The Temporomandibular Joint and Related Orofacial Disorders

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Epidemiology

Epidemiology is the field of science dealing with the relations of the various factors that determine the frequencies and distribution of a disease in the human community. It is the study of distribution and determinants of diseases and injuries in human populations. The goals of epidemiology are multifold: classifying and understanding development of disease, determining etiology, and recognizing factors leading to prevention. The goals of clinical epidemiology focus on success of treatment or cure of disease.

Rationale

Clinicians have been concerned with epidemiology of TMD for at least 20 years. Practically, why would a clinician need to be concerned with the epidemiology of TMD? One answer is that the difference between healthy and unhealthy conditions is not always obvious. Normal anatomy and physiology vary widely between and among individuals of different populations. Because dentists have acquired the major responsibility for diagnosis and treatment of TMD, this information affects dental clinicians and individuals of the general population who are treated or advised to undergo treatment by these practitioners.

Questions frequently asked by patients include the following: How common is this disorder? What do my symptoms mean? If one of my parents has it, can I get it too? Is there a test or examination for it? What risks are involved in this condition? What is the prognosis?

Attempts to provide satisfactory answers are fraught with problems. Many clinicians and patients are obsessed with deriving a specific percentage for a given disorder. A projection of future outcome is expected from this percentage. Although such figures sound impressive, some questions have answers and some do not. The present level of information may be too low to explain this disorder.

Recently, multidisciplinary clinics have evolved in major health centers to consolidate clinical efforts and research on major health problems. Information about health problems is often biased because conclusions are drawn from patient referral to the clinics. It is not known whether these clinics reflect a representative sample of persons in the community who suffer from complains. Lack of information about clinic populations versus the population at large often limits general understanding of disorders. Thus, false associations are made about diagnosis and treatment outcome.

Types of Studies

Epidemiologic studies may be characterized as observational or experimental. Observational studies are subgrouped as either descriptive or analytic. Analytic studies involve interpretation and evaluation of an observed pattern of disease. Descriptive studies concern descriptions of occurrence and determinants of disease. Interventive studies describe the effect of environmental changes or effect of treatment on the occurrence of disease in selected risk groups.

Descriptive studies deal with prevalence. Prevalence denotes the frequency of a disease or condition in a population at a given time. Period prevalence refers to the frequency of accumulated cases of a disease in a population during certain period. Analytic studies deal with incidence. Incidence denotes the frequency of new cases of a disease or conditions diagnosed for the first time during a certain period (usually 1 year).

Most research on the epidemiology of TMD has involved the prevalence in cross-sectional studies of single populations. Little information is available on the incidence of TMD. Typically, incidence focuses on longitudinal studies, mostly prospective in nature. A few have been conducted on children and young adults.

Assessment

It is not easy to study the epidemiology of TMD. Consider the problem of estimating the prevalence of serious, chronic musculoskeletal disorders. Such disorders have complex organic and psychological variables. Drawing conclusions about them from individuals in the USA is complicated. There are so many diverse races and ethnic groups that declaring a sample as representative is difficult. A smaller percentage of these individuals would be expected to suffer from chronic head and neck complaints. A lesser percentage would suffer from orofacial TMD.

In epidemiology, the definition of what is and what is not a case of the disease is critical. Opinions differ about which symptoms and signs should be considered important in TMD and which complaints or clinical findings should be judged dysfunctional. Lack of consistency across studies makes comparison of prevalence rates difficult. Estimates are complicated by the absence of universally accepted classification for these disorders. Various clinicians have applied different criteria for diagnosis. Conclusions drawn about rates of TMD in the population at large contrast with judgments made from rates on populations perceiving themselves in need of treatment.

Information about the natural course of development of TMD is limited. It is unclear whether individuals with mild symptoms develop serious, chronic conditions. This paucity of information is understandable because the field is virtually in a stage of infancy compared with what is known about many other musculoskeletal disorders.

Several other factors confound understanding the epidemiology of TMD. These variables are age, gender, ethnic group, occupation, social factors, and educational level.

The existing epidemiologic studies of TMD have been criticized by investigators. The major criticisms are poor research design, selection of different methodologic criteria, and lack of or inappropriate statistical analyses. Summarily, most of the inherent bias in these studies may relate to asking individuals the wrong kinds of questions.

Critical problems include differences in the manner of collecting and processing data. Information may include anamnestic data and data collected subjectively from individual self-report by questionnaire, interview or both. Objective data are obtained by clinical evaluation. Collection of anamnestic and objective data simultaneously provides the most comprehensive picture of the disorder.

Reliability

The criteria for evaluation of population-based studies need to be reliable. Reliability means that results can be repeated under the same conditions. Although sampling of a population once may be significant, greater reliability can be implied if the population is sampled again with the same findings.

Validity

Although opinions and clinical judgments are important, appropriately designed studies need validity. A screening test should give some indication of which individuals have the disease and which do not. This validity should include the testing of an hypothesis, objective measures, and appropriate controls.

Often, questionnaires employed in collection of data are not standardized and thus are not reliable instruments. Validity can be enhanced by an understanding of its components, namely sensitivity and specificity. An ideal test or questionnaire would be 100% sensitive and 100% specific.

Sensitivity

Sensitivity is the ability to correctly detect the presence of a condition in individuals with confirmed disease (true-positive results). Failure to detect disease is called a false-negative result. It is the conditional probability of a positive response to a question given the presence of a clinical sign. The higher the value for sensitivity, the greater the correspondence. The lower the value, the lesser the correspondence. Generally, little correspondence exists if values fall below 0.7 (70%).

Specificity

Specificity is the ability to correctly detect the absence of disease in individuals without the disorder. This is a true-negative result. Detection of disease in individuals without the disorder is a false-positive result. It is the probability of correctly identifying (negative response to a question) an asymptomatic person given the absence of a sign (questionnaire). Like sensitivity, little association exists if values fall below 0.7 (70%).

Measurements of sensitivity and specificity allow the clinician to determine the correspondence between information obtained about symptoms from the questionnaire or interview with data obtained about signs from the clinical examination. Ideally, findings of the clinical examination should reveal associations or coincide with symptoms reported by the individual. Hence, there would be a high correspondence. Poor correspondence would be reflected by low sensitivity (inability of questions to detect clinical signs) and high false-positive rates.

Unfortunately, few extant studies use these criteria. A study conducted on Michigan children used these criteria and found low sensitivity (5% to 40%) and high false-positive rates (52% to 77%) for complaints of pain, pain on opening wide, joint sounds, headache, and grinding of the teeth compared with the clinical signs of joint clicking and tenderness on palpation of the masticatory muscles and the TMJs. The authors concluded that the correspondence was poor; they challenged the findings of several other researchers who ignored these criteria while working with children and adults.

Comparative study showed that headache frequency, masticatory muscle tenderness, cervical muscle tenderness, and maximal opening differed between adults with and without TMD. Only tenderness of masticatory muscles proved highly sensitive and specific. Maximal opening and cervical muscle tenderness showed high specificity but low sensitivity. Both specificity and sensitivity were low for headache. The authors claimed that relevance of headaches was questionable because of 37% false-negative and 33% false-positive findings.

Indices and Scales

Other means of assessment combine symptoms with signs and provide an overall estimate of the extent of dysfunction of individuals. A widely used assessment instruments has been the Helkimo index. The index has an anamnestic component (A_i) and a clinical component (D_i). The A_i questionnaire combines pain complaints with other symptoms, such as joint sounds, locking, and fatigue. The D_i assesses range of jaw movement, detection of joint sounds, deviation on opening-closing movements, tenderness on palpation of masticatory muscles, tenderness on palpation of TMJs, and pain on movement of the mandible. Although scores on this questionnaire correlate fairly well with clinical ratings, it is unclear whether this scale is an index of dysfunction due to TMD or simply represents some subset of symptoms often associated with facial pain disorders.

A modification of the Helkimo D_i index has proved useful in clinical assessment of the functional status of the masticatory system in children. Numerous signs were evaluated at two examinations. Findings were judged on whether they were positive or negative at both examinations, or were different at the first and second examinations. From these findings, a constancy index was obtained to evaluate the reproducibility of single signs. The reproducibility of single signs was high when including both positive and negative findings, but the reproducibility of positive findings was lower. The authors concluded that the greatest value of this index was to differentiate between children with no moderate signs and children with severe signs.

Another instrument useful for screening of symptoms is the validated Orofacial Pain Symptom Checklist (OPSC). The series of 14 questions indicated that TMD symptoms could

be described by four indices: joint movement symptoms (JMI), parafunction (PI), pain symptoms of daily living (PSI), and other vague circumoral complaints (CI) around the ears, temporal area, or cheeks. Only the PSI index was related to clinical pain and illness behavior, most likely reflecting individuals with a "somatic focus" to their complaints. Two of the indices were influenced by diagnosis. Individuals primarily having joints complaints scored higher on the JMI and lower on the PI than individuals primarily having myofascial pain. The OPSC was unrelated to personality and appears to be a simplex index useful for screening orofacial pain patients and evaluating treatment outcome.

Significance: Future studies on TMD should rely on the criteria of reliability, validity, sensitivity, and specificity. Adherence to these criteria would establish standards against which signs and symptoms could be tested.

Given the multifactorial etiology of chronic orofacial pain disorders and the lack of knowledge concerning etiology, it is unlikely that even the best questionnaire would be more than supportive in the diagnostic process. Based on the heterogeneity of signs found after clinical examination of individuals in populations at large and among symptomatic individuals reporting to health care centers, the need is to validate a scale for nonevident patients. A given scale must be validated and capable of detecting patients correctly. Nondysfunctional individuals must be classified, thus reducing false-positive and false-negative results.

Aside from obvious shortcomings, the findings from the extant literature on epidemiology have some face validity, set a baseline for estimating signs and symptoms, establish a source for discussion with colleagues and patients, and provide reference for future studies of this disorder.

Prevalence

Numerous surveys describe the prevalence of orofacial complaints in population around the world. Because of heterogeneity about descriptions of individuals (eg, age), studies have been divided arbitrarily into categories. Minor overlap occurs between assignments, but most investigations fit one of the following:

1. *Nonclinical settings:* Children, adolescents, and young adults (18 years or younger) and adults (18 years or older) surveyed randomly from the population at large.

2. *Selected groups:* Adults of similar age or gender and usually from different localities (dental or medical students, nurses, military personnel).

3. Patients presenting to *private clinicians* or *clinics* for routine dental care.

4. TMD cases presenting to *diagnostic* or *treatment clinics for TMD,* usually at large dental and medical centers.

Symptoms include the following: general complaint of orofacial pain, pain or difficulty on opening the jaws wide, pain on chewing, pain on mandibular movement, headache, feeling of fatigue or tiredness in the jaws, complaint of joint sounds, and report of joint locking.

Signs include the following: tenderness on palpation of the masticatory muscles, tenderness of specific muscle groups, tenderness on palpation of the TMJs, limitations on opening wide, deviation of the mandible on opening, and detection of joint sounds during mandibular movement.

The effects of age and gender as related to signs and symptoms are reviewed. Clinician estimates of need for treatment, demand by subjects for treatment, and the frequency of advice or treatment sought by subjects are considered.

Morphologic and functional malocclusions are excluded because of inconsistent agreement on the meanings of terms and data on occlusal studies suggest that the teeth should be considered minor contributing factors in dysfunction.

Nonclinical Settings

Signs and Symptoms in Adults

A summary of 25 different studies of adults across America, Europe, Taiwan, and Tanzania indicates that symptoms ranged from 12% to 64% and that signs ranged from 27% to 88%. With little exception, more signs were found after examination by investigators than symptoms reported by individuals. The broad diversity of populations severely limits comparison between populations.

Age and Symptoms

The relation between symptoms and age is controversial. Some symptoms have been reported as stable with increasing age, whereas others have been reported to increase or decrease with age. This difference depends partly on the way in which the data are expressed. The change may be expressed as two or more symptoms lumped together rather than being reported as a single symptom.

Generally speaking, no major relations have been found between age and the total complex of TMD symptoms in populations at large from the same localities, including Virginia, Maryland, Canada, Sweden, Finland, Norway, and Australia. In these and the remaining populations, changes within a few symptoms have been associated with age. Unless the data of two or more symptoms have been grouped, each change is discussed under a specific heading described below.

A study among Israeli elderly persons from 61 to 90 years of age showed fewer dysfunctions than were present in many young individuals sampled at random from other countries. This same relation was found in a comparison of a group of elderly nuns in Minnesota (75 to 94 years of age) with younger individuals.

Age and Signs

Although certain signs have been found to change with age, few changes have proved statistically different in populations at large. The findings indicate that the number of

individuals free of signs markedly decreased with age. To put it another way, more signs appear with advancing age.

Gender and Symptoms

Many investigators have ignored possible differences in gender and grouped the gender data for an entire population. In a study conducted in North America that considered gender, the findings were minimal for the total complex of symptoms. In Scandinavia, Norwegian women reported twice as many symptoms of general bodily rheumatic and joint pain as men. Swedish women reported more frequent symptoms (18 versus 10%) than men.

Gender and Signs

Generally, few differences exist between older subjects. Slightly higher frequencies for some signs have been reported in women more often than in men.

Significance: Generally speaking, one third of the adults sampled from non-clinical settings have one or more symptoms. One half to nearly three fourths have at least one sign. These estimates would put the prevalence of one or more TMD symptoms at roughly 80 million and the signs at 185 million in individuals in the USA. These figures are higher than mentioned in a general statement about TMD reported in one reputable journal.

According to the *Guide to Dental Health,* published by the American Dental Association, roughly 20% of the adults of the USA suffer from overlooked, misdiagnosed, and complex dental conditions known as TMD. Considering the diversity of total symptoms (eg, TMJ sounds, limited opening, deviation on opening, pain), fewer than 20% would be expected to suffer from orofacial pain. This estimate conflicts with a reported issued by the National Institute of Dental Research in 1990, which stated that some 25% of the population in the USA suffers from orofacial pain.

Signs and Symptoms in Children and Young Adults

A summary of 15 studies conducted in 10 countries showed that the prevalence of TMD symptoms ranged from 7% to 74% and the prevalence of signs from 33% to 80%. In older adults, signs proved more common than symptoms. The wide variation in symptoms results partly from inclusion of data on bruxism and malocclusion in some studies and not in others. Several studies focused on the need for orthodontic treatment. Sampling for malocclusion and bruxism might be expected in these reports. In contrast to most studies conducted in older adults, percentages were nearly equal for gender and age groups. This equality allows greater uniformity when comparing signs and symptoms across populations.

Few gender differences have been reported in young children. None existed in a gender-equal sample of 2198 Japanese children. The findings have been lumped in most other studies. Fluctuations have been observed in certain signs of adolescents and young adults.

Significance: The prevalence of symptoms and signs in children and young adults is lower than in older people. Comparison between studies suggests that about one half of white children could present with signs, although less than one half would be expected to complain.

Complaints are more likely to be important than are signs because young people often lack understanding of signs, particularly when questioned about palpation of muscles or joints or how to perform jaw movements. Further study is required to determine which signs and symptoms are important.

Report of Orofacial Pain

Subjective pain of the orofacial region has been reported as a common complaint in TMD. The meaning of this broad expression is not clear. Much ambiguity exists because of the diverse questions asked. If specific anatomic regions of pain, such as the angle of the mandible, cheek, or TMJ, have been designated, improved interpretation follows. If the location is ignored, uncertainty remains.

Comparison across cultures shows that generalized orofacial pain varies widely. Evaluation of most nonclinical studies confirms that many individuals are either asymptomatic or cope effectively with the pain.

The 1989 National Health Interview Survey (NHIS) conducted on 42.370 individuals with the USA should be considered the "gold standard" on orofacial and dental pains. The number of adults with an acute episode of pain around the jaw joint was 9.495 million, a prevalence of 5.3% (US Public Health Service, Hanes II Epidemiological Survey). For facial or cheek pain, the numbers were 2.541 million and 1.4%, respectively. The prevalence of combined joint and facial pains was 6.4%. Within this group, 67% reported that the pain became chronic, which was defined as lasting longer than 6 months.

Similar findings have been reported for other populations from North America. A telephone survey conducted among 897 French Canadians in Quebec revealed clinically significant jaw pain of frequent to moderate intensity in 5% of the population. One third of adults 18 years or older reported the presence of jaw pain, and 27% had frequent episodes of pain. Within the group with episodic pain, 69% had moderate to severe pain. Of one fourth with frequent jaw pain, 9% had accompanying joint sounds, and 4% had difficulty opening the mouth widely.

Large percentages have been cited in other reviews for pain localized to the jaw region. Reviewers have discussed this pain based on tenderness to palpation of the face or TMJs or based on the presence of static jaw pain occurring without mandibular movement. Still others have grouped pains of the head, face, or ear with pain of the jaw. Although these pains may be of the same etiology, they should be differentiated from one another until this issue is resolved.

Complaint of generalized orofacial pain was almost nonexistent in citizens randomly sampled from England. Pain localized to the face or head was found in less than 1% to 5% of a group of Swedish citizens. However, face-ache was reported as occurring in 38% and neckache in 52% of a Finnish population. An extremely low percentage of 0.47 was described for various symptoms among 5142 citizens visiting dental centers in Zimbabwe.

Age

Based on cumulative probability of onset, TMD pain has been predicted to increase steadily between 20 and 70 years of age. This prediction was made from information obtained by standardized questionnaire through a mail survey of enrollees (mainly white) of the Group Health Cooperative of Puget Sound. Although making such predictions is interesting, the clinical relevance appears diffuse, considering the uncertainty of what is meant by TMD pain. It contrasts with findings reported for nonclinical settings across the world.

Specific anatomic regions with localized pain have been reported to increase with age. Based on the NHIS for the adult civilian population, the incidence of jaw joint pain decreased from 6.500 per 100.000 at 18 to 34 years to 3.873 per 100.000 at 75 years and older. Facial pain remained constant between these ages.

In a sample from Virginia, only pain associated with the ear region (not jaw, head, facial, or chewing pains) increased significantly with age. The highest frequency of ear pain was found in citizens 70 years and older. Still, the percentage was low, as was found in a study of very elderly nuns in Minnesota.

Studies conducted in Scandinavia support the above findings that changes in pain with age are generally minimal. Some exceptions exist. Unfortunately, some data have been lumped together. For instance, face, ear, temple, head, and neck and shoulder pains increased from 61% to 77% between the ages of 25 and 65 in Finnish citizens. Pain in or near the ear increased from 3% to 6% and throat pain from 7% to 27% between 25 and 65 years of age in Swedish citizens. The greatest prevalence of facial pain and headache occurred in Swedish women between 20 and 59 years of age. Mild to severe symptoms occurred between the ages of 20 and 39. In men, moderate to severe symptoms appeared at 80 years of age and older. These differences imply lower prevalence in women younger than 20 and older than 39, and less occurrence in men under 80 years.

An analysis of several Swedish populations showed variability in young subjects. No significant difference in orofacial pain was found between 7 and 14 year olds. The percentage was low and remained so for young adults. A prevalence of about 1% was reported in populations of 13 to 15 year olds and 15 to 20 year olds. Twenty-one percent (17 occasional; 4 frequent) was reported for 15 to 20 year olds. The highest recorded percentage of orofacial pain was facial or jaw pain in adolescents and young adults whose dentitions had been restored. A comparison with adolescents and young adults of the same age and with intact dentitions showed only occasional pain in 2% of this group. The authors concluded that dental filling therapy was etiologically important in producing the pain.

Gender

Among civilians of the USA, both jaw joint (6.885 women versus 3.524 men per 100.000) and facial pain (1.874 women versus 908 men per 100.000) were nearly twice as prevalent in women as in men. In a random sample from Virginia, no significant gender difference was found for pain of the face, eyes, neck, or throat.

No specific reference was found in the literature that described the frequency of static orofacial pain in children from the USA. In Michigan children, an association was made between TMJ pain and status of the occlusion. TMJ pain correlated with excessive overjet and negative overjet. The authors concluded that adolescent and young adult males with class II and cusp-to-cusp relation and females younger than 11 years with class II and cusp-to-cusp relation appeared to be at greater risk of TMJ pain than their class I cohorts.

In Australia, jaw pain and fatigue, head, neck, and shoulder pains were generally more frequent in women than in men.

In Sweden, women reported more frequent head and facial pain than men. In other adults, no gender differences were found for pain of the face, ear region, eyes, throat, or neck. In young subjects, pain in the temples was significantly more frequent in females than males. No pain was found in the face or jaw (mostly around the ears) or cheeks. Nonetheless, face/jaw pain was more prevalent in 19-year-old women than in men of the same age, but not in 17 and 18 year olds.

In other parts of northern Europe, no gender differences was found in face/jaw pain of Finnish Lapps. Pain at more distant sites showed differences. Neck/shoulder pain was significantly greater in women than men.

In Finnish children, no gender difference was found in the frequency of orofacial pain. Pain prevalence ranged from 0% to 4%, whereas temporal pain was slightly increased at a second examination (16% versus 10%) in girls but not in boys.

Pain of the TMJ region decreased significantly (19% versus 13%) in both sexes of Finnish children sampled initially at 12 years of age and then again at 15 years. No gender difference was found during that period. Overall symptoms did not change much from 12 to 15 years of age in either sex.

TMJ pain in either gender was less than 2% of 2198 Japanese children between 10 and 18 years of age.

Significance: Generalized orofacial pain is an uncommon complaint in older adults and is of minimal importance in young children and adolescents from populations at large. Little clinical data exist to differentiate individuals suffering orofacial pain of musculoskeletal origin from individuals suffering dental pains caused by eruption or decay of teeth or by periodontal problems.

The site of the pain must be determined. A quantitative estimate should be made of the intensity and unpleasantness of the pain.

Report of Pain on Chewing

Fewer individuals complain of pain on chewing, compared with people suffering orofacial pain of nonchewing origin. Difficulty exists in interpreting findings because some clinicians do not always differentiate pain caused by chewing from other generalized orofacial discomfort.

Age

Information is scant about the relation of age to chewing pain. No age effect was found in a random adult population from Virginia. A slight increase was observed in two populations of Pennsylvania children between 6 and 10 years of age. The children were divided into "calm" and "non-calm" groups based on parental opinion of the activities of the children. Frequencies for the youngest children were similar between the groups and were lower than reported for older children and adults sampled from Virginia.

Findings of Scandinavian populations are conflicting. Less than 1% of a random sample of urban Swedish citizens complained of problems with chewing, whereas 15% of retired Swedish citizens experienced these problems. In children and young adults, no difference was found in a small sample. None was found in another population of adolescents and young adults. However, in adolescents and young adults sampled by questionnaire at age 15 and again at 20 years, pain or tiredness of the jaws or face during chewing was reported initially as 66% (12 frequent; 54 occasional) and later as 59% (16 frequent; 43 occasional). Inclusion of tiredness with painful symptoms inflated the percentage. Clearly, the frequency for pain precipitated by chewing would have been less.

A difference might be expected between elderly and younger adults because the elderly tend to lose teeth more readily and likely experience discomfort associated with dental prostheses. A general dissatisfaction with chewing ability was reported more often by older than younger adults in a Swedish population.

Support for this logic is found in other studies. Greater difficulty in chewing was reported more frequently in older than in younger Lapps from Finland. Furthermore, children with erupting permanent teeth would be more likely to complain of greater pain on chewing. These fluctuations have been reported. Pain on chewing increased significantly (5% to 10%) in Finnish boys, but not girls, from 12 to 15 years of age.

In Poland, no significant difference was found between subjects 15 to 22 years old.

Gender

In a community-based population in Virginia, significantly more women reported pain on chewing than men.

In Sweden, no gender difference was found in individuals of the general population, in elderly women and men, or in adults of another population.

Significance: Taken together, pain caused by chewing relates more to dental and periodontal problems than to joint and muscle complaints. Dental problems must be ruled out during the screening and interview.

Report of Pain on Opening Wide

Overall, few individuals across populations complain of pain on opening wide. Samples from Virginia and Missouri showed that frequencies were low.

In northern Europe, just one of 358 Norwegian citizens sampled by questionnaire had this problem. A prevalence of 11% was reported by Finnish workers, but the data are inflated by inclusion of pain on chewing.

Age

Prevalence ranged from 1% to 6% in most populations of children. An exception was in Pennsylvania, where the overall frequency was 17% and reached 25% in 9 year olds. Still, no significant difference was found between 6 to 10 year olds.

The absence of age as a factor was confirmed in Swedish children and young adults between 7 and 18 years of age. Impaired mobility, identified as difficulty on opening wide and joint sounds, was significantly greater in Swedish citizens aged 55 to 75 years than in younger individuals.

No significant difference was found in an adult Finnish population. Citizens were sampled at 25, 35, 50 and 65 years.

Gender

In Swedish populations, significantly more women than men complained of difficult opening, but no difference was found in report of pain on opening wide. When difficulty opening wide was lumped with joint sounds as impaired mobility, significantly more women than men had impairment. But findings differ between populations. No significant difference occurred among the elderly, younger adults, or adolescents.

In Finnish populations, no significant gender difference was found among 10 to 16 year olds or among 12 to 15 year olds.

Significance: Although difficult opening is considered important, it is unclear whether the pain that accompanies it is the same as that reported when the mandible is in the static position.

Difficulty opening may be caused by muscle, joint, or combined muscle/joint problems. Clinicians must determine the origin to make a definitive diagnosis.

Report of Pain on Mandibular Movement

Review of the literature shows large discrepancies in the report of pain on mandibular movement. Typically, percentages were low across populations. About 10% or less of citizens in Washington complained of this problem.

In Sweden, just 1% of elderly 80 years or older and 10% between 40 and 49 years complained of this pain.

Exceptionally larger percentages were probably related to discomfort from loss of teeth, dental, or fatigue on chewing. For example, 30% of Finnish Lapps reported this pain.

Apparently, chewing dissatisfaction from loss of teeth contributed to this high percentage in Lapps. Variation in age accounted for some divergence.

Age

Functional pain was significantly greater in young Swedish adults than in older subjects. Functional pain was interpreted as pain on chewing, difficulty opening, and making mandibular movements. No pain was reported on mandibular movement by 12- to 15-year-old Swedes.

A study from three different groups from Norway showed little age effect involved with TMJ pain on function. Prevalence was 9% for a random sample of 1740 subjects from the population at large and was the same in 25 year olds, but it decreased slightly to 6% in 65 to 79 year olds. Frequencies were generally low overall for the population, but women reported pain more frequently than men at each age group.

In Poland, 39% of 15 to 18 year olds experienced this pain. Lower frequencies were found in younger and older individuals of this same population. A major increase was found from 6 to 22 years.

Gender

In Swedish populations, no significant difference was found in citizens of various ages. None was found for pain on gaping or for pain on mandibular movement between 17 and 19 years of age.

None was found in Finnish children between the ages of 10 and 16 years.

In Norway, women reported significantly more frequent pain on movement than men at 25 years and at 65 to 79 years.

Significance: Pain associated with joint movement must be differentiated from static pain and dental pain on chewing.

Report of Headache

Whether headache should be viewed as part of TMD symptomatology is debatable, but this symptom is considered because some individuals are unable to differentiate headache from TMJ or from other facial pains.

Much variation exists between populations. The manner in which data are expressed accounts for some of the confusion. Some findings are expressed as generalized headache, others as headache occurring daily, once or more per week, once or more per month, or even once or more over the last 6 months.

In North America, about one fourth to one third of adult populations from Virginia and Missouri reported generalized headache.

This percentage compares favorably with samples from northern Europe. Twenty-one percent of Finnish Lapps reported headache. Recurrent headache (once or more per week) occurred in 8% of citizens randomly sampled from Sweden. About 70% never complained of this symptom. Put another way, 30% probably suffered headache at some previous time.

Age

Most information about adult headache derives from studies conducted in Finland and Sweden. In Finnish Lapps, generalized headache reached a peak of 60% in 15 to 24 year olds and decreased significantly to 20% by 55 to 65 years of age. Unlike headache, neck and shoulder pain increased from 5% to 51% during that period.

In Sweden, headache increased little between 25 and 65 years of age; prevalence was one tenth that reported in Lapps. When adjusted for age, neck and shoulder pain increased by the same ratio as found in the population of Lapps.

In young children and young adults, variation is wide within and between populations. The mean was about 15% across populations. In Swedish children, the findings varied. No difference was found between 7 and 18 year olds. None was found between adolescents and young adults questioned at 15 years and then questioned again 5 years later. On the other hand, headache increased from 13% at 7 years to 36% at 15 years.

Among children from Pennsylvania belonging to the "calm" group, headache was twice as frequent in 10 year olds as in 6 year olds. Within children belonging to the "non-calm" group, no difference was found between 6 and 10 years olds, although the frequency was 25% in 9 9 year olds. Dissimilarities in the number of subjects sampled probably affected these findings.

Gender

Significant differences occur across all populations. Females suffered from headache more often than males. For example, headache was significantly more frequent (29% versus 17%) in women than in men of an urban Virginian population.

This trend was consistent across Scandinavian populations. In Sweden, the occurrence of daily headache was low but was more prevalent in women than in men. Recurrent headache was more prevalent in women (28% versus 15%) than men. Women reported headache in the afternoon and on walking in the morning more frequently than men.

At 20 years of age, significantly more young women reported headache than young men. Adolescent girls reported significantly more frequent headache (18%) than adolescent boys (1% to 6%).

In Finland, women reported more frequent headache than men. The findings on children differ slightly. No difference was found between girls and boys of 10 to 16 years in headache once or more weekly. At 15 years of age, girls reported significantly more recurrent headache (2 to 3 times per month) than boys. No difference was found at 12 years. The

difference at 15 years resulted from a significant decrease in headache for boys (19% versus 10%).

Headache occurred more often in Norwegian women (31% versus 24%) than men.

Significance: Because headache may occur simultaneously with major symptoms of TMD, its presence should be recorded in the charts of patients. Reasons for the reporting of headache more frequently in females than males need investigation. Efforts should be directed towards diagnosing the kind of headaches.

Report of Jaw Fatigue and Tiredness

A feeling of fatigue, tenderness, or stiffness of the jaw is a fairly common complaint across populations. For individuals of early to middle age, the variation ranges from 12% to 40%. Slightly less than one third of citizens randomly sampled from Canada had this symptom.

Age

This symptom was age related in Scandinavian populations. In Sweden, prevalence of fatigue was 2% in the elderly but was 22% in to to 29 year olds. Only 4% to 8% of children between 7 and 15 years of age had this symptom. The frequency in adolescents and young adults was 26%. In another population, the frequency was the same at 15 years as it was at 20 years for the same subjects. At about 17 and 19 years, fatigue related to facial pain, difficulty opening wide, and recurrent headache. The authors suggested that fatigue may mean impending dysfunction.

In Finnish Lapps, the prevalence was 40% within 35 to 44 year olds, but was only 18% in 15 to 24 year olds. No change was found in the same children questioned at 12 years and again at 15 years.

Gender

Significantly more elderly Canadian women than men reported jaw fatigue or ache. The prevalence of this feeling was 2% to 9% and was lower than observed for most other populations. These same women complained of generalized arthritic pain.

Among Swedish populations, women had significantly greater stiffness in the face and jaws on waking in the morning than men. Significantly more women than men reported jaw tiredness at 17 and 18 years, but not at 19 years. The authors concluded that for most individuals the symptoms were mild and fluctuated longitudinally. Fifty-six percent with fatigue had four or more areas tender to palpation.

Fatigue was reported more frequently in Finnish women than in men. But reports of stiffness and tiredness did not differ between girls and boys.

Significance: Reported jaw fatigue in adolescents may represent dysfunction or imply impending dysfunction. Fatigue should be noted in the charts on admission. Reasons for gender differences require further study.

Report of Difficulty on Opening Wide

Information about the frequency of difficulty in opening wide is low in most populations. The prevalence ranged from 6% in Swedish shipworkers to 13% in heavy metal workers from Finland.

Age

No significant effect was found in a large Swedish population. A slightly lower frequency (2%) was reported in 7 to 14 year olds than in 15 to 20 years olds (11%). Difficult opening occurred in 23% of children.

Limited opening was found in less than 1% of 2198 Japanese adolescents.

Gender

Analysis of gender reflects the ambiguity between populations. This difference was notable in Swedish people. Difficulty in opening wide proved greater in women than in men. But no significant gender difference was found on taking a large bite. In other populations, more women reported problems opening wide and complained more of locking of the TMJs than men. But no difference was found in another adult population, or between 17 and 19 year olds in opening the jaws wide or taking a big bite.

Significance: These is scant information to explain possible reasons for difficult openings. Examination should follow these reports to determine whether the complaint is joint, muscle, or joint and muscle related.

Report of Locking

Little information exists about locking of the TMJs. A prevalence of 10% was found in Canadian citizens sampled by telephone questionnaire. Examination of certain subjects showed 1% experienced locking and 17% had problems with luxation.

A prevalence of less than 1% was reported in Swedish citizens of various ages. Locking was virtually absent in most studies on children and occurred in only 3% of 15 year olds.

Age

Locking increased significantly (4% versus 7%) in Finnish boys at 12 years and when they were questioned again at 15 years. No change was observed in girls during the same time.

Gender

Locking was not significantly different between women and men in a Swedish population. No locking or luxation was found in adolescents. Results on adolescents and young adults fluctuated because a difference occurred at 18 years of age but not at 17 and 19 years.

Unusual ear symptoms, including locking, feeling of water, and ringing in the ear were more than twice as common in Finnish girls as boys at 12 years, and were higher, but not significantly higher, at 15 years. Luxation was more common in men than women in another Finnish population.

Significance: More information is needed about locking, particularly in children from populations of the USA. Reports of locking need confirmation by examination to determine possible long-term outcomes of these restrictions.

Report of Joint Sounds

Joint sounds varied extensively across populations and within the same population. In populations with the highest frequencies, the reporting was consistent for each age level. Thus suggests differences in the questions asked by investigators. The occurrence of crepitus was low, but this low percentage may relate to pooling of findings under the heading of "joint sounds". Another possibility is that the subjects were unable to differentiate one kind of sound from another.

Age

In North America, the prevalence of clicking was about 32% between the ages of 25 to 45 years and was lowest at 9% in elderly from Missouri. Overall lower percentages were found in a sample from Virginia. Age did not prove an important factor, but the highest percentage occurred between 21 and 40 years of age. A similar relation was found among community citizens from Washington. Crepitus proved an infrequent finding. A prevalence of 2% to 13% was reported in 6 to 10 year olds from Pennsylvania. The frequency of noise was higher in two populations of children from Michigan than in the children from Pennsylvania. It was 24% in a population younger than 11 years and 20% in a population of 6- to 18-year-old migrant children.

Among Scandinavian populations, sounds were the most frequently found symptom. The highest prevalence occurred at older ages, but no statistically significant differences existed between age groups. Clicking or popping was reported by 2% to 3% of elderly Swedish citizens and by 17% to 40 to 49 year olds. Crepitus occurred in 2% of Swedes.

Sounds were reported three times as frequently by 15-year-old Swedish children as by 7 year olds. The frequency increased slightly from 23% to 30% between 15 and 20 years. A 5-year longitudinal study of adolescents and young adults confirmed that the perception of joint sounds increased in frequency from 15 to 20 years. Sounds were the only symptom that changed significantly during this period.

Longitudinal study of adolescents and young adults from Sweden showed that clicking increased with age. The increase was more pronounced in girls, increasing from 14% at 17 years to 23% at 19 years. Much fluctuation was found, with only 5.8% of the group consistently reporting sounds.

Crepitus reached 13% in young Swedish adults with juvenile rheumatoid arthritis but was absent in matched, asymptomatic subjects.

Joint noises proved prevalent in the general population of Lapps. The highest percentage occurred between 35 and 44 years of age, the same ages reported for Swedish adults.

Age differences have been found in groups of subjects from Norway. Comparisons showed that clicking was reported by 15% of 1740 subjects from a random sample of the population at large, by 18% of 25 year olds, and by 11% of 65 to 79 year olds. Older women reported sounds more frequently (20% versus 0.9%) than older men.

Significantly fewer edentulous middle-aged and elderly Danish citizens reported sounds than dentate citizens.

The prevalence of sounds ranged from 32% to 78% in adolescent and young Polish adults. Crepitus was negligible in children. No significant difference was found for clicking between 6 to 8 year olds and 13 to 15 year olds or between asymptomatic adolescents and young adults. The frequency of sounds in adolescents and young adults described as symptomatic was twice that of asymptomatic subjects.

In Japan, joint sounds were reported by about 9% of adolescents.

Gender

Gender was not a factor in a samples from Virginia or in adults from Missouri.

The findings varied in Swedish populations. Women reported sounds more often than men. The sounds proved more embarrassing to women than men in another population. No significant difference was found in another population.

No significant difference was found for joint sounds among Swedes at 17 and 18 years, but girls reported significantly more frequent sounds at 19 years than boys. Young Swedish women reported significantly higher frequency of joint sounds than men.

In Finland, no effect was found for clicking or crepitus in Lapps. Gender was not a factor between the ages of 10 to 16 years. But clicking and crepitus increased significantly (13% versus 22%; 1% versus 6%) from 12 to 15 years in boys but not in girls.

Significance: Evidence suggests that detection of sounds by palpation represents the most reliable means of assessment. Studies should focus on longitudinal changes of the same subjects. Information should be focus on possible differences between genders and what this means to the individual. Specific kinds of sounds should be identified.

Tenderness on Palpation of Masticatory Muscles

Palpation of the head and neck muscles is considered useful to differentiate healthy individuals from those with dysfunction. The results of digital palpation have proved highly variable among populations. The lowest percentages (3% to 15%) were found in middle-aged Finnish citizens. The highest (74%) was recorded in Maryland citizens.

Many reasons account for this variation. There has been a lack of standardized procedures in applying pressure. Investigators have palpated to assess the presence of tenderness, to assess reflex response, to assess response to pain rather than tension, or to assess trigger points. Some investigators make these distinctions, others do not. Others have selected certain masticatory muscles, ignored others, or have lumped findings of masticatory muscles with findings of paraspinal muscles or TMJs.

Another factor includes the number of individuals used to perform the palpations. In some studies, one examiner may have performed palpations, whereas in other studies the palpations may have been performed by several examiners. In the Maryland study, one examiner performed the palpations and the procedure was standardized. Pain was recorded as present if individuals responded "yes" to the pressure of palpation. No pain was recorded if individuals answered "no". Scores were totaled for eight groups of masticatory muscles and six groups of paraspinal muscles. After such a thorough examination, the high percentage result cited in the previous paragraph was not unexpected.

Finally, the composition of most populations varies widely with respect to age and gender.

Age

Certain muscles have proved more tender to palpation than others in different populations. In Maryland, more young individuals (71%) had more than half of the paraspinal muscles tender compared with older individuals (59%), but the difference was not statistically significant. Little difference was found for the masticatory muscles within Pennsylvania children of various ages. No difference was found between 6 and 10 year olds belonging to the "calm" group or between 6 and 10 year olds in the "non-calm" group. But tenderness was significantly greater in the "non-calm" group than in the "calm" group.

In Swedish populations, a prevalence of only 6% was found in a sample of Swedish subjects ranging from 9 to 28 years of age. In 15 to 20 year olds, 85% had tenderness. Tenderness of the lateral pterygoids increased from 20% at 7 years to 43% at 15 years.

In Finnish Lapps, the masseter, temporalis, and trapezius muscles were more commonly tender with advancing age. No tenderness was found for the digastric and sternocleidomastoid muscles. Comparison of adolescents and young adults showed that tenderness was less than one half that found in subjects between 55 and 65 years of age. In another population, tenderness of the masticatory muscles and TMJs increased from 35% at 25 years to 51% at 65 years.

The lateral pterygoids, but not the temporalis tendons, were more tender in 65-year-old Tanzanians compared with 35 to 44 year olds.

Among Israeli children, no significant difference was found between the ages of 10 and 18 years.

In Polish samples, tenderness of the masticatory muscles increased from 15% in 6 to 8 year olds to 26% in 13 to 15 year olds. Prevalence of tenderness of the lateral pterygoids ranged from 16% in asymptomatic 15 to 18 year olds to 10% in 19 to 22 year olds, but it was 24% and 14%, respectively, in symptomatic individuals.

Among asymptomatic Finnish children, tenderness decreased from 30% at 5 to 8 years to 13% at 13 to 15 years.

Gender

Certain masticatory muscles have proved more tender to palpation in one gender than the other. Differences are complicated by age variation. For Michigan children, no significant difference was found for the population. Higher frequencies occurred in male adolescents and young adults with cusp-to-cusp relations than in their class I cohorts.

In Sweden, women exhibited more frequent tenderness of the lateral pterygoids than men. The masseters were more tender in elderly women than elderly men. Of the 18 areas palpated, 12 were more commonly tender in women than in men. Most common were lateral pterygoid (40% women versus 29% men), temporalis (33% versus 22%), and posterior digastric (24% versus 12%). Tenderness was significantly more common in females at 17 and 18 years than males of the same ages, but not so at 19 years. Only palpation of the temporalis tendon proved significantly different between sexes. No major differences were found for lateral pterygoids, superficial and deep heads of the masseter, anterior temporalis, sternocleidomastoid, and trapezius muscles.

In Finnish populations, no significant difference was found between girls and boys from 10 to 16 years of age.

Tenderness of Specific Muscles

Certain muscle groups appear more tender than other groups. Generally, the frequency in adolescents and young adults parallels the prevalence found in most adult populations. This relation is consistent in populations from non-clinical settings, selected groups, and private or clinic dental patients.

Where sufficient data were available for comparison between adults, tenderness localized within or near the lateral pterygoid muscle appeared to be the most frequently involved area. This finding was consistent for studies conducted in Australia, Egypt, and Finland, Hungary, and Sweden. The lateral pterygoid was reported to be tender to pain in more than one half of Canadians found with muscle tenderness. Tenderness was common in 44% of that sample, making the lateral pterygoid tender in at least 22% of the total

population, Coupled with the temporalis muscle, it was cited as being the most tender muscle in Finnish Lapps.

Tenderness of the temporalis, either at the coronoid attachment or the anterior fibers, was next among remaining muscle groups. When simultaneous palpation is done for other muscles, the superficial fibers of the masseter may approximate the temporalis in tenderness. In a few studies in which palpation has been conducted for the digastric muscle, the posterior fibers may be as tender as those of the masseter. Slightly lower percentages have been found for the medial pterygoid than for other groups.

Age and Specific Muscles

Based on age studies, tenderness was frequently lower in younger adults than older adults. An exceptionally low prevalence of 4% was recorded for combined palpation of masseter, medial pterygoid, temporalis, and sternocleidomastoid in an elderly population of British Columbia.

Specific muscles exhibit tenderness at an early age. Tenderness of the lateral pterygoid was found in 6 year olds from Ohio and in 7 year olds from Sweden.

This tenderness may be widespread, as found for the temporalis attachment at the coronoid and the masseter in Swedish children.

Investigations varied within different populations fro the same country. In Swedish populations, young adults had significantly less tenderness of the temporalis and lateral pterygoids than older adults. A trend was observed for the masseters. Increased tenderness was found in several muscles between 5 and 14 years in another population. Still, decreased tenderness was noted at 15 to 18 years compared with younger individuals.

The frequency of tenderness of the trapezius muscle in young Lapps was about one-fourth of that in old Lapps.

Children and young adults of similar ages in the same population differed in degree of tenderness. In a Polish sample, 15 to 18 year olds and 19 to 22 year olds were separated into symptomatic "TMJ" and asymptomatic "non-TMJ" groups. This distinction was based on the presence of more symptoms and signs in the "TMJ" group. In both age groups, the lateral pterygoid muscles were more tender in the "TMJ" group than in "non-TMJ" individuals.

Gender and Specific Muscles

The frequency of tenderness in the lateral pterygoid and temporalis muscles was more common in women than in men in a random sample of Swedish citizens. On the other hand, no difference was found for the lateral pterygoids (women 51% versus men 46%), but a significant difference was found for the masseters (women 39% versus men 27%) in retired Swedish citizens. In adolescents and young adults, a single difference occurred for tenderness of the temporalis attachment at the coronoid. Of six groups of muscles palpated, males had more frequent tenderness (24% versus 16%) at the coronoid than females.

Significance: Although review of the literature makes one question the reliability and validity of findings in some studies, muscular tenderness on palpation should be judged particularly relevant as a predictor of dysfunction. Tenderness of muscles seems the major factor responsible for genesis of pain. This finding has strong implications for treatment.

Studies show that tenderness on palpation can be used to distinguish asymptomatic individuals from symptomatic TMD patients. Both sensitivity (0.76) and specificity (0.90) proved high for palpations of masticatory muscles.

In a test-retest for agreement, repeated clinical palpations performed 6 weeks apart on muscles of the same TMD patients showed no major systematic variation between the two examinations. Fifty-seven percent of the palpatory findings were the same at both examinations. In a similar study, the same adolescents were palpated with a minimum of 1 week between palpations, and the agreement for palpations of several masticatory muscles was higher, ranging from 68% to 99%. Thus, the difference in percentage between the two studies suggest that the status of some muscles of symptomatic individuals changed during the longer interval between the first and second examinations.

Known amounts of pressure must be applied. Pressure of 2 lbs has been recommended for extraoral and neck sites.

Tenderness on Palpation of TMJs

Investigators differ widely in the manner of recording data on palpation of the TMJs. Some record a total percentage regardless of the area palpated, whereas others differentiate between palpation at the lateral pole of the condyle and posterior palpation by way of the auditory meatus. Combining sites promotes confusion.

In North America, the percentage for an adult population from Canada fell within the range for adult populations around the world. The lowest percentages, 1% to 4% laterally and less than 1% posteriorly, were found in 6 to 10 year olds from Pennsylvania.

In adult Swedish populations, tenderness was found in 2% of palpations at the lateral pole of the condyle and in less than 1% of posterior palpations. For the total TMJ area, a prevalence of 38% was recorded for another population of citizens of differing ages.

In Finnish workers, a frequency of 2% was found by palpation of the lateral pole of the condyle. Tenderness of the entire TMJs was found in 32% to 45% of Lapps.

A prevalence of 10% was reported for adult Egyptian desert dwellers by posterior palpation. When the lateral and posterior palpations were pooled, 30% were tender, a figure not unlike the total percentages found in the Swedish and Finnish citizens described above.

Age

No significant effect was found in Michigan children between 6 and 17 years of age.

No significant effect was found in a study of Swedish adults. The highest percentages occurred in at study of 13 to 15 year olds, in which 47% had lateral tenderness and 9% had posterior tenderness. Percentages of nearly the same magnitude occurred in another group of 15 to 18 year olds. In another population, no difference was found in children between 7 and 15 years.

None was found between 15 and 22 year olds in Poland or in Israeli children of 10 to 18 years.

Gender

Tenderness of the TMJs was not significantly different in female and male Michigan children between 6 and 17 years old.

In elderly Swedish citizens, significantly more women than men had tenderness on palpation of the lateral pole of the condyle and external auditory meatus. In an urban population, women had more lateral tenderness of the TMJs (25% versus 18%) and more posterior tenderness (13% versus 3%) than men. In another adult population, TMJ tenderness was significantly more common in women (4% versus 1%) than in men. On the other hand, no significant effect was observed on palpation at the lateral pole of the condyle or by way of the meatus in adolescents and young adults.

No significant difference was found between middle-aged and elderly Australians.

Significance: Lateral palpation must be differentiated from posterior palpation. Known amounts of pressure must be applied if values are to be considered meaningful. A pressure of 1 lb applied to either site has been recommended.

Limitation on Opening Wide

Several questions need to be addressed regarding the importance of maximal mouth opening. What is the normal range of opening? How reliable are measurements made at one time compared with measurements made at another? What constitutes limitation on opening wide? Are vertical overbite and horizontal overjet important in making judgments? Are there significant differences in opening capacity between asymptomatic and symptomatic individuals? Are age and gender significant factors?

The first question, how wide is normal, remains debatable. Some conclusions are possible. Comparison of localities across North America, South America, and Europe shows remarkable similarity for asymptomatic individuals of similar age and gender. Maximal mouth opening in adults falls nearer the upper limits of values between 40 and 60 mm. The range on each side of these limits may be greater for a given population, but this 40 to 60 mm grouping is consistent for the populations surveyed. These findings are interesting, considering the potential racial variation.

In North America, the mean openings for young adults examined from New York do not differ significantly from mean openings for military enlistees living in Hawaii. They do

not differ from means of patients visiting a dental clinic in California or a group of dental patients treated for periodontal disease in Hawaii.

The values on North American populations correspond favorably with asymptomatic individuals randomly sampled from Brazil.

Means for individuals from numerous locations across northern Europe are within the range of 40 to 60 mm. They differ little from means obtained on samples from England, Belgium, and Greece, if age and gender are excluded.

The second question concerns repeatability of measurements of maximal mouth opening. Study of the normal range among asymptomatic individuals shows that maximal mouth opening is stable from one time to the next. Interincisal openings were not significantly different when measured in women at different occasions (initially, 1 week later, and 4 months later) or in men measured initially and 18 months later. The author concluded that observed differences should be at least 4 mm in vertical mobility if they are to be accepted as a sign of a true effect of treatment for a given patient. Furthermore, no significant difference was found in maximal vertical opening after measuring patients with TMD initially and 6 weeks later. Jaw movement capacity proved a reproducible parameter in children.

Although limitation of jaw opening has been considered a major sign of dysfunction, disagreement exists about what constitutes limitation. The argument has been made that establishing a limit at less than the traditional 40 mm fails to recognize that some individuals may open much wider but be dysfunctional, whereas other individuals may open less and have no evidence of dysfunction. A similar opinion has been voiced after study of jaw movement capacity in children. This logic deserves praise.

Most researchers judge the opening to be limited if the interincisal distance is < 40 mm. Others set the limit at < 39 mm, at 38 mm, at < 37 mm, and at 35 mm. Some investigators consider 30 to 35 mm as a normal range and < 30 mm as abnormal, whereas others judge < 35 mm for men and < 30 mm for women as restricted opening. Still others consider 32 ± 6 mm as limited and 42 ± 5 as within normal limits. Finally, others make this judgment if the patient cannot insert the index and middle fingers interincisally when the hand is turned vertically in the mouth. So much variation causes problems in determining differences between symptomatic and asymptomatic individuals and among individuals of different populations.

In children and young adults, restricted opening has been accepted at < 50 mm, at < 40 mm for 7 to 14 year olds and for adolescents and young adults, at < 38 mm for 9 to 12 year olds, at < 36 mm for 6 year olds, and at < 35 mm for 5 to 8 year olds. Other accepted measures of restricted opening are < 30 mm, 30 to 39 mm (grade 1) and < 30 mm (grade 2) limitation, and < 31 mm to 42 mm as moderate limitation and < 31 mm as severe limitation. An argument has been made that limited movement cannot be used as a sole indicator of function in children because they suffer functional disorders of the chewing apparatus even when they have no limits of movement capacity.

In a classic paper, 35-mm interincisal distance was set as the limit for 5 to 10 year olds and 38 mm for 11 to 19 year olds. But the author showed that measurements made

between the alveolar crests represented more valid indices than measurements of interincisal distance. With this procedure, 44 mm was accepted as the limit for the younger age group and 49 mm for the older group. In a recent study conducted in Pennsylvania, 44 mm was accepted as the limit set by the recommendation of Landtwing.

The question of whether vertical overbite should be included during measurements has been studied. An impressive analysis of 1050 subjects showed that determination of normal mandibular opening using the alveolar crest distance proved superior to that of interincisal distance. The author recommended that alveolar crest distance be used routinely in general practice. Unfortunately, most studies on asymptomatic and symptomatic individuals have findings reported as interincisal distance. Inconsistency has been found between maximal opening capacity and overjet in Michigan children.

Whether limitation on opening can be used to distinguish asymptomatic individuals from symptomatic individuals is open to question. Mouth-opening capacity has been considered to have high discriminant power in identifying individuals with and without jaw pain. Because of its constancy, maximal mouth opening was considered to be most reliable clinical parameter for evaluating treatment. It has been recommended that this variable be routinely recorded because even a moderate reduction of mouth-opening capacity may indicated TMD. In contrast, the value of limited opening as an indicator of dysfunction was considered small and not highly predictive of TMD. The argument is that restricted opening capacity might be significant if there is severe hypomobility or hypermobility. Although statistically significant difference was found between TMD patients and asymptomatic individuals in maximal opening capacity, the sensitivity score was too low to confirm a relation.

Review of the literature shows reduced opening capacity for many symptomatic TMD cases around the world. Data supporting this belief have been sampled from populations in Hawaii, California, New York, Sweden, and The Netherlands. In contrast, no statistically significant differences in opening capacity were found between symptomatic and asymptomatic patients in a large dental clinic sample from California. Further study of a population from Washington supports this conclusion. Although TMD clinic cases showed less maximal opening capacity than asymptomatic individuals, when the clinic cases were assisted in opening their mouths, two thirds achieved an opening of 40 to 54 mm. The authors concluded that clinic cases had adequate vertical opening capability and lacked structural changes preventing a wider opening.

Age and Normal Opening

Variation in mouth opening has been related to age. Differences have proved dependent on both age and body stature. Maximal mouth opening increased with age from a mean of 45 mm at 5 years to 59 mm at 19 years, a 31% increase. During this period, the bodily stature increased 54%, confirming that the change in mouth opening is significantly less than the change in stature. Maximal opening capacity is reached in the early teens.

The mean opening capacity differs between populations of similar ages. Children from Michigan have smaller openings than children from Finland. Starting at 6 years, children from

Michigan average nearly 6 mm less opening than children from Finland. By about 16 years, the difference is nearly 8 mm.

In a community-dwelling population from Maryland, limitation on opening occurred in 13% of individuals 56 years or older compared with 5% for younger adults.

No limitation was found in 15- to 20-year-old Swedish adolescents and young adults.

Age and Limited Opening

In Sweden, limited opening was found from 1% to 15% in a random population. This range compared with the 3% to 16% in a similar population. A change in prevalence was observed at 2% in 15 year olds to 10% for the same individuals 5 years later. A high occurrence of 28% was found in a small sample of symptomatic juvenile rheumatoid arthritic patients between 9 and 28 years of age.

Limited opening was not significantly different between 6- to 8-year-old Polish children and adolescents and young adults.

Little difference was found in Israeli children between 10 and 18 years.

Gender and Normal Opening

On average, males have greater opening capacities than females. When compared within the same population, the results of all the studies confirm this relation. This disparity relates to body stature. Typically, girls have smaller openings compared with boys. This relation remains throughout life.

Gender and Limited Opening

Reduced opening was more common in older Greek women and men than in younger individuals of the same population. The decrease was comparable in both genders. The loss was about 12% between 18 and 20 years and 61 and 70 years.

A similar loss was found in Swedish men and women. The decrease to < 40 mm between 25 and 65 years was about 13%. No significant difference was found between Swedish adolescents and young adults.

In Maryland, no significant difference was recorded in a gender-equal sample of adults.

Significance: Definitions of what constitutes normal opening vary widely, but most adults wall within the 40 to 60 mm range. Measurements are repeatable over time if no dysfunction occurs. Measurements made between the alveolar crests proved more reliable than measurements made interincisally. Universal agreement is needed to establish what is meant by limitation. Whether opening capacity can be used a significant predictor of TMD remains conjectural. Clearly, setting the limits at 35 mm for men and 30 mm for women recognizes differences in stature not otherwise considered by the traditional interincisal measurement of

< 40 mm. Individuals 60 years and older can be expected to have less opening capacity than younger individuals.

Measurement of mouth opening has potential clinical value for assessment of mandibular function in children. But allowance must be made for variation in body size, populational difference, deviation from the normal range, age, gender, and the manner in which measurements are taken.

Study across populations shows that age and gender significantly affect findings. Younger children have less limitation than young adults. Girls have smaller opening capacity than boys. Although arbitrary, establishing interincisal restriction on opening at < 35 mm for boys and < 30 mm for girls in the early teens fits most children. Extrapolation of measurements for interincisal distance yields < 39 mm alveolar crest distance for boys and < 34 mm for girls. In sum, this modification fits children of most populations.

There is not much value in measuring horizontal mobility unless individuals become symptomatic or have growth anomalies. For example, the mean for horizontal mobility was about 9.5 mm (6 to 13 mm) to each side in 24 asymptomatic women. The mean for protrusion was 8.6 (6 to 12) mm. Agerberg found no significant difference after measuring on different occasions (initially, 1 week later, and 4 months later). He concluded that the observed difference in horizontal mobility should be at least 2 mm if it is accepted as a sign of a true effect of treatment for a given patient.

Deviation on Opening

Most investigators record this percentage if the mandible deviates laterally from straight opening or from the midline by > 2 mm. Yet 1 mm was accepted as the limit in dental patients examined from New York. Among elderly of Canada, ? > mm was used. The inflated percentages reported in some studies resulted from pooling of data with joint sounds, locking, or luxation.

The scattered findings in children are variable. Clearly, this parameter depends on interpretation of the investigator. Most studies follow > 2 mm lateral deviation on opening, but > 5 mm has been used.

Deviation on opening has been correlated with difficult opening, joint clicking, pain on jaw movement, and tenderness of the TMJs. It has been associated with dysfunction based on analysis of tooth contacts and has been used to differentiate patients with orofacial muscle-related complaints from patients with psychogenous complaints. The prevalence was significantly higher (50% versus 15%) in Swedish young adults judged to need treatment than in Swedish young adults not needing treatment.

Age

Within populations at large, 17% deviated in a sample of Canadian citizens. A high frequency of 60% to 63% was recorded in Finnish Lapps.

With age as a factor, results are mixed. In North America, deviation was significantly higher among adult Canadians younger than 65 years compared with more elderly individuals. None was found between girls and boys of different ages in a Pennsylvania study.

None was found in 14 to 16 year-old Danish adolescents. Deviation on opening was unusually high (50%) in another population. But irregular opening and deviation on opening were low in a comparable Danish sample. The authors attributed the difference to sensitivity.

In Sweden, 55% of 15- to 20-year-old adolescents and young adults had this problem. A higher percentage was found in children with dental restorations than in children with intact dentition. The authors related this difference to symmetrical function of the lateral pterygoid muscle in the intact group.

Among Polish children between 6 and 15 years of age, deviation was unusually high in a group described as having slight dysfunction. These children were divided into those with normal occlusion and those with malocclusions or lack of teeth. In 6 to 8 year olds, deviation occurred in 30% of normals and 38% in abnormals. Deviation was present in only 19% of 13- to 15-year-old normals and in 19% to 25% of abnormals of these ages.

Gender

Irregular opening pattern was not found to differ with respect to gender in several populations or with respect to laterality.

No significant difference was found in Finnish children between 10 and 16 years of age. Yet deviation proved more frequent (22% versus 13%) in adolescent females than in adolescent males. No gender difference was found in younger children.

Significance: Coupled with radiographic and palpable findings, this sign should be a useful parameter for discerning developmental anomalies, muscular incoordination, internal derangement, or pathologic changes. It is simple to observe and measure. Uniformity would be improved by acceptance of > 2 mm as the limit for adults and children who possess anterior teeth.

Detection of Joint Sounds

As found for self-reports of joint sounds, some investigators group these sounds, whereas others differentiate sounds from one another. Most distinguish between clicking and crepitus, whereas few discern between clicking and popping. Other variation is related to the way the sounds are detected. Reports are based on findings by palpation, by auscultation with stethoscope, and by both procedures.

Clicking or popping was found in 5% of community residents of Washington. The frequency was recorded as 48% in Canadian citizens.

In Sweden, joint sounds have been recorded in up to 65% of shipworkers. A division of these sounds showed that 42% had clicking, 21% had crepitus, and 2% had both noises.

Crepitus was 2% in 50 year olds and 33% in subjects of an urban population. When examined by stethoscope, 58% of these citizens had sounds.

Age

According to studies conducted on Swedish adults, age was not a significant factor influencing TMJ function, including joint sounds, deviation on opening, luxation, or locking. This broad statement is not supported by findings in other studies.

Crepitation was more frequent (37% versus 7%) in 65- to 74-year-old Tanzanians compared with 35 to 44 year olds. No difference existed in clicking.

Joint sounds are frequent in children and young adults. Usually they are less prevalent than in older adults. Crepitus is uncommon in children and young adults. Even when recorded, values average 2% or less.

In North America, clicking was significantly lower at 6 years of age than at 10 years in Pennsylvania children belonging to "calm" or "non-calm" groups. a prevalence of only 4% was recorded for migrant children from Michigan.

Furthermore, regression analysis showed an age effect and clicking in Michigan children. Between 6 to 12 years of age, boys with cusp-to-cusp molar relations had a higher risk for clicking than their class I cohorts. From 11 to 17 years of age, girls had higher rates of clicking if the occlusion was class II rather than class I. After 13 years, girls with cusp-to-cusp occlusions had greater rates of clicking than other cohorts. The authors concluded that such associations were greater in older children than in younger children.

In Swedish populations, clicking doubled between 7 and 15 years of age. A similar relation was found between 7 to 14 year olds and 15 to 18 year olds in another population. But no significant difference was found between 15 year olds examined again at 20 years.

Clicking doubled, from 10% to 20%, between 6 to 8 years and 13 to 15 years in Polish children.

Clicking was significantly higher in 16- to 18-year-old Israeli children than in 10 to 13 year olds. The highest percentage recorded for any population was 44% in adolescents and young adults from Israel. But if the percentages are pooled between 10 to 18 year olds, they do not differ from percentages obtained by pooling data of 15 to 29 year olds from Sweden.

Sounds were about one half as frequent (7% and 4%) in 13- to 15-year-old Finnish adolescents as in 5 to 8 year olds.

Gender

Some differences have been ignored in studies, particularly involving young children.

In elderly from Canada, women had more frequent sounds than men. The number of individuals with joint sounds was low. Among Maryland citizens, the percentages were similar in women and men.

In Swedish populations, findings were mixed. Gender was considered important in TMJ function. Fewer women than men had normal TMJ function between 20 and 70 years of age. Differences were observed in joint sounds and deviation on opening. In another population, the frequencies of both clicking (28% versus 21%) and crepitus (40% versus 26%) were greater in women than in men.

No significant difference was found in joint sounds in a comparison of elderly Swedish citizens. Examination showed that at 17 years, the frequency of sounds in girls was not significantly different from that in boys. At 18 and 19 years, women had nearly twice the frequency as men (25% versus 13%).

No difference existed between middle-aged and elderly Australians, and no difference was found in Finnish children between 10 and 16 years and younger children.

Significance: The diversity of joint sounds among populations shows the need for improvement in detection. In one study, digital palpation proved superior to stethoscopic examination. Reliability was marginally acceptable (K = 0.62), even with the palpation method.

Numerous recommendations have been made about sounds. In sum, sounds should be differentiated from one another (eg, clicking from popping, and crepitus from grating). Little is known of the prognosis of sounds, need for treatment, and long-term results of therapy.

Selected Groups

The findings of most studies suggest that individuals of similar age and gender suffer nearly the same complaints and exhibit similar signs. For most populations, the percentage of complaints was slightly less than reported for populations in nonclinical settings. Muscular tenderness and joint sounds detected by examination were as variable as observed in studies of nonclinical settings. In samples with equal gender ratios, women had more frequent complaints and more frequent signs than men.

Report of Orofacial Pain

Differences reflect the kinds of questions posed to subjects. Investigators asked about generalized orofacial pain, jaw pain, TMJ pain, and ear pain. Whether any of the findings can be considered comparable remains patently unclear.

In Virginia, prevalence of jaw pain was 4%, and pain within or surrounding the ear was 8% in Virginia dental students and dental hygienists. Pain localized to the jaw was reported in 22% of nursing students from Minnesota. Orofacial pain was not a major complaint in a small sample of dental students from California. The prevalence of pain of the cervical neck region was less than 1% in these subjects.

Just 15% of dental students from Belgium complained of jaw pain.

Pain in or surrounding the ear was 35% in heavy metal workers from Finland. This latter percentage is inflated because other symptoms (eg, tinnitus, stuffiness, itching, reduced hearing, and pain without infection) were lumped with pain surrounding the ear region.

In Poland, orofacial pain was less than 1% in medical students, 10% in military students, 3% in young soldiers, and 5% in middle-aged soldiers.

Gender

No significant differences were found in pain of the face, jaws, eyes, throat, neck, or ear in college students from California or in dental students and dental hygienists from Virginia. In a small sample of dental students from California, twice as many women reported static jaw pain (8% versus 4%) as men.

The possibility of difference was ignored in a largely male-dominated sample of shipworkers from Sweden and among dental students from Sweden.

Report of Pain on Opening Wide

Information about this pain is limited. Just 8% of 25-year-old rural citizens from Norway complained of pain on opening. The pain was twice as common in women as men (11% versus 5%).

Report of Pain on Chewing

The way in which data are expressed produces differences between populations, and the range of reports of pain on chewing is great. Chewing pain was present in 2% of rural, 25-year-old Norwegian citizens.

In a sample of 20-year-old Swedish young adults, the prevalence was 51%. This is an inflated percentage because the data were expressed as pain or tiredness and subdivided into frequent and occasional. In a nontreatment group, frequent pain and tiredness occurred in 11% and occasional pain and tiredness in 41%. In a smaller group of these young adults described as needing treatment, pain or tiredness on chewing was frequent in 28% and occasional in 47%.

Gender

No significant differences were found in a heterogenous sample of college students from California. From this same region, significantly more women dental students than men dental students (14% versus 5%) reported chewing pain.

No gender difference was found in 25 year olds from Norway.

Report of Pain on Mandibular Movement

This symptom was of low to moderate frequency among selected groups of individuals. In Sweden, a frequency of 3% was reported by conscripts and by a sample of 20 year olds. A prevalence of 5% was observed in dental nurses.

Gender

Differences have been found in dental students from California. Significantly more women (14% versus 8%) than men reported jaw pain on movement.

TMJ pain on function was significantly greater (14% versus 3%) in 25-year-old Norwegian women than men of the same age.

Report of Headache

For most populations, the prevalence of headache was low. In Swedish soldiers, it was 8%. In a limited sample of 20 year olds from Sweden, no history of headache was reported by 9% of a group needing treatment and by 18% of a group not needing treatment. Extrapolation of percentages yields unusually high prevalences of 91% and 72%, respectively, for subjects with a history of headache. Such differences reflect the importance of asking about recent occurrence of headache.

Gender

Differences have been found in populations from North America and Scandinavia. Significantly more women attending a California university reported headache (15% versus 10%) than men. Subjects suffering headache had more frequent tenderness of the TMJs (15% versus 4%) and muscles of the head and jaw (58% versus 31%) than individuals not suffering headaches. Significantly more women dental students and dental hygienists from California reported moderate to severe headache (16% versus 6%) than men dental students.

Within 25-year-old Norwegians, women had significantly more frequent headache (31% versus 24%) than men.

Report of Jaw Fatigue and Stiffness

Conclusions about reports of fatigue and stiffness are limited by the paucity of data. Yet populational differences are evident. Thirty-two percent of nursing students from Minnesota suffered this complaint. A prevalence of 2% was reported in a small sample of 20-year-old Swedish young adults.

Gender

Studies showed that significantly more women dental students from California reported jaw fatigue (25% versus 13%) than men dental students.

Report of Difficulty on Opening Wide

Data about difficulty on opening wide are limited. No significant difference (9% for both groups) was found between 20-year-old Swedish young perceived as not needing treatment or needing treatment of TMD.

Report of Joint Sounds

Joint sounds were of low to moderate frequency among populations. There was remarkable similarity in frequency. In North America, self-reported clicking or popping occurred in 15% and crepitus in 6% of dental students from Virginia. These percentages were similar to the presence of combined clicking and popping in 29% of dental students from California.

In northern Europe, 15% of 20-year-old Swedish young adults had sounds, whereas 22% of male heavy metal workers from Finland had clicking and 6% had crepitus.

In Poland, 10% of medical students, 22% of military students, 17% of young soldiers, and 2%5 of middle-aged soldiers had both joint sounds and deviation on opening.

Gender

Initial responses showed no significant difference in joint sounds among college students in California; however, direct questioning by examiners indicated that women gave 11% more positive responses than men. This finding is supported by finding from another study of California students. Frequency of clicking was greater (50% versus 39%) in women dental students than in men dental students. Women reported that the clicking disturbed them more (40% versus 30%) than it did the men.

Gender differences have been found in other populations. The occurrence of sounds has been related to other symptoms. Clicking and crepitation were significantly greater in 25-year-old Norwegian women (23% versus 14%) than men of the same age. Among individuals with joint sounds, headache was greater in women (35% versus 20%) than in men. For subjects with sounds, 19% of women and 12% of men reported no headache.

Report of Locking

Joint locking was of minor frequency in these selected groups. A history of locking was reported by 8% of nursing students from Minnesota. This frequency corresponded favorably to the 7% frequency found in Finnish heavy metal workers.

The frequency of locking was significantly greater (13% versus 5%) in women dental students than in men dental students from California.

Tenderness on Palpation of Masticatory Muscles

Some variation occurred even for samples from the same locality and for individuals of about the same age. Ten percent of a small sample of California dental students had

tenderness. Within a large sample, a prevalence of 48% was found. In Minnesota nursing students, the frequency was 24%.

Gender

Significantly more California women dental students and dental hygienists had muscular tenderness (68% versus 33%) than men dental students. Most tenderness was graded as mild. Global tenderness, judged as 4 or more sites, was present in 14 of 16 women. This same relation was observed in college students from California. More women than men (42% versus 26%) had tenderness.

In consistencies exist between men of similar ages in different populations from northern Europe. Percentages were less than one half in Finnish workers compared with Swedish soldiers. The latter percentage was not significantly different from the percentage found in nursing students examined from Minnesota.

No gender difference was found in a large sample of Iraqi college students.

As in nonclinical settings, the lateral pterygoids proved the most tender muscle group in all selected groups. This finding agrees with the finding in another study. In California college students, tenderness of the lateral pterygoids was nearly twice as frequent in women as in men.

Tenderness on Palpation of TMJs

Tenderness of the TMJs varied within individuals of similar ages and within different populations. Generalized joint tenderness occurred in one fourth of Minnesota nursing students. A prevalence of 18% was found by way of the auditory meatus. In contrast, just 3% was found by palpation at the lateral pole of the condyle and 1% by the auditory meatus in Virginia dental students.

Generalized tenderness on palpation was found in 1% of Swedish soldiers.

Gender

Most differences between populations probably relate to gender. All Swedish soldiers and nearly all the dental students from Virginia were men, whereas the nursing students from Minnesota were women.

Significantly more California women dental students and dental hygienists had tenderness than men dental students. Of 32 subjects with tenderness, 25 were women. Tenderness of moderate to severe nature was more prevalent in women (12 of 15) than in men. Still, no difference was found among college students from California.

None was found among Iraqi college students, or among Taiwanese university students.

Limitation on Opening Wide

The frequency was low in most populations. Only 1% was detected (<40 mm) in dental students and hygienists from California and 4% in college students from California. Limitation among the college students was not gender related but was significantly related to pain on opening wide (17% versus 3%) and to awareness of joint sounds (21% versus 8%).

Asymptomatic university students from Taiwan had significantly greater maximal mouth opening compared with symptomatic students.

Only 3 of 121 Belgian dental students had limited opening. They were women.

In Swedish 20 year olds, limitation has been used as a basis for treatment. The frequency was twice as great (16% versus 8%) in a group needing treatment than in a group not needing treatment.

Mild limitation on lateral movement was found in 71% of college students from California.

Deviation on Opening

Frequencies found for deviation on opening were variable. A prevalence of just 3% was found in nursing students from Minnesota, whereas a prevalence of 18% was found in college students from California.

Comparative study of two small groups of 20 year olds from Sweden confirmed this variability. In the group not needing treatment, 15% deviated on opening, whereas in the group needing treatment, 50% deviated 2 mm or more on opening.

Detection of Joint Sounds

Much variation occurred in findings between populations. Some differences resulted from the manner in which the noises were detected. Clicking was found in 17% and crepitus in 12% of California college students. Sounds were detected by palpation and stethoscope. In a small sample of dental students from California, the frequency was 72% when sounds were detected by binaural stethoscope.

In male Swedish drafters, clicking or popping was found in 8%. Sounds from the draftees were reported as being "heard".

Joint sounds have been related to other signs. In dental students, clicking correlated with tenderness on palpation in at least one masticatory muscle. Various kinds of joint sounds were found, indicating different types of disk disorders in these students. Late opening sounds occurred in 45% of students.

Crepitus was absent in Swedish children and young adults ranging from 9 to 28 years old. It was recorded in less than 1% of Swedish soldiers.

Gender

Significantly more women have been found with joint sounds than men. In California college students, the frequency was 35% in women and 22% in men. In dental students and dental hygienists, more women had clicking (36% versus 24%) than men dental students. Five of 7 subjects with crepitus were women.

Gender effects were absent among Iraqi college students and university students in Taiwan.

Private/Clinic Dental Patients

Significance: The occurrence of signs and symptoms in patients presenting to private clinicians or clinics for routine dental care was equal to or slightly less than that found in nonclinical settings. Usually samples from populations at large were obtained from subjects residing in a specific locality and were comprised of individuals of similar races. Most clinic populations, particularly those in large industrialized localities, are comprised of heterogenous cultures. This heterogeneity explains some variation between clinics when comparing the same signs and symptoms.

Report of Orofacial and Related Pain

As in studies in nonclinical settings and selected groups, investigators differed in defining the site of the complaint. In North America, orofacial pain was reported by 40% of a small number of dental patients commingled with TMD clinic cases from New York.

Orofacial pain ranged from 15% in a small sample of asymptomatic dental patients. from The Netherlands. TMJ pain was reported by 17% of the 20 to 50 year olds.

Jaw pain was reported by 11% of Pennsylvania adults between 19 and 30 years of age. TMJ pain was recorded at 47% in dental patients from New York.

Jaw pain occurred in 66% of Swedish dental patients. Their ages ranged from 20 to 82 years.

Age

No significant difference was observed for pain and soreness around the face, ear, eye, or cervical neck in patients from California younger than 30 years or 60 years and older.

Cervical neck pain during the day was found most commonly in 50 yo 59 year olds in a sample from New York. The prevalence reached 45% in an older dental population from New York.

Gender

As in asymptomatic populations, gender differences existed. In a California clinic, the frequency of face and ear pain was more common in women (24% versus 9%) than in men.

Significantly more women than men reported orofacial pain in a sample from Virginia. This same relation was found for ear pain during the day (not night) from New York. The frequency was 7% for females and 4% for males.

Jaw ache and tiredness was reported more frequently by women than in men among elderly from British Columbia. The total of 9% agrees exactly with the 9% in jaw fatigue determined by difference between positive and negative responses observed in subjects from Texas.

Pain of the cervical neck region was found in 11% of dental patients from New York. It was significantly greater in females (5% versus 2%) during the night (not day) than in males.

Chronic neckache was significantly greater in women from California (18% versus 7%) than in men from the same locality.

Report of Pain on Opening Wide

Pain on opening wide was found in 6% and 22% of large samples of dental clinic patients from Virginia and California, respectively. A frequency of 10% to 11% was reported by elderly from California clinics.

In a Virginia clinic, significantly more women reported pain on opening wide than men.

Report of Pain on Chewing

Significantly more women than men reported pain on chewing in a sample from Virginia.

Report of Pain on Mandibular Movement

Pain on mandibular movement was reported in 5% of dental patients from California.

Report of Headache

The occurrence of headache ranged from 13% to 43% in dental patients from California. A frequency of 25% was reported by Virginia patients. Complaints of headache or dizzy spells were not significantly different among Texas dental clinic patients giving positive or negative responses to tenderness of the masticatory muscles or to pain on mandibular retrusion.

Headache occurred in 43% of dental patients from The Netherlands.

Age

Differences occurred in some clinic groups. Chronic headaches was significantly greater in California subjects younger than 30 than in subjects 60 years and older. Daily

headache was significantly greater in 20 to 49 year olds than in other ages from a sample in New York.

Gender

Significantly more women than men reported headache as a frequent symptom in a Virginia clinic. Chronic headache was significantly greater (25% versus 11%) in women than in men from California. Headache was significantly greater in females than males during the day (21% versus 14%) and at night (6% versus 3%) in a sample from New York.

From Sweden significantly more women (40% versus 29%) than men had headache. Women tended to describe this symptom as more severe than did men.

Report of Jaw Fatigue and Tiredness

In a group of California dental patients, 38% experienced tiredness of the jaws. Tiredness was significantly more common (21% versus 8%) in subjects younger than 30 than in individuals 60 years and older. Significantly more women (17% versus 8%) than men complained of this problem.

Tired jaws correlated significantly with tenderness of the masticatory muscles or pain on mandibular retrusion in patients from Texas. In subjects giving positive responses to palpation, 41% reported tiredness, whereas in subjects giving negative responses, 32% mentioned tiredness.

Report of Difficulty on Opening Wide

In the California group significantly more subjects younger than 30 years had difficulty opening wide (22% versus 11%) than patients 60 years and older. More women than men (18% versus 8%) had difficulty.

Report of Joint Sounds

As in nonclinical settings, joint sounds varied widely. Clicking or popping was reported by 6% of dental patients from Virginia and occurred in 45% of patients from California. The dissimilarity was not attributed to unequal size of samples. Both populations were large.

Crepitus ranges from 6% in a large population from New York to 17% of patients from California.

Age

Differences were found in heterogenous samples from New York and California. In New York, the greatest prevalence (31%) occurred in 30 to 39 year olds. In California, more individuals younger than 30 years reported clicking or popping (45% versus 23%) than subjects 60 years and older. No age difference was found for crepitus.

Gender

Joint sounds were significantly greater in females than males during the day (23% versus 17%) in a sample from New York. No differences were found for the night.

In California, significantly more women complained of clicking or popping (36% versus 27%) and crepitus (17% versus 10%) than men.

Report of Locking

No report of locking was found in the literature.

Tenderness on Palpation of Masticatory Muscles

In North America, tenderness was 15% in samples from New York and California.

Thirty-three percent of dental patients from Norway had tender muscles.

Age

In the group from California, muscle pain on palpation was significantly greater (24% versus 12%) in individuals younger than 30 years than in subjects 60 years and older. This difference contrasts with findings from studies in New York. Tenderness of the lateral pterygoid muscle increased with advanced age. Pain was found in 8% of subjects between 10 and 19 years and in 32% of those between 80 and 89 years.

Other important disparities were found in a sample from Texas. Comparison of subjects giving positive responses on palpation of the muscles or pain on mandibular retrusion found a 37% prevalence in 50 to 59 years olds and just 20% in 80 to 89 year olds. The same pattern was observed in subjects giving negative responses, which indicated that age was not a significant factor in discriminating between patients with and without these problems. Furthermore, tenderness did not correlate with maximal mouth opening, headache (41% positive versus 32% negative) or crepitus (70% versus 57% negative).

Gender

No significant difference was found in tenderness of the lateral pterygoids in patients (females 16% versus males 13%) from New York. None was found for several masticatory muscles in a mixed sample of elderly from British Columbia. But tenderness was significantly greater in women than men (195 versus 10%) in a sample from California.

Study of a Norwegian sample showed that tenderness of the masticatory muscles and TMJs was not statistically related to gender or age.

Comparison of specific muscle groups was limited because samples were small. Overall, the percentage within each group was the lowest reported among all populations.

Tenderness on Palpation of TMJs

Values ranged from 4% in patients from New York to 45% in patients from California. The tenderness reported for New York patients was derived from palpation at the lateral pole of the condyle. Just 1% were found tender by palpation of the auditory meatus.

Age

No significant differences were found on palpation of the TMJs in a population from New York. On the other hand, Californians younger than 30 years showed greater tenderness (39% versus 23%) than subjects 60 years and older.

Gender

Palpation of the lateral TMJ region did not differ between genders among New York patients. None was found between elderly subjects in British Columbia. But significantly more women than men (36% versus 24%) were tender in a California sample.

No difference was found in a large sample from Norway.

Limitation on Opening Wide

Limitation on opening wide was found in 4% of the patients from California and in 13% of the Iowa patients.

In Sweden, 35% of 80 dental patients had limitation. Nine percent had severe limitation and 26% had mild limitation.

Age

Limitation was less in young adults than older adults in a population from New York. The frequency was 3% in 20 to 29 year olds and 26% in 80 to 89 year olds. No difference was found between patients younger than 30 years and 60 years and older from California.

Gender

Although the frequency of females with an opening of 37 mm or less was higher than that of males (7% versus 6%), no significant difference was found in patients from New York. None was found in patients from California or in elderly from British Columbia. Limitation was set at 35 mm in the elderly sample.

Deviation on Opening

Deviation on opening was found in 21% of older patients from California.

For the group from Sweden, the frequency was 69%. This finding was considered minor; 3% had severe and 66% had mild signs.

Age

No significant difference was found in subjects younger than 30 years and 60 years and older in a sample from California. None was found in a population from New York.

Gender

No significant difference (females 18% versus males 17%) was found in a population from New York or in a sample of elderly British Columbians. But women showed more significant deviation than men (39% versus 19%) in a sample from California.

Detection of Joint Sounds

Clicking or popping occurred in 52% of dental patients from California.

In Iowa, about 15% of 1000 patients had clinically evident sounds. Clicking was the most prevalent sound. The frequency of crepitus was low. Forty-four percent had reduction of the disk on opening, and 42% had partial subluxation. None of the patients presented with diskal displacement without reduction. One third had present or past discomfort. No significant difference existed between individuals with subluxation, diskal reduction, or crepitus. Patients with crepitus averaged 54 years. Individuals without crepitus averaged 34 and 33 years, respectively.

Clicking or popping was detected in 10% and crepitus in 1% of young German men.

Age

In New York, subjects younger than 9 years and between 10 and 19 years of age differed from other age groups. None had sounds at the youngest age, whereas 26% had sounds by 19 years. Crepitation was absent in both young groups. In California, joint noise was slightly higher (56% versus 41%) in subjects 60 years and older than in individuals younger than 30 years.

Gender

Significantly more females (39% versus 29%) had sounds than males in patients from New York.

This same relation was found among elderly of British Columbia. No percentages were given for each sex, but the overall percentage was significantly lower than that reported for New York patients of the same age.

A greater frequency of females than males was observed in patients from other clinics. Women were found with joint sounds more frequently than men (55% versus 40%) in a sample from California.

TMD Clinic Cases

Significance: The most impressive findings are those comparing TMD patients with asymptomatic subjects from the same populations. Because of the heterogeneity of samples, age-related differences for this group are probably less reliable than those found by comparison of specific age groups selected from nonclinical settings. Studies in which sufficient data exist on gender suffer from the same concerns .

Age

Comparison of symptomatic samples across the world showed that most patients are 30 to 50 years of age. In the USA, 69% of patients from Georgia were younger than 40 years, whereas most patients from Illinois fell between 31 and 50 years of age. In New York, 57% were between 21 and 40 years. In Tennessee, 62% were between 20 and 50 years of age. Such results are consistent with the finding of a mean of 37 years for Virginia patients.

This age range characterizes other areas from the Americas. A sample from Canada found that the greatest number of symptomatic subjects were between the ages of 36 and 41 years. In Argentina, the frequency was slightly less between 20 and 30 years than at more advanced age.

In England, young women were reportedly the most susceptible individuals. Forty percent were between 18 and 30 years of age.

In Scandinavia, 87% of the Norwegian patients were younger than 49 years. Most patients fell between 20 and 50 years of age. Comparison of samples from Sweden showed that most presented for examination between 19 and 55 years, and specifically 20 and 39 years.

Interestingly, age was ruled out as significant factor in studies on signs and symptoms of adults in Australia. Several reasons may account for the absence of an age effect. The mean age for patients and for asymptomatic subjects used for comparison was 40 years. The range was narrow in both groups. The total number of patients above and below 40 years was only 136, and the number of comparable subjects was 55. Finally, the heterogeneity in patients presenting for treatment is large in clinics of this kind.

Gender

Differences existed in patients presenting for diagnosis or treatment. Based on ratios for clinic samples, women outnumbered men by 2:1 to 9:1 across the world.

In the USA, ratios ranged from 65% women to 35% men in a small group in California to 90% to 10% men in a group from Virginia. This relation is consistent for other samples from California, Virginia, Georgia, Illinois, Maryland, Minnesota, New York, Tennessee, and Washington.

Significantly more women than men visited clinics in Canada and in Argentina.

In England, women outnumbered men by about 3.5 to 1 in several studies. An even higher ratio was found in a sample from The Netherlands.

In Scandinavian studies, Norwegian women outnumbered men by about 4 to 1. Slightly lower ratios have been found in samples from Sweden. Exceptions included a selected group of young adults designated as needing treatment and a group of tinnitus patients surveyed for TMD. In these samples, no major gender differences were reported.

Women at all ages were three times as likely as men to visit TMJ clinics in Greece.

Report of Orofacial and Related Pain

The range for pain of the orofacial region was wide across populations. As reported for individuals in nonclinical settings, selected groups, and private/clinic dental patients, the location of pain was not always well defined or was expressed differently from one study to the next.

Most studies showed that the frequency of pain was much greater than reported by subjects from nonclinical, selected, or dental clinic settings. In North America, orofacial pain occurred in 98% of a large sample from Illinois. Pain localized to the jaw was reported by 11% and to the TMJs in 83% of patients from Tennessee. Jaw pain reached 94% of cases from Virginia. Facial pain occurred in 66% and pain localized to the TMJs was 11% in a sample from Minnesota.

A history of head, ear or face pain was significantly more common (90% versus 20% to 27%) in TMD patients than in a group of asymptomatic subjects visiting a health center in Maryland. Pain of the cervical neck was as low as 1% in a sample from New York but was 45% in a large sample from New York. Complaints of neck pain were more common among patients diagnosed with myofascial pain dysfunction (MPD) of the masticatory muscles than in patients with disk interference disorders (DD) primarily. This complaint was more bilateral than unilateral and was found in 66% of MPD patients compared with 36% of DD patients. Face, head, or neck pain was significantly greater (94% versus 85%) in patients from Virginia diagnosed with myogenous pain than in patients with arthrogenous pain.

The same relation was found in Australian patients diagnosed with myogenous facial pain (62% versus 39%) and unilateral static pain (53% versus 7%) compared with patients diagnosed with arthrogenous facial pain.

In The Netherlands, TMJ/jaw pain was significantly greater in patients with myofascial pain (83% versus 17%) than in asymptomatic matched subjects. The frequency of orofacial pain was 11%. No significant differences were found between TMD patients and matched subjects for pain of the forehead (34% versus 33%), temples (14% versus 17%), face (12% each), top of head (24% versus 16%), back of head (9% versus 11%), or neck (34% each).

Comparative studies conducted in Sweden showed that headache, pain of the face or jaws, or pain on moving the mandible were not significantly greater in juvenile arthritic patients than in asymptomatic subjects. No significant differences were found in difficult opening or taking a big bite, in tiredness of the jaws, or in report of joint clicking between

groups. None was found for lateral tenderness of the TMJs or for TMJ clicking determined by palpation.

In Norwegians suffering myofascial complaints, dynamic pain of TMJs was concordant with tenderness of the masseter or temporalis muscles.

Age

Facial pain was not significantly related to age in a large heterogenous sample from New York. But pain localized to the TMJ region was more frequently reported between 31 and 50 years than at any other age. Based on a much smaller sample from Australia, age was not considered a significant factor in the endorsement of orofacial pain between TMD cases and asymptomatic individuals.

Gender

Because the literature reveals that women are overly represented in clinic populations, it is often assumed that more women suffer orofacial pain than men. But the reasons for this gender difference in presentation of chronic orofacial pain are not clear. So much ambiguity exists between studies that uncertainty remains. The following examples demonstrate the diversity.

In cases from California, static jaw pain was significantly greater (73% versus 53%) in women than in men. TMD pain was reported more frequently by women (84% versus 16%) than by men from Washington.

But no significant gender difference was found in static facial pain in an Australian sample. The ratio of females to males admitted for diagnosis was 4 to 1.

No difference was found for initial symptoms, including facial pain, in a sample from England.

Finally, pains of the jaw/face (44% versus 29%), temple (44% versus 28%), in or near the ear (63% versus 49%), and top of head (21% versus 5%) were significantly greater in Swedish women (44% versus 29%) than in men. The following pains were not significantly different: cheek (40% versus 35%), forehead 23% versus 14%), throat (16% versus 9%), eyes (21% versus 12%), teeth and gums (30% versus 24%), and tongue (7% versus 5%).

To settle the uncertainty about gender, extensive analysis was conducted on chronic orofacial pain in women and men visiting a multidisciplinary orofacial pain center. The findings showed minimal gender difference in symptom presentation or sensitivity to pain. No statistically significant differences were found between women and men in pain intensity, chronic pain unpleasantness, pain-related suffering, meanings of pain to the individual, illness behavior, orofacial pain symptoms, the personality factor of neuroticism, or sensitivity to experimental pain.

Report of Pain on Chewing

In the group from Virginia, pain on chewing was a major complaint in 81% of patients with myogenous pain and in 68% with arthrogenous pain.

Biting pain was greater (35% versus 7%) in a Swedish sample of TMD patients than found in the population at large. None was reported in a small sample of Swedish patients with juvenile rheumatoid arthritis.

Gender

Gender differences were observed in a sample from California. More women than men (76% versus 66%) reported this problem.

Report of Pain on Opening Wide

Pain on opening was prevalent in the TMD cases. It occurred in 79% of cases from Virginia and in 42% of TMD patients compared with 7% in community-dwelling individuals from Maryland.

Pain on opening wide was significantly greater in Dutch patients with myofascial pain than in matched, asymptomatic subjects.

In Sweden, pain on moving the mandible was greater (10% versus 3%), but not statistically greater, in patients with juvenile rheumatoid arthritis than in matched, asymptomatic individuals. A similar relation was found in other populations. Comparison of a small sample of TMD patients with a large number from the population at large showed that this pain was greater (42% versus 12%), but not statistically greater, in the patients.

Report of Pain on Mandibular Movement

In a Maryland sample, functional pain was significantly greater in TMD patients (42% versus 5% to 8%) than in asymptomatic individuals.

This finding is consistent with studies conducted in Sweden. Pain on lateral jaw motions was significantly greater (27% versus 4%) in TMD patients than in the population at large. A similar relation was found for pain on gaping (42% versus 12%). Differences in age may be significant because only 3% of young adults needing treatment experienced this pain.

Studies of a large population from England found that 64% had this pain.

Gender

Findings differ between clinics. Jaw pain on movement was significantly greater in women (86% versus 77%) than in men studied from California.

No significant difference was found in a sample from Australia. Still, the authors found that unilateral pain on movement was significantly greater (59% versus 27%) in patients diagnosed with arthrogenous complains compared with myogenous complaints.

No significant difference was found (37% versus 34%) in a large clinical study from Sweden.

Report of Headache

Evidence from most clinical studies showed that the occurrence of headache was significantly greater in patients symptomatic for orofacial pain than in populations from nonclinical settings, selected groups, and private/clinic dental patients.

In North America, about 20% of cases from New York diagnosed with TMD reported headache. In another clinic, 76% had headache. In a sample from California, the frequency was nearly twice (63% versus 33%) as common among TMD patients as among asymptomatic individuals. Because both specificity and sensitivity were low, the authors concluded that the clinical relevance should be questioned.

A study from Australia showed that headache was significantly higher (21% versus 11%) in patients with myogenous complaints than in patients with arthrogenous complaints. Other studies do not always confirm this relation.

Patients sampled from The Netherlands with difference classes of headache (tension, migraine, and combination) were studied for TMD signs and symptoms. Fifty-five percent has concomitant TMD pain; 51% was of myogenous origin and 4% of arthrogenous origin. Tension headache patients had dynamic pain with greater frequency than the migraine and combination groups (33%, 10%, and 15%, respectively).

In Sweden, no significant differences were found in frequency of headache (once or more per week) among patients diagnosed with TMJ crepitus, TMJ tenderness on palpation, or neither crepitus nor tenderness. In another sample of patients seeking treatment of headache, no statistically significant difference was found between subgroups of patients with either arthrogenous or myogenous complaints. The frequencies for headache or joint pain occurring more than once per week were 46% for patients with reversible disk displacement, 70% for patients with permanent disk displacement, and 58% patients with myogenic pain.

Comparison of Swedish TMD patients with the population at large showed that headache was more frequent (78% versus 47%) in the patients. This difference was significant with daily headache (11% versus 3%) and headache once per week (29% versus 15%). No difference was found with headache 1 to 2 times per month and an absence of headache was greater (53% versus 32%) in the population at large.

Another study from Sweden found that TMD patients reported significantly more headaches (women - 78% versus 40%; men - 59% versus 29%) than regular dental patients. Occurrence of headache was associated with menstruation, as was tenderness of the masticatory muscles.

Recurrent headache was significantly greater 68% versus 36%) in Norwegian patients with myofascial pain than in subjects of similar age and gender not diagnosed with the pain.

But no significant difference was found for headache in Dutch patients (59% versus 43%) diagnosed with myofascial pain matched against individuals not diagnosed with myofascial pain.

Age

A major study relating headache with TMD was conducted on patients from New York. Headache was present in less than 1% of 10 to 20 year olds and 71 to 80 year olds. The highest frequency of about 5% occurred between 31 and 50 years.

This report agrees with findings of more than 86.000 Virginia patients visiting medical centers for various health reasons. Headache peaked between 15 and 35 years of age (25% versus 10%) then decreased significantly after 65 years of age. Migraine peaked between 25 and 45 years and was practically nonexistent (20% versus 1%) after 65 years of age. Tension headache ran a course similar to migraine (20% versus 5%).

Headache decreased slightly (61% versus 54%) between Greek TMJ clinic patients younger than 30 years and 50 years and older.

Gender

Generally, no major gender difference was found for tension headache or generalized headache in over 86.000 patients from Virginia. Migraine peaked in women between 25 and 35 years, but was later in men at 35 to 45 years.

Headache was significantly greater (55% versus 34%) in Swedish women than in men.

No statistically significant difference (63% versus 53%) was found between Greek women and men visiting TMD clinics.

Report of Jaw Fatigue and Tiredness

Variation in age may explain disparities in findings among studies. In Swedish studies, fatigue or tiredness was reported in 9% of young adults needing treatment. The symptom occurred in 60% of 10 adult cases of various ages. Jaw fatigue was not a significant complaint of patients diagnosed with TMJ crepitus, with TMJ tenderness on palpation, or with neither crepitus nor tenderness.

Jaw stiffness was significantly greater in Dutch patients diagnosed with myofascial pain than in matched, asymptomatic subjects.

Gender

In a sample from California, more women than men (85% versus 69%) had this complaint. A similar relation was found (46% versus 25%) in a Swedish sample of women and men.

Report of Difficulty on Opening Wide

An inability to open wide results primarily from muscular or joint disorders or from a combination of both disorders. Although limitation is prevalent among TMD patients, few studies disclose whether the disorder is primarily myogenous or arthrogenous. Little information is available about the longevity of restriction.

In North America, 63% of patients reporting to an Illinois TMJ Research Center reported limitation of jaw motion.

In Swedish population, difficult opening was significantly greater (35% versus 6%) in a small sample of TMD patients than in people of the general population. In another study, no significant differences were found among TMD patients diagnosed with crepitus, with tenderness on TMJ palpation, or with neither crepitus nor tenderness.

Based on complex statistical analyses, restricted opening had the highest discriminant power of all symptoms studied in a sample from The Netherlands. Limitation on opening was significantly greater in patients diagnosed with myofascial pain than in matched, asymptomatic subjects.

Age

No significant difference was found between Greek TMD patients younger than 30 years and older than 50 years.

Gender

Swedish women had more difficulty opening wide (36% versus 21%) than men. No difference was found in samples from England and Greece.

Report of Joint Sounds

Some evidence suggests that the presence of joint sounds may be a useful predictor of dysfunction. Discriminant functional analyses conducted in The Netherlands showed that sounds made during mandibular movement could be used to differentiate patients with myofascial pain from asymptomatic dental patients.

The following conclusion tends to support the statistical analyses. Joint sounds were reported significantly more often (79% versus 39%) in a sample of Swedish TMD patients than in a study of the population at large.

However, the range in frequency of sounds is too variable to agree fully. Sounds were reported in 79% of young and middle-aged adults from California. But clicking or popping was reported by just 12% of cases from England. This percentage does not differ from the frequency in several populations from nonclinical settings.

In the group from Virginia, bothersome joint noise was more prevalent in patients diagnosed with primarily arthrogenous disorders (85% versus 58%) than in patients with primarily myogenous disorders.

In Australia, no difference was found between patients with myogenous disorders (clicking 23% versus 24%, crepitation 9% each) compared with patients with arthrogenous disorders. This finding reveals the complexity of relying on patient self-reports.

The following statement illustrates the problem with reporting of sounds. Crepitus was reported by 5% of Swedish patients exhibiting TMJ tenderness and by 55% with clinically distinct crepitus. Furthermore, clicking did not prove significantly different among patients diagnosed with TMJ crepitus detected by stethoscope, with TMJ tenderness on palpation, or with neither crepitus nor tenderness.

Age

A minor relation was found between age and joint sounds. In a sample from New York, the highest frequencies of clicking and crepitus (5% and 4%) occurred between 41 and 50 years of age. The lowest (less than 1% each) occurred in 10 to 20 year olds and in 71 to 80 year olds.

Gender

No significant difference was found in a sample from California. The frequency of clicking was about 90%, and the disturbance to the patient was about 86%. None was found between TMD patients and asymptomatic individuals in another California sample.

None was found in a Swedish sample (women 58% versus men 47%), and for clicking or crepitation in an Australian sample.

Contrary to findings of other symptoms, more men than women presented with a complaint of clicking in a sample from England.

Report of Locking

Comparative study of patients with orofacial pain from Virginia showed that 76% with primarily disk disorders complained of locking, whereas 66% with primarily myogenous pain described locking. The results were not statistically significant.

In Swedish clinics, report of locking was significantly greater (26% versus 7%) in a limited sample of patients compared with the population at large. Locking was not significantly related to crepitus, to TMJ tenderness on palpation, or to the absence of crepitus or tenderness.

No difference was found in a sample from The Netherlands.

Gender

Differences were reported in a sample from California. The frequency was greater in women (64% versus 50%) than in men.

In patients from Australia, no statistically significant gender difference (0% versus 4%) was found between patients with either myogenous pain or arthrogenous complaints.

No significant difference was found (women 17% versus men 12%) in a Swedish sample.

Tenderness on Palpation of Masticatory Muscles

Evidence is overwhelming that tenderness of the masticatory muscles is significantly greater in patients reported with TMD complaints than in individuals sampled from nonclinical settings, selected groups, and private/dental clinics. A similarity in clinical findings has been found between patients from the same locality reporting to a university TMD clinic and a private clinic practice. In Norway, 90% of patients treated at a university setting and 95% of a group seeking treatment at the clinical practice had tenderness.

Muscle palpation has been studied more often in clinic samples from North America than in samples from clinics around the world. The presence of tenderness ranged from 40% in cases from Washington to 96% in cases from Maryland. Compared with community-dwelling individuals from the Maryland sample, 96% of patients had four or more masticatory muscles tender to palpation, whereas 75% of community-dwelling non-patients had four or more muscles tender to palpation.

Enrollees in a Washington Health Maintenance Organization diagnosed with TMD (CLCA) had significantly greater mean scores for extraoral muscle pain on palpation (5.5%) than community subjects free of TMD (COCO) pain (1.2%), but not so often compared with community cases (COCA) of TMD (3.8%). This same relation was found for intraoral palpation (3.4%, with 2.8% each for TMD cases versus 1.8% for asymptomatic subjects).

In a sample from California, the number of masticatory muscles tender to palpation was significantly greater (2.6% versus 0.2%) in TMD patients than in asymptomatic individuals. The same relation was found with tenderness on palpation of the cervical area (1.3% versus 0.05%). High specificity and sensitivity scores were found for the masticatory muscles but not for palpation of the cervical muscles. The authors concluded that palpation of masticatory muscles was a valuable finding.

The presence of widespread tenderness in so many patients diagnosed with orofacial myogenous pain suggests a possible relation with patients diagnosed as having generalized bodily complaint of fibromyalgia. Among Canadian patients with myofascial pain of the masticatory muscles, 52% had pain on palpation of the neck muscles compared with 15% of patients with other causes of joint pain.

Studies in other localities showed that tenderness of the neck and shoulder muscles was a common occurrence even among asymptomatic subjects. Tenderness was found in about 63% of subjects, which compares favorably with the values of 59% for healthy volunteers but is less than the 75% found in patients with TMD and paraspinal muscular pain.

Associations have been made between tenderness and other complaints, but the findings are inconsistent. In The Netherlands, tenderness proved significantly different between three subgroups of headache patients. Tenderness of the masseter and temporalis muscles was significantly more frequent in combination headache patients than in tension headache or migraine patients.

In Swedish clinics, patients diagnosed with myalgia had 2 or more muscles tender to palpation compared with individuals diagnosed with arthritis-arthrosis or disk disorders (78% versus 33% versus 15% for 3 or more muscles). In a smaller sample, tenderness of the masticatory muscles or TMJ was not significantly different between patients with either TMJ crepitus or TMJ tenderness on palpation, compared with individuals with neither crepitus nor tenderness.

Compared with asymptomatic individuals, no significant relation was found between pain on palpation and joint sounds in patients from Georgia.

Age

Statistically significant differences were found between Greek women younger than 30 years and men 50 years and older (73% versus 50%) and between men younger than 30 years and women 50 years and older (72% versus 61%).

Gender

In adults of the Washington Health Maintenance Organization, no significant gender or age differences were found among the CLCA, COCA, and COCO groups.

In Swedish patients, tenderness was the single significant difference (66% women versus 43% men) between patients with myalgia, arthritis-arthrosis, or disk disorders.

Tenderness of Specific Muscles

The lateral pterygoid proved the most tender muscle in seven of nine studies from North America and in only one study from Sweden.

This muscle group was the most frequently involved in TMD patients examined from Canada. Exceptions include the medial pterygoid from a diverse sample of different ages and ethnic groups from New York, the masseter in a smaller number of patients from Minnesota, and the temporalis attachment at the coronoid and trapezius in myofascial pain cases from Norway.

The widespread tenderness has been evidenced in more distant areas, such as the sternocleidomastoid, cervical neck, splenius capitis, and trapezius muscles.

Tenderness of specific muscles has been found to vary within subgroups of patients. Patients with primarily arthrogenous disorders had significantly less tenderness of the lateral pterygoid than patients diagnosed with myogenous or combined arthrogenous and myogenous disorders. Patients with myogenous disorders had greater tenderness in the superficial masseter than patients diagnosed with either joint or muscle and joint disorders. The frequency for the sternocleidomastoid muscle was lowest in the myogenous group compared with the other groups.

Tenderness on Palpation of TMJs

Wide variability exists because of difference in the regions palpated and between samples of different clinics. In a sample from Tennessee, TMJ tenderness was found in 92% of cases. In New York, 25% had tenderness found by posterior palpation. Both the lateral (CLCA - 57%; COCA - 35%; asymptomatic subjects - 9%) and intrameatal aspects of the TMJs were significantly more painful to palpation in TMD clinic cases than in community subjects reporting no TMD pain. No difference was found between clinic and community cases suffering with pain.

Comparison of TMD patients from England with matched, asymptomatic subjects showed that tenderness was significantly greater (59% versus 18%) among patients. Sixty-three patients with tenderness had it at the lateral pole of the condyle.

In Swedish clinics, tenderness of the TMJs was recorded as 4% in patients with diskal disorders but was 78% in patients with myogenous disorders. Tenderness was 21% at the lateral pole of the condyle and 15% by posterior palpation in cases with crepitus.

Division of patients into subgroups having crepitation (E-1 TM), tenderness on palpation (E-2 TM), and neither of the two (R) showed that crepitus was significantly greater in E-1 versus R, with R having the least crepitus. Reproducibility for TMJ tenderness was considered less than acceptable based on low specificity and low Scott's Pi (a measure of sensitivity) for tenderness of the TMJ.

Palpation of the TMJs by the auditory meatus proved significantly more tender in patients with juvenile rheumatoid arthritis (15% versus 0%) than in matched, asymptomatic subjects.

Age and Gender

In Washington, no age or gender differences were found between either CLCA or COCA cases, or asymptomatic community subjects.

No significant gender difference was found in an Australian sample.

Although TMD was reported as being most common in English women between 18 and 30 years of age, tenderness of the TMJs did not differ significantly between women suffering from TMD (48% versus 41%) and asymptomatic subjects of the same age.

In Sweden, an age relation was found between crepitation and TMJ tenderness. Crepitation increased significantly with age. No crepitation was found at 16 to 24 years, 20% was found at 25 to 49 years, and 80% was found at 50 to 88 years. Palpable tenderness increased from 19% in young adults to 27% in the middle aged and 45% in older adults. No gender difference was found in this population.

Limitation on Opening Wide

Comparison of symptomatic and asymptomatic subjects shows that patients had restricted opening. In a heterogenous sample from California, limitation on opening was uneven with respect to other symptoms, and restricted opening alone was judged unreliable for assessing TMJ problems. The author concluded that it can be useful when other signs and symptoms are known.

In Washington, the mean and range for jaw opening without pain (37 mm versus 42 mm versus 47 mm) and maximal unassisted opening (45 mm versus 49 mm versus 51 mm) proved significantly less in CLCA clinic cases than for either COCA cases or COCO subjects without TMD pain. For maximal assisted opening, TMD clinic cases proved significantly less than found for the community group (47 mm versus 52 mm).

In Norway, about one half of TMD patients had limited opening. No significant difference (50% each) was found between TMD patients examined in a university setting and individuals seeking treatment of TMD in a clinical practice.

Studies from Sweden showed that when age and gender were excluded, restricted opening ranged from 8% to 50% (mean = 16%). When the patients were diagnosed in subgroups, the percentages were myalgia - 8%, disk disorder - 27%, and arthrosis-arthritis - 50%. In another study, juvenile rheumatoid arthritics had significantly less opening (28% versus 3%) than matched, asymptomatic subjects.

In The Netherlands, limitation was found in headache patients with TMD pain. Compared with headache patients without TMD pain, maximal mouth opening was significantly less (48 mm versus 53 mm) in the pain group. The mean distance between maximal active opening and passive opening was greatest in the pain group.

Age

In a Maryland sample, an opening of less than 40 mm was found in 33% of TMD patients. This restriction differed from the 5% of community-based adults younger than 56 years and 13% of adults 56 years and older.

Among Greek TMD patients, significant differences (46% versus 25%) were found between women younger than 30 years and older than 50 years. None was found between men patients.

Gender

In Washington, vertical and protrusive jaw motions were significantly greater in males than in females. Males had consistently larger opening (3 to 5 mm) and protrusive movements (0.5 to 1.0 mm) than females. These differences were attributed to greater physical stature in males than females.

No significant difference was found in an Australian sample.

The highest prevalence of restricted opening was 53% among Swedish women. Seven years after treatment, it averaged 22%.

Deviation on Opening

Results from different cultures are incongruent. No statistically significant difference was found between TMD cases and community-based individuals from Maryland. The author argued that this finding indicates that the clinical observation of deviation is unrelated to the clinical presentation of orofacial pain or joint noises.

Comparison of subjects from Washington showed deviated opening patters were more frequent in CLCA cases (29% versus 13%) than in COCO subjects without TMD pain, but no different (26%) from COCA cases. The deviation (more than 4 mm) was striking for CLCA (25% versus 15%) compared with COCO subjects.

TMD patients from England had significantly greater deviation (79% versus 54%) than matched, asymptomatic individuals.

Association with other symptoms has been variable. In Sweden, deviation was 14% in cases with headache, but was 83% in another study of headache patients.

No significant difference was found (60% versus 53%) between Norwegian TMD patients treated at a university setting and individuals seeking TMD treatment at a clinical practice.

Gender

No significant difference was found in an Australian sample.

Detection of Joint Sounds

Great variation was found in detection of joint sounds, probably due to different methods. On an average, joint sounds were more prevalent in patients suffering from TMD than in subjects from nonclinical settings, selected groups, and private/dental clinics.

Assessment of joint sounds by palpation showed that clicking was significantly higher (43% versus 25%) in CLCA patients from Washington than in COCO community subjects (43% versus 25%) and in COCA cases (33%). No significant difference was found in crepitus or grating between these groups. The authors concluded that sounds detected by palpation had

marginal levels of reliability (K = 0.62) and those detected by stethoscope were unreliable (K = 0.26).

Sounds were twice as prevalent (65% versus 33%) in TMD patients as in community-based individuals from a large Maryland population.

Differences in specific sounds have been observed. In large samples, clicking or popping ranged from 8% in patients examined from Tennessee to 92% in a sample from Illinois.

Crepitus was present in 8% of CLCA cases from Washington but was 34% in patients from Minnesota.

In Sweden, crepitation (33% versus 9% versus none) and TMJ tenderness on palpation (63% versus 23% versus 4%) were significantly greater in patients with arthritis-arthrosis compared with subjects suffering from myalgia or disk disorders. Clicking was significantly more frequent in patients with disk disorder (69% versus 31% versus 13%) than in myalgia and arthritis-arthrosis patients. In another study, crepitus was significantly greater (15% versus 0%) in juvenile rheumatoid arthritics than in asymptomatic subjects.

Age

In a Greek population aged 30 and younger, clicking was more prevalent (86% versus 50%) in women than in men. No age or gender difference existed beyond the age of 50 years.

Need or Demand for Treatment

Estimated Need by Clinician

Because need for treatment of the occlusion has been emphasized by some clinicians, much disparity exists among populations across the world. Most practitioners grouped estimates for occlusal problems with need for treatment of pain, limited opening, muscle tenderness, and joint sounds.

Few estimates of need have been made for populations in North America. Five percent of California university students were judged in need of treatment.

Need for treatment was estimated at 20% to 30% for urbanized adults in Hungary, shipworkers, and young adults sampled from Sweden.

Among Danish children, 10% were estimated in need of treatment and another 20% in need of observation. Of Polish children, 33% were judged as needing treatment and another 7% as requiring specialist care.

Subject Demand for Treatment

The percentages differed depending on the kind of subject interviewed and the types of questions asked. Some screening involved questions about need for occlusal treatment.

Usually, subjects were given little opportunity to discern major symptoms from occlusal problems.

Demands for treatment by subjects from Virginia ranged from 15% for citizens interviewed from the general population to 14% for dental patients visiting a clinic and 21% for dental students. Clearly, the greater response by dental students reflected more awareness about TMD than in the other groups.

The greater variation occurred among Swedish populations. About 13% of a small sample of dental students felt the need for treatment. This percentage differed little from requests for treatment by Swedish citizens at 13% to 19%. Yet just 2% to 3% of adolescents and young adults demanded treatment. On the other hand, 90% of TMD patients requested treatment.

Sought Advice or Treatment

Generally, the percentages (5% to 7%) of individuals seeking advice or treatment are about one fourth of the clinician estimates of subjects in need of treatment.

Percentages reported for populations from Pennsylvania and Minnesota closely correspond with percentages for populations from Finland and Sweden.