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ORIGINAL ARTICLE

Association of risk factors with temporomandibular disorders in the Northern Finland Birth Cohort 1966

Päivi Jussila[a,b], Jarno Knuutila[a,b]*, Sampo Salmela[a,b]*, Ritva Näpänkangas[a,b], Jari Päkkilä[c], Pertti Pirttiniemi[a,b] and Aune Raustia[a,b]

[a]Research Unit of Oral Health Sciences, Faculty of Medicine, University of Oulu, Oulu, Finland; [b]Medical Research Center, Oulu University Hospital and University of Oulu, Oulu, Finland; [c]Department of Mathematical Sciences, University of Oulu, Oulu, Finland

ABSTRACT

Objective: To investigate the association between risk factors and pain-related symptoms and clinical signs of temporomandibular disorders (TMD) in Northern Finland Birth Cohort (NFBC) 1966.

Material and methods: A total of 1962 subjects (1050 women, 912 men) attended the follow-up study. The questionnaires included the subjects' background information concerning living conditions and general health, socioeconomic factors, and dental health. The clinical examination was performed using the modified protocol of Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) presented at the International Association for Dental Research (IADR) Conference in 2010. Cross-tabulation, a chi-square test and Fisher's exact test were used to analyze differences between groups.

Results: Female gender showed statistically significant association with symptoms and signs of TMD, while marital status, living conditions, and socioeconomic group showed no association. A strong association was found between self-reported health condition as well as general health problems [i.e. depression, migraine, fibromyalgia (FM), gastrointestinal diseases] and TMD pain-related symptoms and pain on palpation in the masticatory muscles and TMJs.

Conclusion: In conclusion, general health problems and female gender had a strong association with pain-related symptoms and clinical signs of TMD. These findings are important to take into account when diagnosing and treating TMD patients. Conversely to earlier presented results, no statistically significant association was shown here between marital status, living conditions or socioeconomic group and pain-related symptoms and clinical signs of TMD.

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Introduction

Temporomandibular disorders (TMD) are described as a variety of dysfunctions and pain related to the masticatory system [1]. The most common symptoms and signs of TMD are clicking in the TMJs, pain in the masticatory muscles and in the TMJs, and limited mandibular movement, while facial pain, headache, and symptoms in the ears are also frequently registered in TMD patients [1–3].

The prevalence of TMD signs has varied between studies (33–86%), depending on both study samples and study design [4]. In recent studies based on adult Finnish population samples the prevalence was found to be 34.2–38% [3,5]. TMD is more common in females than in males, and the male-to-female ratio of patients seeking treatment has ranged from 1:3 to 1:9 [6,7]. TMD has been shown to be most prevalent at 20–50 years of age [1], while becoming less prevalent in women after menopause [8]. TMD-related pain has been reported as one of the most common musculoskeletal pains in all age groups [9–11]. According to a recent study self-reported TMD pain was found in 25.9% of women and 11.4% of men among Finnish university students [12].

The etiology of TMD is multifactorial, and parafunctions, bruxism and/or TMJ hyperlaxity or hypermobility have been presented as causes of TMD. Association between onset of TMD and facial and neck traumas and psychological factors (i.e. stress, depression) have also been investigated [1,13–15]. Female dominance has been shown in earlier TMD studies [3–6,12], partly due to female hormones and also through estrogen receptors located in female TMJs [16]. In addition, general health, pain sensitivity, psychological characteristics and sociodemographic variables (i.e. education level, occupation and family structure) have also been identified as factors influencing the development of TMD symptoms [17,18].

A follow-up study of the Northern Finland Birth Cohort (NFBC) 1966 subjects at 46 years age living in the Oulu region in 2012–2013 included questionnaires concerning socioeconomic status (SES), general and oral health, as well as clinical medical and dental examinations. The aim was to investigate the association between known risk factors and self-reported pain-related TMD symptoms and clinical signs in 46-year-old NFBC subjects.

Materials and methods

The NFBC 1966 is a longitudinal, epidemiological research program concerning subjects in an unselected population

CONTACT Päivi Jussila paivi.jussila@plusterveys.fi Research Unit of Oral Health Sciences, Faculty of Medicine, University of Oulu, Oulu, Finland
*These authors contributed equally to this work.

born in 1966 in Oulu and Lapland ($n = 12,058$), two provinces in northern Finland (http://www.oulu.fi/nfbc/) [19]. The research program is coordinated by the Department of Health Sciences, Faculty of Medicine, University of Oulu.

The target population of the 46-year follow-up study during 2012–2013 was 11,366 subjects. Cohort subjects with known address ($n = 10,321$) received postal questionnaires. The questionnaires included (i) the subjects' background information, lifestyle, and health, and (ii) economy, work, and mental resources [individual experiences (i.e. stress, optimism/pessimism)]. Self-reported pain-related TMD symptoms were inquired using two questions shown to be valid for screening TMD pain [20].

A total of 3150 subjects living in the Oulu region (range 100 km) were invited to attend the follow-up study which included clinical medical and dental examinations, as well as questionnaire including additional questions about oral health. The subjects supplied written consent for the study. The subjects had the right to refuse to give information concerning themselves at any time and participation was voluntary. The study was approved by the Ethical Committee of the Northern Ostrobothnia Hospital District (74/2011).

A total of 1964 subjects (1050 women and 912 men, 61.7% of all invited) attended the clinical examinations performed at the Institute of Dentistry, University of Oulu. The total number of subjects in the analyses was 1962 (1050 women, 912 men), since two subjects refused to give their data for the study.

The clinical examination was performed for all subjects using the modified protocol of Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) presented in the general session at the Conference of International Association for Dental Research (IADR) in 2010 [21]. The examinations were standardized and performed by six calibrated dentists (examiners). The assignment of clinical TMD signs were; limited mouth opening (<40 mm, measured in maximum mouth opening (without assistance) in mm as distance between d11 and d41 incisal edge including overbite); clicking in the TMJs; crepitus in the TMJs; pain on palpation in musculus temporalis and in musculus masseter; and pain on palpation in the TMJs on lateral pole and around lateral pole.

Background factors were based on the questionnaires. Marital status was determined as being 'Married/co-habiting' or 'Single' and living condition as living 'Alone' or 'With another'. Education level was determined as 'elementary school', 'high school', or 'university'. Employment status was determined by 'Working (full-time or part-time)', 'Not working', 'Retired', or 'Other'. Socioeconomic group was determined as 'Entrepreneur', 'White-collar worker', 'Blue-collar worker', 'Student', or 'Retired'. Self-reported health condition was assessed on a Likert scale with five options (very good, good, fair, poor, very poor) with the question: 'How do you assess your general health at this moment?', and the answers were categorized into three groups: 'Good', 'Fair', and 'Poor'.

Diseases were inquired with the question: 'Do you have or have you had symptoms, diseases, or traumas diagnosed or treated by a physician?' and the answer options were 'Yes' or 'No'. The diseases analyzed here were depression, migraine headache, rheumatic diseases (including rheumatoid, psoriatic, reactive and juvenile rheumatoid arthritis, and ankylosing spondylitis), fibromyalgia (FM), osteoarthritis (including osteoarthritis in the knees, hips, spine, TMJs, ankles, feet, and shoulders), thyroid diseases (both hypothyroidism and hyperthyroidism), gastrointestinal diseases (including ulcer, celiac disease, colitis, and Crohn's disease), sleep apnea and diabetes. Current smoking and use of snuff were categorized as 'No', 'Yes, occasionally' or 'Yes, regularly'.

Statistical analyses

The association between risk factors and TMD symptoms and signs was analyzed. A chi-square test and Fisher's exact test were used to disclose differences between groups. Statistical significance was determined at $p < .05$. The data were analyzed using IBM SPSS Statistics version 22.0 and R software version 3.3.2.

Results

Female gender as well as self-reported health condition showed strong association with pain-related symptoms and clinical signs of TMD ($p < .000$) (Table 1). Subjects with a poor or fair health condition had more pain-related TMD symptoms and pain in the masticatory muscles and TMJs (Table 1). No significant association was found between marital status, living conditions, education or socioeconomic group and pain-related TMD symptoms and signs (Table 1). However, subjects who were not working or were retired had numerically a higher prevalence of pain-related symptoms in the temples, TMJs, face or jaw than subjects currently working (Table 1). Diagnosed depression was found to have a statistically significant association with pain-related TMD symptoms (i.e. pain in the temples, TMJs, face or jaw), as did also migraine, fibromyalgia (FM), rheumatic disease and general osteoarthritis. Migraine, FM, rheumatic disease and general osteoarthritis, were also associated with pain-related TMD symptoms during maximal mouth opening or chewing (Table 1). In addition, thyroid disease and gastrointestinal disease showed association with pain in the masticatory muscles and pain in the TMJs (Table 1). Sleep apnea (self-reported in questionnaire as diagnosed by a physician) was associated with clicking in the TMJs ($p = .029$), while rheumatic diseases were associated with crepitus in the TMJs (Table 1). Subjects reporting current smoking or use of snuff also had an association with clinical TMD signs ($p = .021$).

Discussion

A strong association was found between female gender, general health problems as well as self-reported health condition and pain-related symptoms and clinical signs of TMD in NFBC 1966 subjects at the age of 46 years, being in accordance with earlier studies [5,6,12,16].

Here, subjects with a self-reported poor or fair health condition had more pain-related TMD symptoms and clinical signs. TMD pain has often been noted to be one of the most

Table 1. The effect of risk factors on pain-related symptoms and clinical signs of TMD in NFBC 1966 ($n = 1962$).

	Self-reported TMD symptoms				Clinical TMD signs									
	Pain in temples, TMJs, face or jaw		Pain during maximal mouth opening or chewing		Limited mouth opening (<40 mm)		Clicking in TMJs		Crepitus in TMJs		Pain on palpation in masticatory muscles		Pain on palpation in TMJs	
	%	*p*	%	*p*	%	*p*	%	*p*	%	*p*	%	*p*	%	*p*
Gender		.000		.000		.000		.001		.006		.000		.000
Male ($n = 906$)	8.30		4.10		2.10		22.7		7.60		6.50		6.40	
Female ($n = 1041$)	17.9		8.50		5.10		29.2		11.3		15.3		13.8	
Employment status		n.s.		.015		n.s.		n.s.		n.s.		n.s.		n.s.
Working ($n = 1661$)	12.7		5.8		3.7		26.4		9.5		10.7		10.1	
Not working ($n = 98$)	20.6		13.4		4.10		28.6		12.4		8.20		9.20	
Retired ($n = 38$)	21.6		11.1		10.5		27.0		10.8		15.8		15.8	
Other ($n = 54$)	16.4		7.3		0		20.8		11.3		18.5		9.3	
Self-reported health condition		.000		.000		n.s.		n.s.		n.s.		.000		.000
Good ($n = 1258$)	10.0		5.20		3.30		26.2		9.80		7.90		7.90	
Fair ($n = 560$)	20.2		8.40		4.80		26.9		10.4		17.3		14.6	
Poor ($n = 60$)	23.0		13.1		3.30		22.4		1.70		20.0		21.7	
Depression		.001		n.s.		n.s.		n.s.		n.s.		.000		.000
Yes ($n = 195$)	20.8		8.20		5.10		28.5		8.80		20.0		19.0	
No ($n = 1691$)	12.6		6.20		3.60		26.0		9.90		10.1		9.30	
Fibromyalgia		.000		.001		n.s.		n.s.		.021		.001		.001
Yes ($n = 26$)	37.0		22.2		7.70		11.5		23.1		30.8		30.8	
No ($n = 1863$)	13.1		6.20		3.70		26.4		9.60		10.8		10.0	
Gastrointestinal disease		.0041		n.s.		n.s.		n.s.		n.s.		.001		.004
Yes ($n = 122$)	19.7		8.20		4.90		29.5		8.20		20.5		18.0	
No ($n = 1737$)	13.1		6.30		3.70		26.1		9.90		10.5		9.80	
Migraine headache		.000		.050		n.s.		n.s.		.020		.000		.000
Yes ($n = 352$)	23.0		8.80		4.00		27.6		13.1		16.8		16.2	
No ($n = 1526$)	11.4		6.00		3.70		25.8		9.00		9.80		8.90	
Osteoarthritis		.004		.001		n.s.		n.s.		.040		n.s.		n.s.
Yes ($n = 382$)	18.0		9.90		4.70		26.4		12.6		11.8		10.5	
No ($n = 1472$)	12.3		5.30		3.40		26.5		9.10		11.0		10.3	
Rheumatic disease		.001		.007		n.s.		n.s.		.002		n.s.		n.s.
Yes ($n = 81$)	25.9		13.8		7.40		24.7		19.8		17.3		14.8	
No ($n = 1783$)	13.0		6.10		3.60		26.3		9.30		10.8		10.0	
Thyroid disease		n.s.		n.s.		n.s.		n.s.		n.s.		.033		.013
Yes ($n = 95$)	20.0		8.40		7.40		26.6		10.6		17.9		17.9	
No ($n = 1765$)	13.2		6.40		3.60		26.4		9.70		10.8		9.90	

n.s.: not significant

common musculoskeletal pains [10,22]. Neuromuscular or biomechanical factors [1,23,24] as well as inflammatory mediators in the TMJs [25,26] may have a role in orofacial pain symptoms. In addition, estrogen has been suggested to increase pain sensibility by affecting the limbic system. Estrogen receptors have been found in the TMJs and it has been proposed that they contribute to the degeneration of TMJ cartilage [27,28]. These factors have been suspected to be one reason why TMD is more common in women than in men and most common in women of reproductive age [8,29].

A strong association was found between general health problems (i.e. diagnosed depression, migraine, fibromyalgia, gastrointestinal diseases, rheumatic disease and general osteoarthritis) and TMD pain symptoms (i.e. pain in the temples, TMJs, face or jaw), as noted also earlier [30–32]. A majority of the subjects perceived their health as good. However, when considering the results of this study in relation to the rest of the country, it must be noted that the incidence of mental illness and musculoskeletal diseases as well as the general morbidity index in northern Finland are slightly above the national average [33]. This may have an influence on the results if they are viewed in comparison with the rest of the country.

In addition, thyroid disease had an association with pain on palpation in the masticatory muscles. Although the pathogenesis of hypothyroid myopathy is not clear, the occurrence of muscular weakness and muscular lesions in hyperthyroidism has been well recognized, including suspected mechanisms like altered glycogenolytic and oxidative metabolism, altered expression of contractile proteins, or neuro-mediated damage [34].

Perceived stress and personal experience of well-being were also recorded by means of questionnaires in the NFBC1966 study. Subjective well-being can be seen as an individual's personal view of emotional and physical well-being, while they may differ from the subjects' objective well-being [35]. A strong association between diagnosed depression and pain on palpation in the masticatory muscles and pain in the TMJs was shown, which is in accordance with earlier studies [15]. Neurotransmitters serotonin and norepinephrine are involved in nociception and depression 36] and high levels of cortisol have been reported to occur in both facial pain and depression, possibly due to cortisol dysregulation in the hypothalamic–pituitary–adrenal (HPA) axis [36,37]. In a recent study, the risk of TMD was shown to associate with the severity of depression symptoms [38].

A SES (including, e.g. education and employment) effects an individual's well-being, general health, and lifestyle, and may affect in detrimental habits (e.g. smoking, alcohol and/or substance abuse). SES can to a certain extent be linked to the strenuousness of an individual's occupation and it may also be connected to poorer overall health [39]. In this study, subjects who were not working or were retired had more pain-related symptoms than subjects currently working, which might partly reflect differences in the use of health care services and differences in lifestyle and activities. Conversely to earlier presented results [39], no association with symptoms and signs of TMD and living conditions, educational level or socio-economic grouping was shown. All subjects here belong in NFBC 1966 and they are living in Oulu region (range 100 km) where diversity in local living conditions is relatively mild. In Finland, 2012–2013 combination of taxation and influence of social support effectively equalized standard of living regardless of socio-economic grouping which may to some extend reflect to results, and to clarify this more population level investigation are needed.

Cross-sectional study design may be considered as a weakness of this study, as symptoms and signs of TMD were analyzed at one time. However, the strengths of the present study are the large population-based material as well as the valid methods and the study design [19]. Questionnaires concerning general health and socioeconomic variables have been shown to be valid in earlier cohort studies [40]. The clinical dental examinations were standardized and performed by six calibrated dentists. In addition, the questions screening pain-related TMD symptoms have earlier been shown to be valid both in adolescents and in adults [3,12,20].

In conclusion, general health problems and female gender had a strong association with pain-related symptoms and clinical signs of TMD. These findings are important to take into account when diagnosing and treating TMD patients. Conversely to earlier presented results, no statistically significant association was shown here between marital status, living conditions or socioeconomic group and pain-related symptoms and clinical signs of TMD.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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