Health Care Utilization and Cost Among Health Maintenance Organization Members with Temporomandibular Disorders

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Aims: *Little has been reported on the use of health care services and consequent costs among persons with temporomandibular disorders (TMD). This project compared the use and cost of medical and dental care services for TMD patients and matched comparison subjects.* **Methods:** *Patients were continuously enrolled members of Kaiser Permanente Northwest Division who had at least 1 TMD Clinic visit or TMD-related procedure between January 1990 and December 1995 (n = 8,801). An equal number of comparison subjects were identified electronically and matched on 14 variables, including age and gender. Utilization and cost estimates were determined and compared for selected medical and dental services.* **Results:** *For both groups, the mean age was about 40.5 years, and approximately 80% were female. The TMD subjects used significantly more services than did comparison subjects and had mean costs that were 1.6 times higher for all services. Outpatient visits accounted for about 40% of the difference in mean costs. About 10% of TMD subjects and comparison subjects accounted for about 40% and 47% of the costs in each group, respectively. Female TMD subjects and comparison subjects had higher costs than their male counterparts, and male TMD subjects had higher costs than female comparison subjects.* **Conclusion:** *Patients with TMD used more of all types of services and had higher costs. A small proportion of the subjects accounted for a large proportion of the costs. Gender was an important factor in utilization and cost. Utilization and cost differences were consistent over a wide range of service categories and could not be explained by TMD alone.*

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Temporomandibular disorders (TMD) are a cluster of medical and dental conditions affecting the temporomandibular joint (TMJ) and surrounding tissues.[1] They encompass a wide range of conditions that may present as facial pain, jaw joint pain, headaches, earaches, dizziness, masticatory musculature hypertrophy, limited mouth opening, closed or open lock on the TMJ, abnormal occlusal wear, and clicking or popping sounds in the jaw joint. Individuals often present with TMJ clicking or popping and, consequently, may have limited mouth opening and decreased functional capacity. Temporomandibular disorders are often characterized as chronic, recurrent, nonprogressive pain conditions.[2–4]

There appears to be no common etiology or known biologic explanation for these conditions. Signs and symptoms may overlap,[1] and significant variability among patients makes diagnosis complex.[5–8] LeResche[9] conducted a comprehensive literature review of epidemiologic data on pain in the temporomandibular region and on signs and symptoms associated with specific subtypes of TMD. She found that pain in the temporomandibular region appears to be relatively common, occurring in about 10% of the population over age 18. It is primarily a condition of young and middle-aged adults, rather than of children or the elderly; also, TMD are about twice as common in women as in men in the population.

Pain in one or both TMJs may affect more than 10% of adults at any one time and about one third of adults at some time during their life span.[6] A National Health Interview Survey taken in the United States in 1989 included questions about adults' experience with 5 oral and facial pains.[10] Subjects were asked to report whether they had experienced pain during the past 6 months. Jaw joint pain was reported by 6.9% of the women and 3.5% of the men and represented an estimated 10.9 million people, or 6% of the population. Although signs and symptoms of TMD vary, about 5% of those with signs and symptoms of TMD seek care for these conditions; these patients are primarily females (3-to-1 ratio of females to males) between the ages of 25 and 44 years.[11]

Little has been reported about the use of medical and dental services among TMD patients. At a large health maintenance organization (HMO) in Washington state, annual covered costs of TMD were about US$304 per case for patients seeing a TMD specialist and US$93 per case for TMD patients seen in primary care, although this estimate did not include the cost of any dental care.[12] Garro et al[13] reported on the patterns of care-seeking and consequences of TMD among 32 individuals who were members of a support group for persons with long-term problems attributed to the TMJ and/or the surrounding masticatory muscles. Estimates of lifetime costs borne by the individuals ranged from $35 to $40,000 (figures in U.S. dollars). Half of the subjects reported out-of-pocket costs higher than $5,000, and more than 25% reported costs above $10,000. No information was presented on the amount covered by third-party payers, on the time period in which these expenses were incurred, or on the types of services purchased.

Shimshak et al[11] analyzed data from members of the Blue Cross/Blue Shield of Massachusetts Master Health Plus plan who were continuously enrolled during the calendar years 1989 and 1990. A TMD patient was defined as a person who had 1 or more TMD-related claims during the time period. A comparison group without a TMD claim was matched on age, gender, relationship to subscriber, and employer group. All medical health care claims submitted during 1989 and 1990 were analyzed for 1,819 matched pairs of TMD cases and comparison subjects. Patients with 1 or more TMD claims had twice the rate of reimbursement for claims as comparison subjects, although TMD claims accounted for less than 5% of all claims. Thirteen percent of the TMD cases accounted for 58% of the costs. Pregnancy was the most common reason for hospital admission among the comparison subjects, while digestive system disorders were the most common among TMD cases.

Shimshak and DeFuria[14] analyzed managed care claims filed in 1994 for a New England health care insurer with a large mixed geographic population. There were 1,713 members with 1 or more TMD-related claims; the remaining 534,198 members served as the comparison group. On average, members with TMD claims used more health care services and had higher associated costs than members without a TMD claim.

The purpose of this study was to examine the range of health care services and consequent costs, including dental care, of members of Kaiser Permanente Northwest Division (KPNW), an HMO, who sought care in Oregon at the KPNW TMD Clinic or received a TMD-related procedure. These data were compared with the services and costs of members who did not receive TMD-related care.

Methods

Case Subjects

The authors examined health care utilization and costs among KPNW members with a TMD Clinic visit or TMD-related procedure and compared these variables with a group of subjects without a TMD Clinic visit or TMD-related procedure. Comparison subjects were analyzed *(1)* to estimate the increased use of services and resultant costs that may be attributable to TMD and *(2)* to explore potential differences in care-seeking behavior between the 2 groups. The project used data available electronically in the KPNW medical care and dental care (KPDCP) programs.

Table 1 Procedure and Discharge Diagnosis Codes Used to Identify TMD Subjects

Description	Code	Code source
Procedures		
Radiologic examination, TMJ, open and closed, unilateral	70328	CPT
Radiologic examination, TMJ, open and closed, bilateral	70330	CPT
TMJ arthrography, radiologic supervision with interpretation	70332	CPT
Magnetic resonance (eg, proton) imaging, TMJ	70336	CPT
Injection procedure of TMJ arthrography	21116	CPT
TMJ arthroplasty	76.5	ICD-9-CM
Closed reduction of TMJ dislocation	76.93	ICD-9-CM
Open reduction of TMJ dislocation	76.94	ICD-9-CM
Other manipulation of TMJ	76.95	ICD-9-CM
Injection of therapeutic substance into TMJ	76.96	ICD-9-CM
Other	76.99	ICD-9-CM
TMJ contrast arthrogram	87.13	ICD-9-CM
Discharge diagnoses		
TMJ disorders	524.6	ICD-9-CM
TMJ disorders, unspecified	524.6	ICD-9-CM
Adhesions and ankylosis (bony or fibrous)	524.61	ICD-9-CM
Arthralgia of TMJ	524.62	ICD-9-CM
Articular disc disorder (reducing or non-reducing)	524.63	ICD-9-CM
Other specified TMJ disorders	524.69	ICD-9-CM
Dislocation of jaw	830	ICD-9-CM
Closed dislocation	830	ICD-9-CM
Open dislocation	830.1	ICD-9-CM
Other and ill-defined sprains and strains	848	ICD-9-CM
Other and ill-defined sprains and strains, jaw	848.1	ICD-9-CM

TMJ = temporomandibular joint; CPT = Physicians' Current Procedural Terminology, Fourth Edition[15]; ICD-9-CM = International Classification of Diseases, 9th Revision, Clinical Modification.[16]

The authors used unique health record numbers for each TMD case and comparison subject and linked 7 of the relevant administrative, research, and clinical databases in the KPNW system. These databases include information on membership, dental utilization (including care provided in the TMD Clinic), pharmaceutical dispensings, outpatient visits, inpatient care, and radiologic procedures. Outside claims and referral services for inpatient and outpatient services were included. Laboratory and other services not included in these databases were excluded from the analysis.

The TMD case group consisted of all KPNW medical and dental members who had 1 or more visits to the KPNW TMD Clinic or 1 TMD-related procedure between January 1, 1990, and December 31, 1995. Codes for procedures and discharge diagnoses that were included in the analysis are shown in Table 1.

Identification of Comparison Subjects

The TMD patients were matched as closely as possible to comparison subjects on age, gender, and medical and dental plan eligibility in each of the 6 study years (1990–1995). For each of the 6 years, each study subject was classified as having full, partial, or no eligibility for that year. Eligibility gaps of 3 months or less were "patched" (ie, the member was considered to have continuous eligibility if a gap of 3 months or less was identified in any given year). Fourteen variables (age, gender, 6 years of medical eligibility, and 6 years of dental eligibility) were used to match a comparison subject for each TMD case. To identify comparison subjects, the SAS FASTCLUS procedure (SAS Institute) was used. With this procedure, TMD cases were assigned as "seeds," and potential members from the comparison group were allowed to "form clusters" around the seeds based on the values of the 14 matching variables. Matches for a given seed were obtained by choosing a comparison subject from the cluster with variable values that minimized the sum of squared distances from the cluster seed values. A match was obtained for each TMD case. About 99.9% of both groups had some medical eligibility, and 59.6% had some dental eligibility during the study period. The proportion of members with a drug benefit did not differ between the 2 groups (Chi-squared test = 0.888, degrees of freedom = 1, $P = 0.346$).

Utilization and Cost Estimation

Dental and TMD Clinic Visits. *Utilization.* Services at the TMD Clinic were separated from other dental services by identifying a set of procedure codes used uniquely by practitioners in the TMD Clinic. The number of TMD Clinic visits and non-TMD Clinic visits for each group and the mean number of visits per group were then estimated, and these estimates were compared with the use of a *t* test.

Cost. For each procedure code in the database, an associated non-member fee reflected the fee in the local community for the services. These fees were used to estimate the cost of TMD Clinic and non-TMD dental services in each year of the study. Fees for each procedure code were assigned by KPDCP for each study year. The U.S. dental consumer price index (CPI) was used to convert all costs to 1995 U.S. dollars.

Outpatient Pharmacy. *Utilization.* To determine the utilization of outpatient pharmaceuticals, the authors constructed an analytic file that contained all outpatient dispensings between January 1, 1990, and December 31, 1995. Each dispensing was identified by a unique generic product identifier—a 14-digit number that denoted pharmaceutically equivalent drug products with respect to active ingredients, dosage form, route of administration, and strength or concentration. We grouped each dispensing into 1 of 26 drug groups based on pharmacologic action. For each drug group, the mean number of dispensings for each of the 2 study groups was determined, and *t* tests were used to compare these means.

Cost of Ambulatory Dispensings. Costs for outpatient pharmaceuticals were determined by the standard price that would be paid for a prescription by members who did not have a prepaid prescription benefit, which generally reflects the prevailing retail price of the prescription in the community. Costs were determined for all dispensings in each of the 6 years and were adjusted to 1995 U.S. dollars by the use of the CPI for pharmaceuticals; *t* tests were used to compare mean costs for all TMD cases and comparison subjects.

Outpatient Services. *Utilization.* Initially, the number of outpatient visits was determined for the 2 study groups. For each visit, the authors ascertained the department in which the visit occurred and then compared the mean number of visits by department between the 2 groups.

Cost. Costs for outpatient visits to KPNW facilities were estimated from an internal KPNW management costing analysis to estimate the cost of care for members being treated for TMD. Developed in 1993, the costing analysis contains information that allows assignment of costs to ambulatory encounters by department and provider type (eg, physician, nurse practitioner, physician assistant, or nurse). This costing methodology allows for relative, rather than absolute, comparisons and identifies differences attributable to the type of provider seen and the number of patient encounters; however, it does not capture different levels of service intensity within a visit to the same provider. Mental health visit costs were estimated by determining whether therapy was provided in group or individual sessions and then estimating the cost associated with those sessions. The authors again used billed amounts for each outpatient service. Costs were determined for each year of the study and converted to 1995 U.S. dollars through the use of the CPI.

Inpatient Services. *Utilization.* The authors accessed utilization of inpatient services provided to the 2 study groups within the KPNW system. An analytic file was then constructed that contained counts of inpatient admissions at the 2 KPNW hospitals in Oregon (Bess Kaiser and Sunnyside) operating during the study period. In addition, admissions at the Madeline residential drug treatment center were included.

Cost. Inpatient service costs were determined by adding KPNW costs and billing costs. For KPNW costs, the authors created variables to count the number of minutes spent in surgery and recovery for each surgical hospitalization and the number of routine and critical care days for all hospitalizations. To determine inpatient costs, cost coefficients were merged with the KPNW hospital data to create a cost variable. The bases for the cost coefficients are shown in Table 2. Total KPNW hospital costs were determined by summing operating room, recovery room, routine day, and critical care day costs. Cost estimates for care provided at the Madeline facility were determined by multiplying the length of stay with a cost coefficient obtained from previous Center for Health Research studies to yield a per-admission cost. Costs were determined for each year of the study and the CPI used to convert them to 1995 U.S. dollars.

Radiologic Procedures. *Utilization.* Using current procedure codes contained within a radiology information management system, the authors estimated the number of radiologic procedures. Inpatient, outpatient, ambulatory surgery, and emergency department radiologic procedures were included in the mean estimates. Radiologic

Table 2 Variables Used to Estimate KPNW Inpatient Service Costs

Variable	Unit measure	Unit cost
Operating room	Surgery minutes	$/minute
Recovery room	Recovery minutes	$/minute
Hospital	Routine days	$/day
Critical care	Severe days	$/day

procedures provided outside KPNW facilities were included in the "Outside Claim and Referral Services" utilization and cost estimates described below.

Cost. Radiologic procedure costs were determined by summing the professional and technical fees. The professional fee is a dollar value representing the time needed by a radiologist to interpret the exam, which is the product of a decimal value representing the weight for each exam and an inflation factor used to calculate the cost of services for inpatient, outpatient, and emergency patient exams. The technical fees are determined in a similar manner and represent the cost of service for the exam (film, technologist, machine times, etc).

Outside Claim and Referral Services. *Utilization.* Utilization of outside claim and referral services was determined by analyzing data from a KPNW claims system used to control, pay, and process statistics on outside claims. Only authorized services were included. Each authorized service could include a single procedure or multiple procedures. Procedures were categorized as inpatient or outpatient based on an authorization code. For inpatient services, the authors assumed 1 inpatient stay per authorization.

Cost. The costs of outside claim and referral services were estimated by summing the amount billed for each inpatient and outpatient authorized service. Costs were estimated for each year of the study and converted to 1995 U.S. dollars.

Statistical Analysis

For each service identified above, *P* values reported for cost comparisons are based on the log transformation of the estimated cost. Log transformation results in a reasonably symmetric distribution of the cost data and affords a comparison of the means that approximates comparison of the medians with untransformed data.

Results

Age and Gender Distribution

The age and gender distribution of the final sample is shown in Fig 1. The mean age for TMD subjects was 40.5 years and for comparison subjects was 40.4 years; about 70% were between the ages of 20 and 50 on December 31, 1995. About 80% of each group was female. The ratio of females to males ranged from 2.9:1 in the 60-to-64-year-old age group to 5.8:1 in the 30-to-34-year-old age group.

Utilization

Mean utilization rates for selected medical and dental services by group are shown in Table 3. The TMD cases used significantly more services in each category, excluding outside claim and referral services.

TMD Clinic Visits. Between 1990 and 1995, 28,729 visits were made to the TMD Clinic by 8,286 unique KPNW or KPDCP members; the mean number of visits was 3.26 (median = 3, mode = 1). The majority of procedures were either examinations (26%) or related to insertion and adjustment of a TMJ splint (42%). About 11.5% of the procedures were associated with 1 of 2 education classes that provide information on TMD and self-help strategies for TMD patients.

Dental Visits. On average, TMD cases had about 7.46 dental visits, versus 5.28 visits for comparison subjects ($P < 0.001$) during the study period. As a group, TMD cases had about 19,000 more visits during the study period (65,727 visits versus 46,512 visits). About 40.4% of the TMD cases and comparison subjects (3,554 subjects in each group) did not have dental eligibility during the 1990–1995 study period and therefore did not have a non-TMD dental visit. The TMD cases had an average of 23.1 dental services during the study period, compared to 17.2 services for comparison subjects ($P = 0.0001$). In both groups, about 60% of the services were preventive or diagnostic; about 15% were restorative procedures.

Pharmaceutical Dispensings. The TMD cases received significantly more pharmaceutical dispensings than did comparison subjects. Overall, TMD cases experienced 1.7 times more dispensings ($P = 0.0001$). Table 4 shows drug categories for which there was a mean of 3 or more dispensings per TMD case or comparison subject. It is noteworthy that TMD cases had a mean number of antidepressant dispensings that was 2.6 times

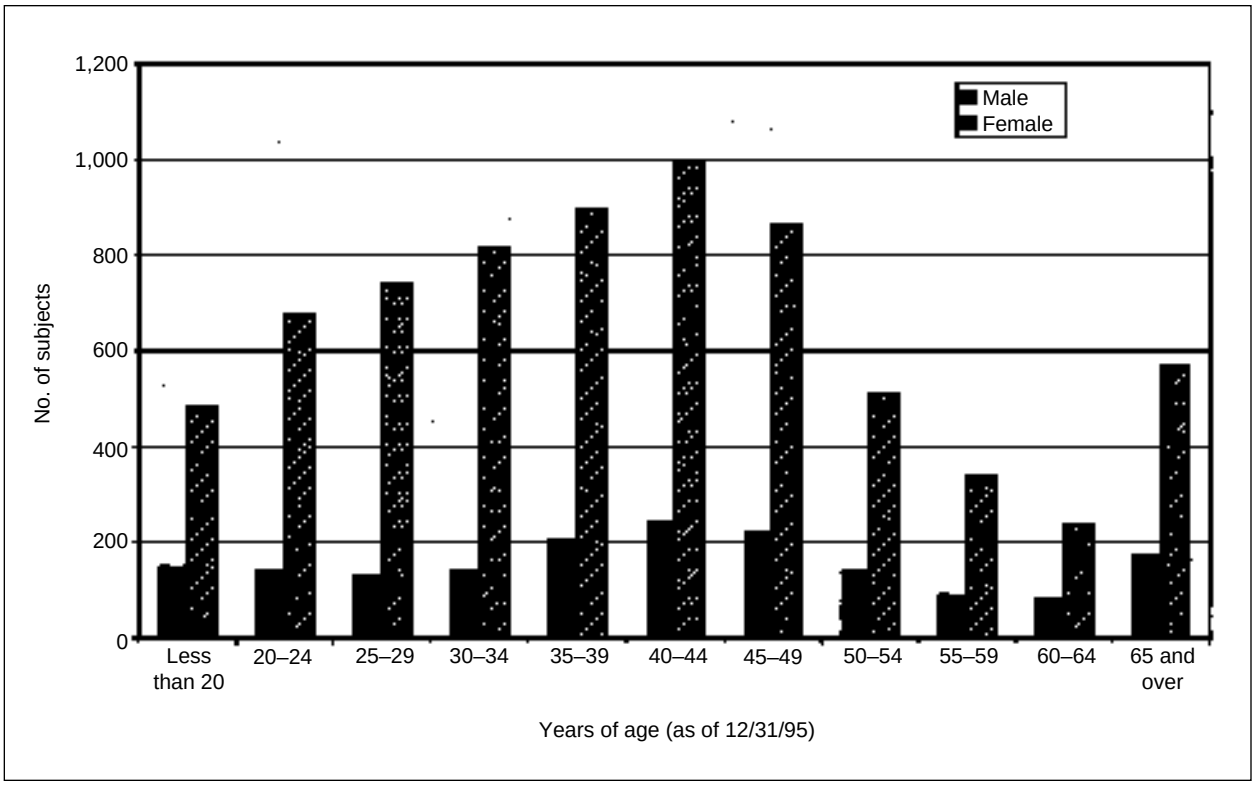

Fig 1 Number of TMD cases by age group and gender, 1990–1995.

Table 3 Mean No. of Selected Services for TMD Subjects and Comparison Subjects, 1990–1995

Service category	TMD subjects	Comparison subjects	*P* value	Ratio*
TMD Clinic visits	3.26	—	—	—
Dental visits	7.46	5.28	0.0001	1.4
Drug dispensings	61.69	35.91	0.0001	1.7
Outpatient visits	42.79	24.94	0.0001	1.7
Inpatient admissions	0.69	0.51	0.0001	1.4
Radiologic procedures	9.49	6.20	0.0001	1.5
Outside claim and referral inpatient admissions	0.09	0.08	0.0377	1.1
Outside claim and referral outpatient services	2.65	2.14	0.1714	1.2

*Of TMD subjects to comparison subjects.

Table 4 Comparison of Drug Dispensings Among TMD Subjects and Comparison Subjects by Drug Category, 1990–1995

Drug category	TMD subjects	Comparison subjects	*P* value	Ratio
All dispensings	61.4	35.9	0.0001	1.7
Endocrine/metabolic	7.7	6.1	0.0001	1.3
Anti-infectives	7.1	4.4	0.0001	1.6
Respiratory	6.7	3.6	0.0001	1.9
Analgesics/narcotics	6.0	2.5	0.0001	2.4
Antidepressants	5.0	1.9	0.0001	2.6
Cardiovascular	4.7	4.0	0.0018	1.2
Antirheumatic	4.6	2.5	0.0001	1.8
Topical	4.2	2.6	0.0001	1.6
Gastrointestinal	3.4	1.6	0.0001	2.1

Table 5 Distribution of Visits for TMD and Comparison Subjects by Department, 1990–1995

	TMD subjects		Comparison subjects			
Department	Mean no. of visits	Percentage of total visits	Mean no. of visits	Percentage of total visits	*P* value	Ratio
Internal medicine	8.7	20.2	4.7	18.9	0.0001	1.8
Family practice	5.5	12.8	3.7	14.7	0.0001	1.5
Physical therapy	4.5	10.5	1.4	5.5	0.0001	3.3
Nurse visit	4.5	10.5	2.6	10.4	0.0001	1.7
Obstetrics/gynecology	3.7	8.7	3.3	13.2	0.0001	1.1
Mental health	3.0	6.9	1.1	4.3	0.0001	2.8
Urgent care (other)	2.6	6.1	1.7	6.8	0.0001	1.6
Total	42.8	100.0	24.9	100.0	0.0001	1.7

greater than that of comparison subjects (P = 0.0001) and a mean number of narcotic analgesics that was 2.4 times greater (P = 0.0001).

Outpatient Services. The TMD subjects had 42.79 outpatient visits per case during the 6-year study period, compared with 24.94 visits per comparison subject (P = 0.0001). The maximum number of visits by TMD cases was 428, compared with 279 by comparison subjects. Among all TMD subjects, there were 188,400 more outpatient visits than among comparison subjects (461,601 visits versus 273,195 visits).

Table 5 details the distribution by number and percentage of outpatient visits by KPNW department for those departments representing 5% or more of all visits. The TMD cases had a higher mean number of visits in each department. About 26% of all visits were to internal medicine or family practice doctors.

Inpatient Services. Table 6 outlines principal discharge diagnoses for KPNW inpatient admissions of any type for TMD cases and comparison subjects for those primary diagnoses accounting for 5% or more of all discharges. There were 7,314 admissions for TMD cases and 5,606 for comparison subjects. The mean number of inpatient admissions was 0.69 for TMD cases and 0.51 for comparison subjects (P = 0.0001). Pregnancy/childbirth represented 18.5% of all admissions for TMD cases compared with 29.8% for comparison subjects. For all other diagnostic categories in which a statistical difference was found, TMD cases had a higher mean number of discharges for each category.

Among the TMD subjects, 206 inpatient procedures were performed on 171 patients. More than 75% of these procedures were either TMJ arthroplasty or other manipulation of the TMJ. Diagnoses codes 524.6 (TMJ disorders) and 524.69 (other specified TMJ disorders) represented more than 50% of all diagnoses for inpatient procedures.

Radiologic Procedures. The TMD patients received more radiographic procedures than comparison subjects. Specifically, they received a mean

Table 6 Comparison of Principal Discharge Diagnoses Among TMD and Comparison Subjects with a KPNW Hospitalization, 1990–1995

Diagnosis category	ICD-9 diagnostic codes	TMD subjects		Comparison subjects			
		Mean no.	% of discharge diagnoses	Mean no.	% of discharge diagnoses	*P* value	Ratio
Complications of pregnancy, childbirth, and the puerperium	630-677	0.13	18.54	0.15	29.81	0.0012	0.84
Diseases of the genitourinary system	580-629	0.09	13.79	0.06	11.52	0.0001	1.62
Diseases of the digestive system	520-579	0.09	12.86	0.05	9.77	0.0001	1.78
Diseases of the musculoskeletal system and connective tissue	710-739	0.07	10.79	0.04	7.73	0.0001	1.89
Injury and poisoning	800-999	0.06	8.57	0.03	6.31	0.0001	1.84
Neoplasms	140-239	0.05	7.06	0.04	8.09	0.0561	1.18
Symptoms, signs, and ill-defined conditions	780-799	0.04	6.50	0.02	4.14	0.0001	2.12
Diseases of the nervous system and sense organs	320-389	0.04	6.34	0.03	5.90	0.0002	1.45
Diseases of the circulatory system	390-459	0.04	5.25	0.04	8.36	0.1771	0.85

number of 9.49 radiologic procedures of any type, versus 6.20 for comparison subjects ($P = 0.0001$). The majority (95.2%) of TMD cases who received any TMJ radiologic procedure underwent a bilateral, open and closed TMJ examination (592 TMD patients had 601 examinations). Twenty-six TMD patients had 30 TMJ magnetic resonance imaging procedures.

Outside Claim and Referral Services. Although a statistically significant difference was found between the 2 groups in their use of outside claim and referral inpatient admissions, this difference was small; on average, TMD subjects had about 0.013 more admissions than comparison subjects. No statistical difference was found between TMD cases and comparison subjects in their use of outside claim and referral outpatient services (Table 3). About 20% of all claims for both groups related to outpatient emergency room use. About 7% of the TMD case claims and 9.3% of the comparison subject claims were for obstetric or gynecologic care. No other service type accounted for more than 5% of total claims.

Costs

Mean and median costs for the services described above are shown in Table 7. Overall, TMD subjects had 1.6 times the mean cost for all services over the 6-year period, versus comparison subjects, representing more than $5,800 per patient. The TMD cases also had higher costs in each service category. About 40% of the difference in mean costs was attributable to outpatient visits, and about 24% was a result of inpatient admissions. Pharmaceuticals accounted for about 12% of the total mean difference. TMD Clinic visits represented less than 7% of the difference in cost between the 2 groups.

Figure 2 shows the mean total health care costs among female and male TMD and comparison subjects.[17] In all 4 groups, total health care cost estimates follow a skewed distribution. As with most health care cost data, there were some TMD cases and comparison subjects who represented significant expenditures during the study period. Median costs—shown as the line bisecting each box—were greater for TMD patients than for comparison subjects. The interquartile ranges—represented here by the box, where the upper border indicates the 75th percentile and the lower border indicates the 25th percentile—were greater for TMD cases than for comparison subjects.

Figure 3 illustrates the distribution of costs among TMD cases and comparison subjects. About 40% of the costs among TMD cases and 47% of the costs among comparison subjects were attributable to health care utilization by just 10% of the subjects. More than two-thirds of all costs could be attributed to only 30% of subjects in each group.

Table 7 Mean and Median Costs for Selected Services Among TMD and Comparison Subjects, 1990–1995*

Service category	TMD subjects			Comparison subjects				
	Mean cost	Median cost	Mean as % of total	Mean cost	Median cost	Mean as % of total	*P* value	Ratio of mean costs
TMD Clinic visits	$397.77	$356.49	2.5	—	—	—	—	—
Dental visits	$951.69	$292.11	5.9	$697.29	$0.00	6.9	0.0001	1.4
Outpatient visits	$5638.75	$4085.24	35.3	$3331.77	$2211.29	32.7	0.0001	1.7
Drug dispensings	$1739.27	$659.92	10.9	$1035.98	$293.06	10.2	0.0001	1.7
Inpatient admissions	$4707.52	$0.00	29.4	$3320.33	$0.00	32.6	0.0001	1.4
Radiologic procedures	$1143.33	$589.87	7.1	$707.37	261.13	7.0	0.0001	1.6
Outside claim and referral inpatient admissions	$834.63	$0.00	5.2	$670.78	$0.00	6.6	0.1234	1.2
Outside claim and referral outpatient services	$583.30	$0.00	3.6	$410.27	$0.00	4.0	0.0001	1.4
Total	$15,996.26	$9420.81	100.0	$10,173.79	$4878.50	100.0	0.0001	1.6

*In 1995 U.S. dollars.

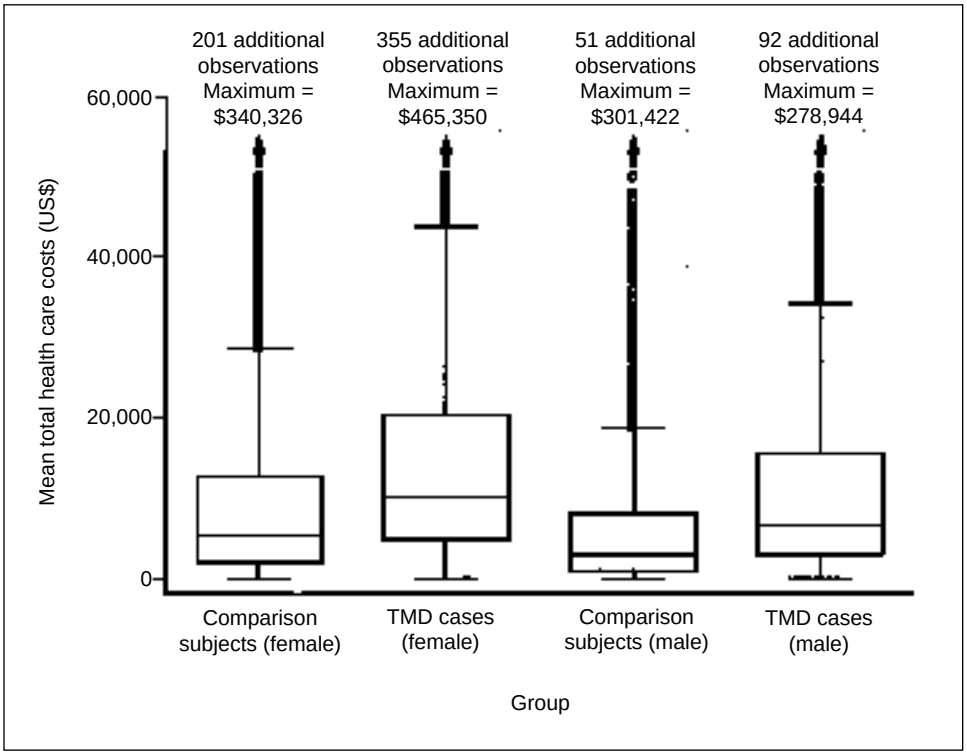

Fig 2 Distribution of mean total health care costs (in 1995 U.S. dollars) among TMD and comparison subjects by gender, 1990–1995. Upper distribution is truncated at $50,000. The number of additional observations and maximum total cost are included.

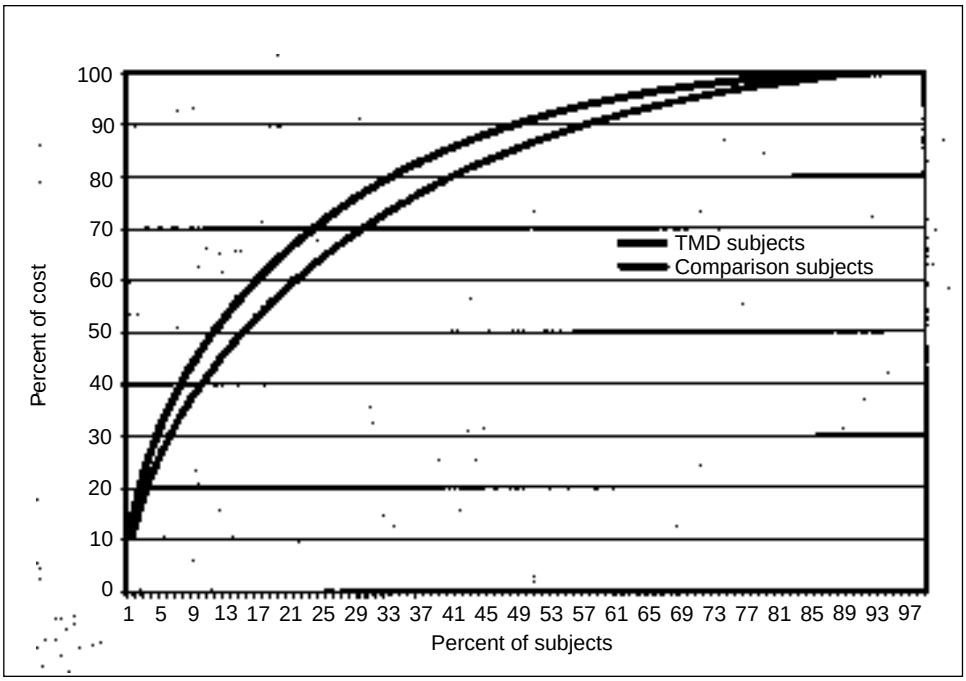

Fig 3 Percentage distribution of costs among TMD and comparison subjects, 1990–1995.

Discussion

This study examined the use of selected health care services and associated costs over a 6-year time period for a group of KPNW members who had a TMD Clinic visit or a TMD-related procedure and compared these estimates with a randomly selected group of members without a TMD Clinic visit or TMD-related procedure. Utilization and cost estimates were not restricted to TMD-related conditions but included all health care services used for any reason. In particular, this analysis includes estimates of differences in dental utilization and cost that have not previously been reported. These results are consistent with other studies: TMD patients use more of all types of services. Differences in utilization are consistent over a wide range of service categories. One would hypothesize a greater utilization among TMD cases, because they were selected based on TMD Clinic utilization or TMD-related procedures. Nonetheless, the difference between the 2 groups is remarkable.

Some of the differences in utilization may be explained by the symptoms. For example, TMD subjects received more narcotic analgesics and antirheumatic dispensings, perhaps as a result of their physical symptoms. Likewise, they may have incurred more physical therapy visits for treatment of their pain. For other categories of services, no clear explanation of the difference was apparent. For example, female comparison subjects had a greater mean number of inpatient admissions for pregnancy and childbirth, while TMD subjects had a greater mean number of urgent care visits.

Increased utilization among TMD cases translates into increased costs. Given the level of imprecision in estimating certain costs, the appropriate cost comparison is the relative, rather than the absolute, cost of the services. Total costs for TMD cases were more than 1.6 times those for comparison subjects over the 6-year period. As noted in another study,[11] a disproportionately large amount of costs was attributed to a small proportion of the subjects for both the TMD cases and comparison subjects. These findings are consistent with work in other areas.[18–20] During any given time period, health care costs will not be uniformly distributed. There will be high and low utilizers and many non-users, resulting in a skewed distribution of costs. The skewed distribution of costs reported here is not as extreme as other studies and may be explained by the longer study period (6 years). Over time, an individual's health care utilization will become similar to some mean expense for a larger group, resulting in a less skewed distribution of costs.[19] Results reported in these analyses have

not employed non-parameteric rank sum methods, as these have limited use in economic analyses.[21] Nor have we reported transformed economic data (eg, square root transformation or reciprocal transformation), because transformation can lead to problems of interpretation. In some instances, cost differences estimated by transformation are not interpretable when back-transformed.[22]

The median cost of care for 3 service categories—inpatient admissions, outside claim and referral inpatient admissions, and outside claim and referral outpatient services—was $0. Since most members are not hospitalized in any given 6-year period and seek care in KPNW ambulatory care facilities, this finding is expected. The median cost of dental care for comparison subjects was also $0. About 40% of the subjects in both groups did not have any dental eligibility during the study period and did not use dental services within the KPNW system. Dental utilization was less than 100% in both groups during the study period.

The gender distribution reported here is also consistent with other studies. The large majority of individuals who seek TMD care are females between 20 and 50 years of age. The association between gender and TMD is not well understood and warrants further investigation.[23] Of note is the difference in admissions for pregnancy and childbirth between the 2 groups. This difference has been noted in other insured populations.[19] Dao and LeResche[23] have hypothesized that female reproductive hormones may play an etiologic role in TMD, as suggested by the higher prevalence of TMD pain among women, the pattern of onset after puberty, and lowered prevalence rates in the post-menopausal years. They note that additional clinical, epidemiologic, and basic science research is needed.

Limitations

The principal limitation of this study is the lack of specific clinical diagnoses, particularly for outpatient visits. During the study period, KPNW did not have outpatient diagnoses available electronically. Consequently, we were unable to determine the extent or severity of TMD or its association with other conditions or symptoms. Further, we were unable to estimate health care use and cost among persons with other chronic pain conditions, such as headaches or low back pain.

The scheme employed to identify TMD cases and comparison subjects could have resulted in 2 types of misclassifications: those members who had a TMD Clinic visit or TMD-related procedure who did not have TMD, and members who had TMD but did not seek care at the TMD Clinic or did not receive a TMD-related procedure. Given the documented variation in TMD diagnosis and clinical presentation, one would expect some misclassification. The concern is whether such misclassification results in systematic bias and affects the utilization and cost estimates. With regard to the misclassification of members without TMD as TMD cases, clinicians in the TMD Clinic report that more than 95% of members with a TMD Clinic visit have TMD signs and symptoms. A pilot study conducted recently by the authors in the KPNW TMD Clinic found that, in a randomly selected sample of 22 KPNW members, all respondents had signs and symptoms consistent with TMD. Misclassification of members with TMD as comparison subjects would likely narrow the mean utilization and cost estimates, since one would hypothesize that they would seek some care for their symptoms (increasing outpatient utilization) and would receive some treatment for those symptoms (physical therapy or pharmaceutical dispensing).

Conclusion

These data indicate that patients with TMD signs and symptoms use greater levels of all services, resulting in significantly higher costs. We can only speculate about the reasons for these findings; however, it is unlikely that TMD alone would account for these differences. We would do well to address our research to better understand these findings.

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