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ASSOCIATION OF NECK PAIN WITH SYMPTOMS OF TEMPOROMANDIBULAR DYSFUNCTION IN THE GENERAL ADULT POPULATION

Riccardo Ciancaglini, MD, DMD,[1], Marco Testa, RPT,[1] and Giovanni Radaelli, BSc, MSc[1,2]

From the [1]Department of Oral Rehabilitation, IRCCS San Raffaele Hospital and [2]Department of Informative Systems, University of Milan, Milan, Italy

ABSTRACT. The association of neck pain with symptoms of temporomandibular dysfunction in the general adult population was evaluated in a sample of 483 subjects selected from the population living in the municipality of Segrate, northern Italy. Subjects were interviewed by a standard questionnaire about oral conditions, temporomandibular symptomatology and neck pain. Symptoms related to the Helkimo Anamnestic Index were the indicators of temporomandibular dysfunction, and the evaluation also included history of trauma of the masticatory system. Troublesome neck pain was experienced within the last year in 38.9% of the total series, and the prevalence of complaints was higher in women than in men (41.7 vs 34.4%). Prevalence increased with age ($p < 0.005$) and was significantly higher in subjects with than without temporomandibular symptomatology (47.4 vs 28.6%, $p < 0.0001$). At univariate analysis, *facial and jaw pain* ($p < 0.001$) and *feeling of stiffness or fatigue of the jaws* ($p < 0.01$) were significantly related to neck pain. Age- and sex-adjusted multiple logistic analysis showed that neck pain is associated with the temporomandibular symptomatology as a whole ($p < 0.001$), and in particular with *facial and jaw pain* ($p < 0.01$). These findings confirm that there is a significant association between neck pain and the temporomandibular symptomatology. Moreover, they suggest that the most relevant relationship is with *facial and jaw pain*, according to recent neurophysiologic studies on pain mechanism. Further clinical and longitudinal studies are desirable in order to give a better clarification of mutual specific roles of craniocervical and temporomandibular disorders in the aetiology of these pathologies.

Key words: facial and jaw pain; neck pain; temporomandibular dysfunction.

INTRODUCTION

Neck pain and temporomandibular disorders (TMD) are common complaints in the general population (3, 5–7, 9, 16, 21, 29–31, 36). These disturbances can lead to an impairment of quality of life, determine the need for treatment and cause work loss (16, 20, 24, 25, 36).

Neck pain is often the main symptom in cervical spine disorders related to acute post-traumatic (as in whiplash injuries) or to chronic microtraumatic (as in wrong work and/or leisure) lesions of joints or periarticular structures (7). The pain generated in these tissues can be perceived in areas far from the cervical spine, depending on common embryologic origin and same radicular supply (7, 39). Furthermore, cervical disorders have been recognized as the possible cause of pain and disorders in distant structures (7, 8, 35, 39).

Nowadays, the assessment of the existence of a significant relationship between neck pain and TMD could be of important practical relevance. This problem is still far from being clarified. Its relevance has been pointed out by different authors (12, 18, 26, 27, 39, 40), and also by the American Academy of Orofacial Pain (32), which in its guidelines considers evaluation of the range of motion and palpation of cervical muscles to be an important part of the diagnostic protocol for identification of craniomandibular disorders.

The aim of the present work was to study the existence of any association of neck pain with symptoms of TMD in the adult population.

MATERIALS AND METHODS

Data were obtained during an epidemiologic study conducted in 1995 mainly to investigate the oral health of the adult population of Segrate municipality (32,877 people, 13,264 families), in northern Italy.

Table I. *Crude (sex-standardized) prevalence rate of neck pain and temporomandibular symptomatology in different age groups*

Variable[1]	No. of subjects	Age groups (years)									
		≤ 30 (*n* = 94)		31–40 (*n* = 108)		41–50 (*n* = 103)		51–60 (*n* = 90)		> 60 (*n* = 88)	
		n	%	*n*	%	*n*	%	*n*	%	*n*	%
Neck pain	188	26	27.7 (28.1)	35	32.4 (32.4)	45	43.7 (42.7)	41	45.5 (43.8)	41	46.6 (44.8)
Temporomandibular symptomatology	266	49	52.1 (51.3)	57	52.8 (53.0)	54	52.4 (51.8)	53	58.9 (58.6)	53	60.2 (59.0)

[1] One d.f. χ^2-test for linear trend was 10.32 ($p < 0.005$) for neck pain and 1.84 ($p = 0.175$) for temporomandibular symptomatology.

Five hundred and twenty individuals aged 18–75 years were selected at random from town census lists. A total of 483 (92.9%) individuals participated in the study (300 females and 183 males; mean (SD) age 44.9 (14.8) years). Randomization was primarily performed among families. Then, within each selected family, one subject was randomly (same chance) chosen; if he/she refused the interview, another subject was selected among the remaining ones. If none of the members in a given family aged 18–75 years agreed to participate in the study, that family was considered a non-responder. Among the 37 non-responder families, 24 consisted of one subject. Of these subjects, 14 refused interview, 9 had temporarily moved from the municipality, and 1 died just prior to the study. The skewness of the ratio of females to males reflected a tendency toward a higher female acceptance to interview (96.8%) in comparison to males (80.3%). However, this skewness did not determine misleading prevalence estimations (Table I).

Information was obtained from each participating individual by means of a standard questionnaire administered by dentists during a personal interview. The questions related to TMD and neck pain were designed to elicit a yes or no answer. Questions focused on TMD symptomatology were adapted from Agerberg & Helkimo (4) and Helkimo (21, 22), while the question related to neck pain was from Bovim et al. (9). Severity and duration of neck pain was not assessed in this study. Reliability of answers was tested by resubmitting the questionnaire one month later to 40 subjects drawn from the original sample. For the TMD and neck pain items, the percentage of exact agreement ranged between 92% and 100%, with a mean of 97%.

Temporomandibular dysfunction was evaluated according to the Helkimo Anamnestic Index (21) and included assessment of the following symptoms: temporomandibular joint sounds (such as clicking and crepitations); feeling of stiffness or fatigue of the jaws; difficulty in opening the mouth wide or in locking it; luxation; pain on movement; facial and jaw pain. Severity of TMD as a whole was evaluated in accordance with Helkimo's index. Neck pain was defined as a troublesome pain experienced within the last year in the neck area between the occipital bone and the spinous process of the seventh cervical vertebra.

Comparisons of proportions between subjects with and without neck pain were performed using the χ^2-test or the Fisher's exact test, when appropriate. The odds ratio and its 95% confidence interval were also calculated for each studied factor. The odds ratio provides an estimation of the number of times the risk of neck pain increases for a single subject when the related factor is present. The linear trend of the odds ratio was tested by the χ^2-test.

Multiple logistic analysis was further performed, adjusting for age and sex, to evaluate the independent contribution of each symptom of temporomandibular dysfunction in recognizing the presence of neck pain and the corresponding odds ratio. For each symptom entered in the logistic model a coefficient β was estimated and the related odds ratio was then calculated as exponential β. The 95% confidence interval was obtained as described by Miettinen (33).

RESULTS

Troublesome neck pain occurred in 188 (38.9%) subjects. Prevalence increased significantly with age ($p < 0.01$), and was higher in females than in males (41.7 vs 34.4%). Evaluation of symptoms of TMD permitted identification of 266 (55.1%) subjects with such a dysfunction. Prevalence of TMD also increased, but not significantly with age, and was slightly higher in females than in males (56.7 vs 52.5%).

Table I shows the estimated crude prevalence rate (and the sex-standardized value) of neck pain and TMD in the different age groups.

Table II shows the relationships between TMD, history of trauma and occurrence of neck pain. A significant correlation of neck pain with TMD ($p < 0.001$) resulted at univariate analysis. Moreover, an increased risk of neck pain was observed with increasing severity of TMD ($p < 0.001$). History of trauma was not significantly associated with neck pain.

In order to avoid confusing effects of age and sex, and to assess the independent association of TMD with neck pain, a multiple logistic analysis was carried out. This analysis (Table III) confirmed the independently significant prognostic role of TMD as a whole ($p < 0.01$). Furthermore, it pointed out that the risk of neck pain is increased with severity of temporomandibular symptomatology.

Table IV shows the neck pain rate related to specific symptoms of temporomandibular dysfunction. Univariate analysis showed a significant association with *feeling*

Table II. *Relationships between Helkimo index, history of trauma and neck pain*

Variable	No. of subjects	Neck pain No.	Neck pain %	Odds ratio	95% confidence interval	p[1]
Helkimo index[2]						
No symptomatology	217	62	28.6	1	–	–
Mild symptomatology	83	37	44.6	1.24	(1.15–3.51)	< 0.05*
Moderate or severe symptomatology	183	89	48.6	2.37	(1.53–3.66)	< 0.0001*
History of trauma						
Yes	82	35	42.7	1.21	(0.72–2.01)	0.521
No	401	153	38.1			

[1] χ^2-test.
[2] Odds ratio and statistical significance related to subjects without temporomandibular symptomatology. One d.f χ^2-test for linear trend was 11.80 ($p < 0.001$).
* = Statistical significance.

of stiffness or fatigue of the jaws ($p < 0.01$) and *facial and jaw pain* ($p < 0.001$).

At this point another multiple age- and sex-adjusted stepwise logistic analysis was performed to evaluate the independent association of each symptom of TMD with neck pain. At this analysis only *facial and jaw pain* maintained a significant independent role in association with neck pain. Table V shows the step of the analysis as all symptoms are forced to enter into the regression model. It should be noted that, with the exception of *facial and jaw pain*, all associations are too distant to be statistically significant.

DISCUSSION

Different authors have studied the association between TMD, neck pain and altered head posture (10, 12, 14, 19, 26–28, 34), but there is still disagreement on these items, and possible relationships are far from being exaustively explained. Nowadays, the debate is controversial and a lot of work has still to be done. The purpose of the present study was to evaluate whether any independent association exists between referred troublesome neck pain and symptoms of TMD in the general adult population.

In our data neck pain was experienced in 38.9% of subjects (age- and sex-standardized value 37.2%), and this result is similar to the findings of Lawrence (30) and Bovim et al. (9). In Lawrence's study 35% of subjects remembered at least one episode of neck pain. Bovim et al., in an epidemiologic study in the Norwegian general population, found that the overall prevalence of troublesome neck pain experienced in the past year was 34.4%. As in Bovim et al., in our series prevalence of neck pain increased significantly with age ($p < 0.005$) and was higher in females than in males.

Symptoms of temporomandibular dysfunction were recorded in 55.1% of subjects (age- and sex-standardized value 54.3%). This value is similar to the one (57%) found by Agerberg & Carlsson (3) and Helkimo (21), who, in an anamnestic survey, examined populations comparable with our data.

At univariate analysis a significant relationship was found between neck pain and TMD and this association

Table III. *Multiple logistic analysis with Helkimo index and history of trauma (age- and sex-adjusted)*

Variable	β	SE(β)	Odds ratio	95% confidence interval	p
Helkimo index[1]					< 0.01*
Mild symptomatology	0.6503	0.2722	1.92	(1.12–3.27)	< 0.05*
Moderate or severe symptomatology	0.8457	0.2152	2.33	(1.53–3.55)	< 0.0001*
History of trauma[2]	0.1765	0.2692	1.19	(0.70–2.02)	0.512

[1] Odds ratio and statistical significance related to subjects without temporomandibular symptomatology.
[2] yes vs no.
* = Statistical significance.

Table IV. *Relationships between symptoms of temporomandibular dysfunction and neck pain*

Symptom	No. of subjects	Neck pain		Odds ratio	95% confidence interval	p^1
		No.	%			
Temporomandibular joint sounds						
Yes	104	48	46.2	1.46	(0.92–2.32)	0.111
No	379	140	36.9			
Feeling of stiffness or fatigue of the jaws						
Yes	110	55	50.0	1.80	(1.15–2.84)	< 0.01*
No	373	133	35.7			
Difficulty in opening the mouth wide or in locking the mouth						
Yes	98	45	45.9	1.44	(0.90–2.30)	0.140
No	385	143	37.1			
Luxation						
Yes	11	5	45.4	1.32	(0.34–4.95)	0.876
No	472	183	38.8			
Pain on movement						
Yes	60	29	48.3	1.55	(0.87–2.77)	0.145
No	423	159	37.6			
Facial and jaw pain						
Yes	139	73	52.5	2.20	(1.45–3.36)	< 0.001*
No	344	115	33.4			

[1] χ^2-test or Fisher's exact test.
* Statistical significance.

became more marked with increasing severity of dysfunction (Table II). Subjects classified as mild or moderate/severe symptomatically showed an estimated risk of suffering from neck pain equal to 1.24 and 2.37, respectively, when compared with subjects without TMD symptoms. The association remained significant even after age- and sex-adjusted multiple logistic analysis. Furthermore, analysis showed that subjects with moderate/severe TMD had more than a double risk (odds ratio 2.33) of suffering from neck pain. Ability of TMD in predicting the presence of neck pain showed a sensitivity of 67.0% and specificity of 52.5%.

In order to investigate whether there is any TMD symptom that is particularly related to neck pain, further analyses were performed, in which symptoms were assessed individually. At univariate analysis, *feeling of stiffness* or *fatigue of the jaws* and *facial and jaw pain* were significantly associated with neck pain, and the risk was 1.80 and 2.20, respectively. After adjustment for age and sex, a multiple logistic analysis confirmed an independent correlation of neck pain only with *facial and jaw pain* (odds ratio 2.09). This symptom had a sensitivity of 38.8% and specificity of 77.6%, showing that absence of neck pain is often reflected by absence of facial pain.

Even if our analysis of the association between neck pain and TMD was mainly unidirectional, the findings suggest that possible relationships between TMD and

Table V. *Multiple logistic analysis with symptoms of temporomandibular dysfunction and history of trauma (age- and sex-adjusted)*

Variable[1]	β	SE(β)	Odds ratio	95% confidence interval	p^1
Temporomandibular joint sounds	0.1423	0.2462	1.15	(0.71–1.87)	0.563
Feeling of stiffness or fatigue of the jaws	0.3420	0.2417	1.41	(0.88–2.26)	0.157
Difficulty in opening the mouth wide or in locking the mouth	0.0726	0.2680	1.07	(0.64–1.82)	0.786
Luxation	0.0613	0.3415	1.06	(0.54–2.08)	0.857
Pain on movement	0.0208	0.3364	0.98	(0.51–1.89)	0.951
Facial and jaw pain	0.7373	0.2234	2.09	(1.35–3.24)	< 0.01*
History of trauma[1]	0.1982	0.2724	1.22	(0.71–2.08)	0.467

[1] Yes vs no.
* = Statistical significance.

neck pain may be primarily expressed in the experiencing of pain in both locations. Owing to the cross-sectional study design, no conclusions concerning cause-effect relationships can be drawn here. However, it should be noted that experimental studies showed the existence of neurologic circuits that allow convergence of proprioceptive and nociceptive afferences from C1–C4 to the trigeminal nucleus and the close functional relationship between cervical spine and the masticatory system in swallowing, chewing and moving the head (1, 2, 13, 15, 23, 37, 38). From a biomechanical point of view, the masticatory muscles enter into a synergic or antagonistic relationship with cervical muscles acting as extensors or flexors of the cervical spine (11, 17, 28). Variations of length and of tonic response in cervical muscles might influence the activity of masticatory muscles (17). Clinical studies also showed that pain of cervical origin might affect the facial area, particularly the forehead and the orbital area (8, 35, 39). Therefore, based on our investigation and the above-quoted results, a reciprocal influence also in dysfunctional situations can be hypothesized, and the primary effect may be pain occurrence in neck, facial and jaw areas.

In conclusion, whether or not clinical and longitudinal studies are desirable in order to clarify the reciprocal aetiopathogenetic role of neck pain and temporomandibular dysfunction, our data suggest that, to investigate this problem more deeply, particular attention should be paid in determining the topography of pain and related structures. A systematic clinical examination of cervical spine areas, including specific active and passive motion tests and palpation, may be important in identifying cervical algogenous structures which may influence orofacial pain perception.

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Address for offprints:

Professor Riccardo Ciancaglini
Department of Oral Rehabilitation
IRCCS San Raffaele Hospital
Via Olgettina, 60
IT-20132 Milan
Italy