg 2010;21:1692–1697.

[h]TMD headache is defined as headache located in the temple(s) and headache is modified by functional and/or parafunctional activity. Familiar headache is modified by at least one of the following provocation tests: palpation of the temporalis muscles(s) or maximum unassisted or assisted opening, right or left lateral or protrusive movement(s). 49. Schiffman E, Ohrbach R, Truelove E, Look J, Anderson G, Goulet JP, et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: recommendations of the International RDC/TMD Consortium Network and Orofacial Pain Special Interest Group. J Oral Facial Pain Headache 2014;28:6–27.

3.1 | Patient satisfaction

Patients reported an overall mean satisfaction satisfied with their PT of 6.7 (SD = 2.5) and approximately 73% (n = 261) achieved a satisfaction score above 6 (Figure 1, Table 3). Table 4 contains the coefficients, 95% confidence intervals, and p-values for all variables considered in a univariate model. In the univariate linear regression model predicting overall patient satisfaction, there were five significant factors. Overall patient satisfaction was negatively associated individually with initial CNFDS score ($\beta = -0.07$, $p = .0116$), duration of symptoms ($\beta = -0.25$, $p = .0005$), number of healthcare professionals seen ($\beta = -0.19$, $p = .0143$), signs of subluxation ($\beta = -0.87$, $p = .0484$), and referral by an oral surgeon ($\beta = -0.98$, $p = .0426$). Considering duration of symptoms, this indicates that for every 1 day increase in the duration of symptoms there would be an expected decrease in overall patient satisfaction by 0.25 units. When considering these covariates in a multivariate model, only the initial CNFDS score was a statistically significant predictor of overall patient satisfaction such that higher levels of self-reported neck functional disability were associated with reduced patient satisfaction (Figure 2, Table 5).

3.2 | Number of PT visits

The average number of PT visits was 6 (Table 3). For prediction of the number of PT visits, the univariate zero-truncated negative

binomial regression model identified eleven significant predictive factors (Table 4). Gender showed that males had less visits than females with 1.4 times the number of visits for females compared to males, indicating if males averaged 4.6 visits the model would expect females to have approximately 6.4 visits ($p = .0019$). Individuals who completed post-graduate education were more likely to have a larger number of care visits than those who completed a middle/high school degree by a factor of 1.4 ($p = .0416$). Those who completed middle school/high school education were more likely to have a smaller number of care visits than those who completed a post-graduate degree. As expected, time between initial visit and discharge was a significant predictor of number of visits ($p =< .0001$). For every additional healthcare provider seen before referral to PT, the number of care visits would be expected to increase by a factor of 1.1, meaning a patient who saw no additional healthcare providers

TABLE 2 Demographic and Predictor Variables for the Sample ($n = 511$)

Variable	*N*	Mean (SD) or *n* (%)
Age (mean [range])	511	42.41 (8–85)
Gender, male	511	89 (17%)
Distance from PT (miles)	500	28.25 (34.1)
Education level	433	
In middle/high school		39 (9%)
HS grad/technical school		41 (9%)
Partial college (in or some college)		84 (19%)
College graduate		164 (38%)
Post-graduate		105 (24%)
Number of medications currently prescribed	511	2.03 (1.9)
History of prior jaw surgery	511	63 (12%)
History of trauma to the jaw	511	31 (6%)
Dental referral source	511	
TMJ specialist		317 (62%)
Dentist		87 (17%)
Oral surgeon		107 (21%)
Prior number of healthcare providers seen (mean [range])	511	3.2 (1–10)
Time since onset of symptoms	511	
< 4 weeks		91 (18%)
4–12 weeks		157 (31%)
3–6 months		86 (17%)
6–12 months		61 (11%)
>12 months		116 (23%)
Time between initial visit and discharge (days)	510	60.63 (140.1)
Resting numeric pain rating score at initial visit	445	4.60 (2.5)
Total number of areas on pain diagram	511	8.57 (7.5)
Self-reported history of migraine	511	95 (19%)
Self-reported history of headache (non-migraine)	511	328 (64%)
Self-reported neck pain	511	315 (62%)
Self-reported dizziness	511	62 (12%)
Self-reported bruxism	511	342 (67%)
CNFDS score at initial visit	297	8.06 (6.5)
Biopsychosocial factors	511	1.67 (2.4)
Use of antidepressants at initial visit	511	124 (24%)
Prior imaging jaw	511	362 (72%)
Total number of oral appliances prescribed	274	1.90 (1–9)
Diagnosis given on referral	511	
Myofascial		364 (71%)
Trismus		18 (4%)
TMD		18 (4%)
Degenerative joint disease		50 (10%)
Disc displacement with reduction		48 (9%)
Disc displacement without reduction		91 (18%)
Functional disc displacement with reduction		14 (3%)
TMJ pain		148 (29%)
Jaw pain		12 (2%)
Ear symptoms		1 (0.2%)
Status post-arthroplasty		12 (2%)
Status post-arthroscopy		6 (1%)
Arthrocentesis		6 (1%)
Neck pain		80 (16%)
Migraine		6 (1%)
Low back pain		1 (0.2%)
Total joint TMJ		1 (0.2%)
Post-orthognathic		5 (1%)
Status post-trauma		3 (0.6%)
Headache		
PT evaluation number of diagnostic subsets	511	1.79 (0–4)
Myofascial pain without limited opening		321 (63%)
Myofascial pain with limited opening		106 (21%)
Disk displacement with reduction		88 (17%)
Disk displacement without reduction with limited opening		70 (14%)
Disk displacement without reduction without limited opening		41 (8%)
TMJ arthralgia		240 (47%)
Osteoarthritis		24 (5%)
Osteoarthrosis		25 (5%)
Signs of subluxation	511	61/511 (12%)
TMD headache	511	97 (19%)

(Continues)

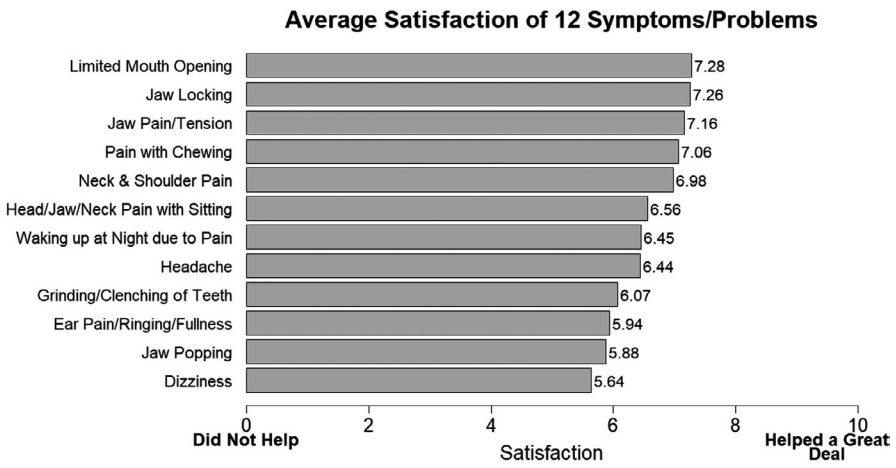

FIGURE 1 Mean patient satisfaction across symptom area with an overall satisfaction of 6.7

TABLE 3 Primary Outcomes ($n = 511$)

Variable	*N*	Mean (SD) or *n* (%)
Overall patient satisfaction (0–10)	357	6.68 (2.5)
Number of visits (mean [range])	511	5.92 (1–43)

averages 5.4 visits and a patient who saw two additional healthcare providers before referral would be predicted to average approximately 6.5 visits ($p = .0002$). Similarly, every additional pain area identified on intake was associated with a slightly increased number of care visits (a factor of 1.2, $p = .0006$). Presence of neck pain was associated with having a number of care visits 1.4 times greater than those without neck pain indicating a patient without neck pain averages 5 visits and a patient with neck pain would be expected to average approximately 7 visits ($p = .0004$). Individuals with bruxism are expected to have a number of care visits 1.2 times greater than those without (0.0288). Similarly, a nine-point increase in the CNFDS score, and a one-unit increase in the number of biopsychosocial factors were each associated with an increase in the expected number of PT visits by a factor of 1.27 ($p = .0020$) and 1.05 ($p = .0096$), respectively. Dizziness was associated with a number of PT visits 1.3 times greater compared to those without dizziness ($p = .00363$). Finally, a one-unit increase in resting pain level based on initial pain rating was associated with an increase in the expected number of PT visits by a factor of 1.08 ($p < .0001$).

When considering these significant univariate factors in a multivariate model, only gender, the number of healthcare professionals seen, and the pain rating together were statistically significantly associated with the number of care visits (Table 5). Both number of healthcare professional seen (IRR = 1.07, 95% CI: 1.01–1.12, $p = .0161$) and pain rating (IRR = 1.07, 95% CI: 1.03–1.11, $p = .0003$) showed that the number of care visits increased for each additional healthcare professional seen and for a one-unit increase in pain rating, respectively. Figure 3 shows the predicted number of care visits based on the pain rating as a function of the number of healthcare professional seen and gender. In this figure, males would have a lower number of visits compared to females regardless of pain rating and number of healthcare providers (IRR = 0.71, 95% CI: 0.56–0.91, $p = .0069$). However, both genders are predicted to have an increased number of PT visits if they present with increased pain levels and a higher number of healthcare providers seen before PT.

4 | DISCUSSION

Comprehensive evidence based approaches to care for individuals with TMD are of critical importance.[2] Physical therapy is an evidence based, conservative and, individualized approach to the management of TMD, which is built on a biopsychosocial model of care.[19-21] The purpose of this study was to retrospectively examine intake factors collected during a PT initial evaluation in a cohort of individuals with TMD to determine which factors were associated with an increased number of PT visits and with reduced patient satisfaction following treatment. Understanding factors that can prolong the course of care is important for informing patients, for justifying prognosis and treatment planning, and for understanding cost of care associated with TMD. Additionally, understanding the patient perspective including satisfaction in their experience with PT intervention is limited for individuals with TMD.[29] Results of the current study showed that there were two common factors associated with lower patient satisfaction and an increased number of PT visits: a higher initial patient rated functional neck disability and a larger number of healthcare professionals seen before starting PT. Patient satisfaction was additionally associated with singular factors of a longer duration of symptoms, signs of subluxation on initial evaluation, and a referral to PT from an oral surgeon. In terms of predicting patient satisfaction, only patient rated functional neck disability score was a significant predictive factor. Singular factors associated with an increased number of PT visits were patient gender, educational level, time between initial visit and discharge, the number of pain areas, self-reported bruxism, a higher number of biopsychosocial factors, dizziness, initial pain ratings, and the presence of neck pain. Taken together, female gender, a higher number of healthcare professionals seen, and higher pain rating were significant predictors of an increased number of PT visits. The results of this study provide novel findings that can inform treatment planning and patient and

TABLE 4 Univariate linear regression coefficients, 95% confidence interval, and *p*-value for the overall patient satisfaction outcome

	Overall Patient Satisfaction		Number of PT visits	
	β (95% CI)	*p*-value	IRR (95% CI)	*p*-value
Age	0.003 (−0.01, 0.02)	.7600	1.004 (0.99, 1.01)	.1156
Weight	0.002 (−0.01, 0.01)	.5850	0.997 (0.99, 1.00)	.0513
Gender, female	0.069 (−0.64, 0.78)	.8480	1.44 (1.14, 1.81)	.0019
Education level (Reference group = Post-graduate)				
In middle/high School	0.129 (−0.97, 1.23)	.8170	0.676 (0.46, 0.99)	.0416
HS grad/Technical school	−0.639 (−1.69, 0.41)	.2310	0.753 (0.52, 1.09)	.1292
Partial college	0.171 (−0.72, 1.06)	.7060	0.883 (0.66, 1.18)	.3956
College graduate	0.373 (−0.36, 1.11)	.3180	0.798 (0.62, 1.02)	.0720
Distance from PT	0.0002 (−0.01, 0.01)	.9960	1.001 (0.99, 1.01)	.4643
Time between initial visit and discharge	0.002 (−0.002, 0.006)	.2500	1.005 (1.00, 1.01)	<.0001
Number of Meds	−0.067 (−0.21, 0.07)	.3440	1.013 (0.97, 1.06)	.5780
Prior TMJ surgery	−0.497 (−1.28, 0.29)	.2120	1.02 (0.79, 1.33)	.8584
Trauma to jaw	−0.272 (−1.49, 0.95)	.6610	0.854 (0.59, 1.23)	.3962
Referral by (Reference group = Dentist)				
TMJ specialist	0.085 (−0.62, 0.79)	.8110	0.832 (0.66, 1.05)	.1196
Oral surgeon	−0.979 (−1.73, −0.03)	.0426	0.922 (0.70, 1.21)	.5618
Number of healthcare professionals seen	−0.188 (−0.34, −0.04)	.0143	1.095 (1.04, 1.15)	.0002
Duration of symptoms	−0.247 (−0.39, −0.11)	.0005	1.035 (0.99, 1.09)	.1487
Total number of diagnostic subsets	−0.096 (−0.35, 0.16)	.4680	1.058 (0.97, 1.15)	.2010
Diagnosis of subluxation	0.866 (0.01, 1.72)	.0484	1.117 (0.86, 1.45)	.4056
Total number of pain areas	−0.102 (−0.42, 0.22)	.5300	1.198 (1.08, 1.33)	.0006
Neck pain	−0.268 (−0.84, 0.30)	.3580	1.418 (1.17, 1.72)	.0004
Jaw pain	0.588 (−063, 1.81)	.3440	1.262 (0.83, 1.93)	.2810
Face pain	−0.157 (−0.68, 0.36)	.5530	1.18 (0.99 1.40)	.0558
Self-reported migraine	−0.087 (−0.77, 0.60)	.8030	1.080 (0.87, 1.34)	.4890
Headache	−0.291 (−0.83, 0.25)	.2870	1.109 (0.93, 1.33)	.2591
Self-reported bruxism	0.469 (−0.08, 1.02)	.0947	1.226 (1.02, 1.47)	.0288
CNDFS initial score	−0.071 (−0.13, −0.02)	.0116	1.027 (1.01, 1.04)	.0020
Biopsychosocial factors	−0.107 (−0.22, 0.01)	.0767	1.047 (1.01, 1.08)	.0096
Use of antidepressants	−0.197 (−0.81, 0.42)	.5290	1.078 (0.88, 1.31)	.4617
Prior imaging	−0.382 (−0.95, 0.19)	.1910	0.883 (0.73 1.06)	.1935
Dizziness	−0.650 (−1.46, 0.16)	.1170	1.313 (1.02, 1.69)	.0363
Number of oral appliances	−0.180 (−0.41, 0.05)	.1190	1.021 (0.94, 1.11)	.6210
Resting NPRS	−0.002 (−0.12, 0.12)	.9800	1.081 (1.04, 1.12)	<.0001

Note: Univariate incidence rate ratio, 95% confidence interval, and *p*-value for the number of care visits outcome based on a zero truncated negative binomial regression model.

provider expectations as well as to provide insight on factors that may drive prolonged treatment and thus an increased burden of care for individuals with TMD.

4.1 | Biopsychosocial factors

Patients with TMD can present with high intensity pain-related impairment and high to moderate levels of somatization and depression.[38] Psychosocial factors have been shown to be a predictor of treatment outcome in individuals with TMD.[39] Physical therapy is based on a biopsychosocial model of care.[40] Biopsychosocial distress in individuals with TMD has previously been classified in the range of none to severe.[41] The majority of patients (86%-92%) were classified in the none, minimal, mild, to moderate range. Physical therapists are trained to address this range of biopsychosocial distress by reducing pain,[42] promoting aerobic exercise,[43,44] improving general relaxation,[45] reducing fear of movement,[46] and addressing unnecessary distress/fear that can come from healthcare professionals offering misinformation and conflicting information

pertaining to diagnosing and treatment of TMD.[2] Typical behavioural modifications needed in TMD management via biobehavioural strategies[5] can often be done without the need for referral to a psychologist, but referral may be needed or advisable in some cases.[41] In the current study, fifteen biopsychosocial factors were evaluated on intake (see footnote d in Table 1). However, the factors assessed were based on a yes/no questionnaire only without validation of whether patients accurately reported their answers. The number of biopsychosocial factors present on intake did not predict patient satisfaction and only slightly increased the likelihood of an increased number of PT visits. Using a total number of biopsychosocial factors versus considering factors independently was an attempt to capture biopsychosocial load or burden, and thus, it is possible that additional or more focused biopsychosocial factors may individually have been predictive. Previous evidence has shown that individuals with TMD can vary in their self-reported pain, levels of depression and somatization, and self-reported physical well-being compared to individuals without TMD.[47,48] Individuals with a combination of several clinical presentations of myofascial pain, disc displacement, and degenerative joint disorder have also been shown to have greater somatization relative to individuals without TMD or those with singular TMD diagnoses of myofascial pain, disc displacement, or degenerative joint disorders.[47,48] Current diagnostic criteria for TMD includes the collection of information related to behavioural and psychosocial factors.[49] Inclusion of instruments such as the Graded Chronic Pain Scale and the Patient Health Questionnaire (PHQ-4 or PhQ-9) into the evaluative process may help to individualize PT care. These biopsychosocial assessment tools were not readily available at the time of data collection for this study. However, based on the results of the current study, consideration of such factors may not contribute to a decrease in patient satisfaction or help as much with predicting the number of PT visits. However, consideration of coping strategy in addition to biopsychosocial factors in select cases may be warranted to help inform prognosis similar to what has previously been shown for individuals with TMD who underwent a cognitive-behavioural intervention.[50]

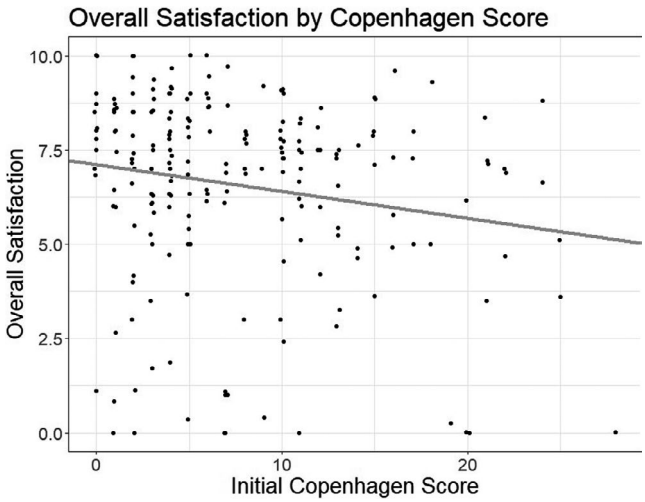

FIGURE 2 Scatterplot of the initial Copenhagen score by the overall satisfaction. The blue line represents the linear regression fit to the relationship

4.2 | Number of healthcare providers

In the current study, one factor that was associated with both a lower patient satisfaction and an increased number of PT visits was the number of healthcare professionals seen before starting PT. When considering prediction of the number of PT visits, the combination of the number of healthcare professionals seen, gender, and pain level was predictive of the number of PT visits. Patients with TMD often consult with multiple healthcare professionals, which can lead to conflicting diagnoses and treatment recommendations. Individuals in the cohort of the current study saw an average of 3.2 providers prior to PT, with a range of 1 to 10 previous providers. However, the PT in the current study was well known in the geographic area and had established referral pathways with surrounding dentists. Therefore, it is likely that the number of healthcare professionals seen may underestimate the experience of the typical patient with TMD seeking PT care. The results of the current study suggest that patients who see a higher number of healthcare professionals before starting PT are more likely to be less satisfied and have a higher number of PT visits. Thus, considering the number of previous healthcare providers seen on a clinical intake may inform extending the plan of

TABLE 5 Multivariate regression models for overall patient satisfaction and the number of care visit outcomes

Overall patient satisfaction		
Covariate	**Coefficient (95% CI)**	***p*-value**
CNDFS initial score	−0.071 (−0.13, −0.02)	.0116
Number of PT Visits		
Covariate	**Incidence Rate Ratio (95% CI)**	***p*-value**
Gender	0.714 (0.56, 0.91)	.0069
Number of healthcare professionals seen	1.066 (1.01, 1.12)	.0161
Resting NPRS	1.069 (1.03, 1.11)	.0003

Note: Covariates that were significant in the univariate model or of particular interest clinically were included. The linear regression coefficient or univariate incidence rate ratio, 95% confidence interval, and *p*-value are reported.

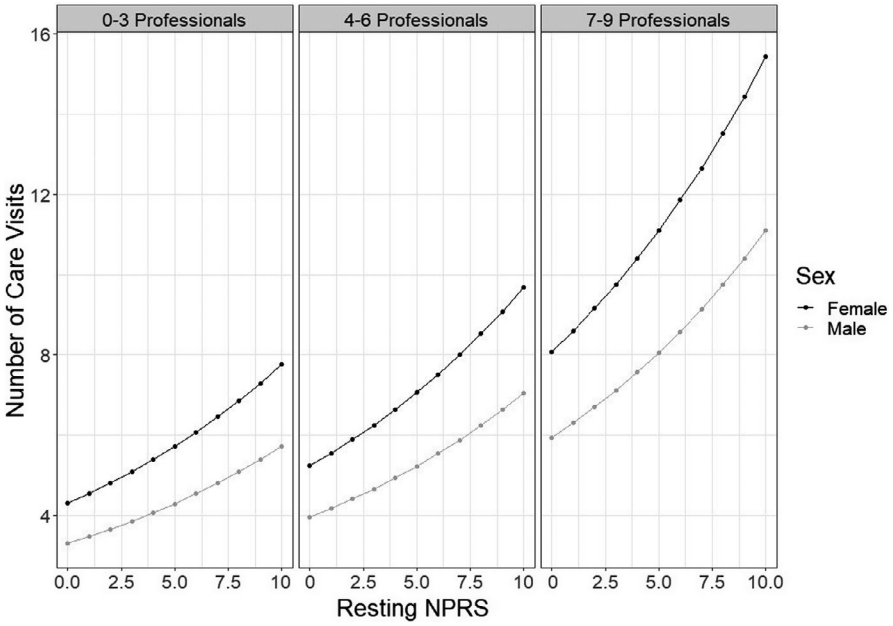

FIGURE 3 The predicted number of care visits based on the resting numeric pain rating scale, the grouped number of professionals seen, and gender from the multivariate zero truncated negative binomial regression model. NPRS, Resting numeric pain rating scale. Grouping by number of professionals is for illustrative purpose only

care for a patient. It is not unusual for patients to consult with their primary care physician, their dentist, other dentists who advertise a TMJ specialty, a neurologist, an otolaryngologist, complementary alternative clinicians, or other physical therapists. Differences in training and terminology used among different healthcare professions can make it confusing for patients, and interactions with different professionals can increase patient anxiety and depression over their condition, particularly if catastrophic language is used as has been shown in individuals with chronic low back pain.[51] Additionally, differences in and experience of healthcare providers related to the treatment of individuals with TMD can impact the recommendations and treatments offered to patients. Early access to PT in other conditions has shown increased cost-effectiveness in fewer visits than physician-first access in the United States, with greater functional improvement.[52] Every state in the United States, the District of Columbia, and the US Virgin Islands allow for physical therapists to evaluate followed by some form of treatment without a physician or dental referral. Earlier referral to PT for individuals with TMD and its effects on cost saving and improved quality of care should be further examined.

The standard of care for individuals with TMD is a conservative, reversible, individualized, and evidence-based approach to both diagnosis and treatment of TMD,[18,53] and evidence-based care should include evidentiary support together with clinical judgment and patient-values and expectations. The three evidence-based approaches to conservative care that are currently recommended are appliance therapy, pharmacological management, and PT that in addition to utilization of modalities and procedures (manual therapy and therapeutic exercise) focuses on behavioural modification.[18] This places dentists, physical therapists, and physicians clearly on the interprofessional team for the initial management of acute or chronic TMD. Learning how to work together to expedite care and reduce the number of healthcare professionals involved to provide coordinated and multi-disciplinary care should be a priority for improving care of individuals with TMD.[2] In addition to improving care, reducing the number of healthcare providers seen will likely reduce the overall burden of cost for managing this condition.

Individuals with TMD have reported that they have spent thousands of dollars (e.g., $25,000) in out-of-pocket payments for tests, appliances, and care not covered by their insurance.[2] Costs associated with TMD have been estimated based on chronic orofacial pain costs, and these costs include consultation, medication, and oral appliances as well as the cost of imaging, medical, and dental interventions.[2] Seventy two percent of individuals in the current study had previous imaging. Fifty four percent of individuals had worn or were wearing an oral appliance at the time of the examination and patients noted that the cost for their oral appliance fabricated by their dentist ranged from $200 to $6,000, with an average cost estimated to be $1,000 per appliance. In a study conducted in the United Kingdom, the average cost of orofacial care for a group of 198 patients was estimated to be approximately $2,280 with consultations (i.e. visits to healthcare professionals for discussion) having the highest cost.[54] Therefore, reducing the number of consultations with different healthcare providers, and potentially the number of oral appliances fabricated, that a patient with TMD has could have a significant impact on reducing the cost of TMD care. The evidence from the current study suggests that increasing the number of healthcare providers is associated with reduced patient satisfaction and an increased number of PT visits that would further increase the cost of care. Streamlining access to appropriate evidence-based care and reducing the number of healthcare professionals seen prior to referral to PT may be advantageous for improving satisfaction and reducing cost of care.

Cost of care was not a collected outcome in the current study. Retrospectively assessing cost of care is difficult given differences in insurance coverage and regional differences in healthcare charges. Patients using insurance to cover costs would typically use a copay plus the deductible cost for PT. A conservative current estimate of

the average cost of PT for patients paying out-of-pocket would be approximately $200–300 for an initial evaluation and $150–200 per treatment visit thereafter. Given that the average number of PT visits in the current sample was 6, this would yield a conservative average cost of PT care of $1300 for individuals in this cohort. Reducing the number of healthcare consultations prior to PT initiation would be one way to reduce healthcare costs for this population. Going forward, outcome studies that capture cost of care are needed for this population.

4.3 | Self-reported functional limitation

A predictor of both patient satisfaction and number of care visits in the current study was self-reported functional neck limitation as assessed by the CNFDS.[34] As discussed above, a patient's ability to cope with their disease has been shown to be more strongly associated with patient satisfaction than disease severity or limitations in other health conditions.[55] Self-reported functional disability of the jaw was not assessed in this study. The three-construct Jaw Functional Limitation Scale was not available at the time data were collected for this study.[56] Future studies should consider using a functional assessment tool specific to the jaw such as the Jaw Functional Limitation Scale,[56] the Craniofacial Pain and Disability Inventory,[57] or the Steigerwald/Maher TMD disability index.[58] The CNFDS used in the current study provides an indication of how limited the patient themselves feels and their perceived disability due to neck pain. A strong relationship between neck disability and jaw disability has previously been shown,[59] and patients with TMD have reported worse self-reported neck disability compared to individuals without TMD.[16] Involvement of the cervical spine may also differ as a function of subtype of TMD.[60] In the current study, the presence of neck pain with existing disability was associated with having an increased number of PT treatments compared to patients in this study without neck pain. Treatment should not only focus on the subtype(s) of TMD but on neck pain since the improvement of one (or the lack of improvement) could have an influence on the other.[59,61,62] Individuals with chronic neck pain have previously shown reduced strength in the deep neck stabilizing muscles,[63] and individuals with TMD have shown reduced neck muscle endurance compared to healthy individuals.[16,59] Physical therapy for individuals with TMD typically includes an assessment of the cervical region, including both cervical joints and muscles. Treatment often includes neck strengthening and stabilization activities, neuromuscular reeducation to improve muscle activation, joint mobilization and manipulation, and dry needling. Exercises used to improve cervical muscle functioning, manual therapy, and joint mobilization applied to the cervical spine have been shown to decrease symptoms in individuals with TMD.[64,25] However, it can take time to change a patient's behaviour,[65] improve mobility of a chronic neck condition, and change muscle function through progressive strengthening and loading. These are some of the factors that may explain why the number of PT visits was higher when neck pain was present. Evidence suggests the presence of neck pain to be associated with TMD up to 70% of the time.[15] Neck pain may contribute to the progression of TMD and increases the risk of resistance to treatment.[66] It is unclear at this time if neck pain is a comorbid condition associated with TMD or if it is implicated in the pathogenesis for TMD.

In addition to neck pain, dizziness, an increased numbers of pain areas, and self-reported bruxism were found to be associated with an increased number of PT visits. Although dizziness was not a common compliant seen in this population, dizziness itself can be due to multiple causes including cervicogenic causes, primary headache disorders, or vertigo. The prevalence of vertigo has been shown to be higher in individuals with TMD compared to controls.[67-69] Twelve percent of patients in the current study reported dizziness as a symptom. However, dizziness was not classified according to cause although a screening for benign paroxysmal positional vertigo was done to rule out this condition during initial evaluation. Regardless, the presence of dizziness was associated with an increased number of PT visits. Dizziness may also be related to medication, aging, or to cervicogenic causes.[69]

4.4 | Patient satisfaction

Patient satisfaction is an important patient-centered health outcome and satisfaction has been used as a patient focused indicator of the quality of patient care.[70] Beyond quality of care, considering the perspective of the patient and their satisfaction in the care that they receive is important to clinicians as they strive to continually improve the care that they offer to patients. Hush et al.[30] conducted a systematic review with meta-analysis of musculoskeletal PT care delivered to patients with varying complaints across multiple outpatient settings in northern Europe, North America, the United Kingdom, and Ireland. They found that patients were highly satisfied with their PT care, with a pooled estimate of patient satisfaction of 4.4 (95% confidence interval 4.4–4.5) on a scale of 1–5, where 5 indicated high satisfaction and 1 indicated high dissatisfaction. Similar results were found specific to patient satisfaction with PT and TMD in an earlier study than the current one using data from one specific subset of individuals included in the current study (disc displacement without reduction with limited opening).[29] That study showed a mean patient satisfaction response of 6.8/10 (SD 0.6) where subjects were asked to circle the number that best indicated their satisfaction with treatment with 0 representing “Did not help” and 10 representing “Helped a great deal”. Individuals in the current study showed an overall satisfaction of 6.7/10 (SD 2.5) which is consistent with these levels of satisfaction with PT. Taken together with the current results, these studies suggest that patients are satisfied with the care that they receive for their musculoskeletal problems in PT, including TMD.

There are many factors other than treatment outcomes that can affect patient satisfaction including organization of care and interpersonal communication.[31] Patient satisfaction itself may not guarantee high quality or even effective care. However, understanding

the factors that might drive patient satisfaction for individuals with TMD is generally lacking. For example, satisfaction with PT care has been shown to be higher in patients with acute musculoskeletal conditions than in patients with chronic musculoskeletal conditions.[31] The issue of acuity of symptoms and satisfaction with PT is more difficult to assess in individuals with TMD than other musculoskeletal complaints given that the majority of patients who seek treatment are already in the chronic stage of the condition.[17] Results of the current study support that a longer duration of symptoms is associated with reduced patient satisfaction related to TMD care.

Two other factors shown in the current study to be related to patient satisfaction were signs of subluxation and referral to PT from an oral surgeon, both of which were negatively associated with satisfaction. Related to subluxation, the original RDC/TMD guidelines that utilized in the current study did not address or define subluxation.[37] Signs of subluxation as defined in the current study were excessive mandibular condylar translation on the articular eminence during wide opening,[71] with aberrant jaw movement and/or a click both occurring at the end of wide mouth opening. The condyle(s) catching briefly on closing from a wide-open position may or may not occur.[71] These findings identifying subluxation may or may not been associated with pain. It is important to note that the updated diagnostic guidelines for TMD (DC-TMD) considers subluxation differently, defining it as equal to locking or catching in the wide-open jaw position with a maneuver required to close the mouth.[49] These current guidelines do not address excessive condylar translation without locking as defined in the current study although, anecdotally, this is not an uncommon patient presentation. Although subluxation can be asymptomatic (i.e. an absence of pain), repeated subluxation occurring with yawning and eating a large sandwich may aggravate existing subtype disorders of TMD such as TMJ arthralgia or clicking associated with a disc displacement with reduction.[72] A possible contributing factor to reduced satisfaction with subluxation in the current study may be the inherent challenge faced by the patient in controlling subluxation. Controlling subluxation requires the patient to pay attention at the precise time an activity (e.g. yawn or eat) leads to subluxation. The patient will need to apply certain activities that will limit their mouth opening and be consistent with practice. Some patients may find adherence to this level of attention and practice challenging, instead preferring a treatment that would correct the problem without them needing to participate. Since subluxation is difficult to control without patient participation, this may account for reduced patient satisfaction when subluxation is present. Surgical management for subluxation is rare and should only be considered in select cases.[71]

Referral to PT from an oral surgeon was also related to reduced patient satisfaction in the current study. Reduced satisfaction in this case may be related to the patient anticipating the worst (i.e. “My TMJ is damaged so badly that I needed to see a surgeon”). However, in the current study, reduced satisfaction was also related to the number of prior healthcare providers seen, and often the surgeon is the 3rd or 4th healthcare professional a patient may consult with. Referral from an oral surgeon was not an associated factor to a higher number of PT visits, suggesting that complexity of care alone may not account for why referral from an oral surgeon was associated with reduced satisfaction. A patient's expectation for outcomes based on their surgeon's instructions is one factor that may drive ultimate satisfaction with treatment. For example, if a patient was not told that they may continue to experience clicking related to a disc displacement with reduction on opening after minimally invasive surgery, despite a post-surgical reduction in pain and improvement in function, this may affect their interpretation of a successful outcome. Further research is needed to understand additional factors associated with patient satisfaction and surgical consultation.

The current study provides novel findings that the only significant predictor of patient satisfaction was the patient's self-reported functional neck disability at the initial visit. Patient satisfaction and functional limitations have been examined in other conditions such as ischemic heart disease, chronic obstructive pulmonary disease, and diabetes in which the patient's ability to cope with their disease was more strongly associated with patient satisfaction than disease severity or functional limitations.[55] Given that chronic TMD has been associated with high levels of fear, anger, anxiety, and depression,[17] examining a patient's coping strategy on intake may provide additional clues to inform patient satisfaction in outcomes. Coping strategy, however, is different than the typical biopsychosocial factors examined on intake and can be assessed with scales such as the Coping Strategies Questionnaire and the Chronic Pain Coping Inventory which has been used in various musculoskeletal conditions.[73-75] Self-efficacy in coping with pain has been shown to be an important factor associated with quality of life for individuals with chronic TMD.[75]

4.5 | Limitations

While a relatively large sample was captured, limitations in the current study include that satisfaction data and some clinical information were not obtained from all participants due to drop out from PT or loss to follow up. However, the high return rate of the satisfaction questionnaire (74%) should mitigate potential skew in the data due to drop out. Using a validated patient satisfaction tool such as the Health Care Satisfaction Questionnaire[76] would make comparison of satisfaction across disciplines and conditions easier. Additionally, data collected were from only one clinical site in the United States of America with one expert clinician using clinical data collection protocols in place at the time of recruitment. While missing data are minimal in most cases (<5%), the Copenhagen score is missing approximately 42% data, which is above the 40% threshold generally accepted to attempt multiple imputation methods. Although patients in this study lived in a metropolitan city, data from a sample in only one geographic area limited diversity in the sample and precluded analysis of some possible predictor variables (e.g., ethnicity, socioeconomic status) into the statistical analysis. The results of the current study may not be applicable to the international practice of PT given country specific differences in training and practice of PT and TMD,

or to novice PTs with little practical experience working with these patients. Similarly, while all current PT professional programs in the United States require inclusion of training for TMD evaluation and treatment in the professional education program for PT, the extent that content is covered can vary across programs, which can lead to discrepancy in the level and quality of care provided.[77] Additionally, while PTs in the United States at the current time receive training in evaluation and management of TMD,[77] anecdotal evidence suggests that PTs trained prior to the adoption of the doctoral level of entry level training for PT likely have varied training and experience with TMD. This is one factor that can reduce a PTs self-perceived adequacy and confidence level with respect to working with individuals with TMD.[78] If not covered during their entry-level training, PTs would need to have relied on post professional training or certification to ensure application of evidence-based examination and intervention for this patient group. This can make it challenging for interprofessional practice and referral in the identification of appropriately trained PTs to collaborate with. Finally, recent validation of outcomes tools for use with this population has occurred as suggested by the Diagnostic Criteria for TMD[49] and including such tools in future data collection efforts is needed.

5 | CONCLUSION

Different factors can influence satisfaction with PT and the number of PT visits in individuals with TMD. Two factors that were common across patient satisfaction and number of visits in this single cohort study were higher initial patient rated functional neck disability and a greater number of healthcare professionals seen before starting PT. Patients were satisfied with their PT care, but higher self-rated functional neck disability on intake was predictive of lower patient satisfaction. The combination of being female, having a higher pain level and seeing more healthcare providers before being referred to PT may predict an increased number of PT visits. Results from this study will help to inform a universal goal of improving patient-centered healthcare for individuals with TMD. One direction to consider is to involve physical therapists with appropriate knowledge and training in the management of TMD earlier in the care to diagnose and treat patients with cervical and temporomandibular disorders.

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JP analyzed and interpreted the data, SK collected and interpreted the data, and ABS analyzed and interpreted the data. All authors were responsible for the interpretation of the results and contributed to writing and editing the manuscript. The authors did not receive any financial support for this study. The authors declare they have no conflicts of interest that pertain to this work.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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