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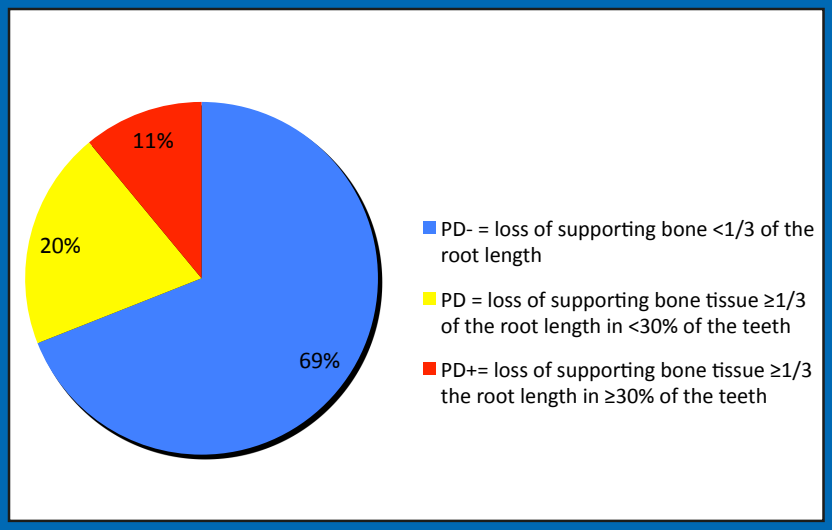

Marginal bone loss in the adult population in the county of Skåne, Sweden

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Clinical signs indicative of temporomandibular disorders in adults: time trends and associated factors

ALKISTI ANASTASSAKI KÖHLER[1,2], ANDERS HUGOSON[2], TOMAS MAGNUSSON[2]

Abstract

◎ The study aimed to examine possible time trends in the prevalence of clinical signs indicative of temporomandibular disorder (TMD) in an adult population, to analyse possible associations between TMD signs and associated factors and to estimate the need for TMD treatment. Three independent, stratified and randomly selected samples of around 100 individuals in the age groups of 20, 30, 40, 50, 60 and 70 years participated in the Jönköping studies in 1983, 1993 and 2003.

The study material consisted of 1,693 subjects who, after answering a questionnaire and being interviewed about the presence of TMD symptoms, were clinically examined in terms of the presence of TMD signs according to the Clinical Dysfunction Index (Di) by Helkimo. Associations between clinical signs and the Di as dependent variables and each of the independent variables of age group, gender, reported bruxism, trauma, self-perceived healthiness and the year of investigation were analysed in binary logistic regression models. Estimates of the need for TMD treatment were based on the presence of a combination of severe symptoms and clinical signs.

The prevalence of severely impaired jaw movement capacity, relating to horizontal movements, had increased in 2003. The prevalence of muscle pain and temporomandibular joint pain upon posterior palpation was found to vary statistically significantly between 1993 and 2003. Gender differences were noted in these changes over time. Female gender, advancing age, awareness of bruxism, self-perceived health impairment and the wearing of complete dentures were associated with TMD signs and a higher degree of clinical dysfunction. The estimated need for TMD treatment increased from 5% in 1983 to 8% in 2003 and was higher in women than in men.

In conclusion, the results indicate that the prevalence of some TMD signs and of estimated treatment need increased during the period 1983-2003.

Key words

Bruxism, headache, secular trends, TMD, treatment need

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Kliniska fynd tydande på temporomandibulär dysfunktion hos vuxna: förändringar över tid och associerade faktorer

ALKISTI ANASTASSAKI KÖHLER, ANDERS HUGOSON, TOMAS MAGNUSSON

Sammanfattning

◎ Studiens syfte var att undersöka eventuella förändringar över tid avseende förekomst av kliniska fynd tydande på smärta och funktionsstörningar i käksystemet (temporomandibulär dysfunktion, TMD) hos vuxna, att studera eventuella samband mellan dessa fynd och olika bakgrundsfaktorer samt att skatta behandlingsbehovet för TMD. Materialet bestod av 1693 individer i åldersgrupperna 20, 30, 40, 50, 60 och 70 år som ingick i Jönköpingsundersökningarna 1983, 1993 och 2003.

Deltagarna besvarade ett frågeformulär och intervjuades gällande symtom tydande på TMD och därefter undersöktes de kliniskt avseende tecken tydande på TMD. Det kliniska dysfunktionsindexet (Di) enligt Helkimo beräknades. Behandlingsbehovet bedömdes baserat på en kombination av svåra symtom och kliniska fynd. Förekomst av nedsatt käkrörlighet, avseende horisontella rörelser, noterades ha ökat hos kvinnor 2003 i jämförelse med 1983. Statistiskt signifikanta skillnader noterades också avseende käkledsömhet och muskelömhet mellan 1993 och 2003. Stigande ålder, kvinnligt kön, medvetenhet om bruxism, helprotesbärande och upplevt nedsatt hälsotillstånd relaterades till TMD-fynd och till en högre Di-grad. Behandlingsbehovet skattades till 5% 1983, 7,5% 1993 och 8% 2003 och var högre hos kvinnor än hos män.

Sammanfattningsvis tyder resultaten av denna studie på att förekomst av vissa TMD-fynd och det skattade behandlingsbehovet hos vuxna ökade under perioden 1983-2003.

Introduction

The clinical signs that have most frequently been used as indicators of temporomandibular disorders [TMD] are impaired jaw movement capacity, tenderness upon palpation of the temporomandibular joints [TMJs] and the masticatory muscles, pain on jaw movements and TMJ sounds. These signs have been the core variables in both early established index systems, like the Helkimo indices (16), and diagnostic systems developed at a later stage, such as the Research Diagnostic Criteria for TMD [RDC/TMD] (14) and the American Academy of Orofacial Pain diagnostic criteria (4).

Studies of non-patient populations have shown that almost every third adult individual presents with at least one TMD sign, with the commonest being TMJ sounds and muscle palpation tenderness (4). An age and gender difference has also been reported in some studies. Some findings, especially those related to palpation tenderness, have been more frequently registered in women than in men (12, 32). Despite a decrease in reported TMD symptoms by older individuals, an increase in the prevalence of clinical signs with advancing age has been found (15, 31, 32).

The presence of clinical signs does not always correspond to the presence of symptoms. In a previous study (5), we found that the prevalence of TMD symptoms in an adult population, according to the Anamnestic Dysfunction Index (16), had increased during a period of twenty years, 1983-2003. The present investigation aims [1] to evaluate the prevalence of clinical signs indicative of TMD [hereinafter called TMD signs] in the same adult population and to study possible time trends over the same time period; [2] to analyse possible relationships between TMD signs and factors such as age, gender, reported bruxism, trauma to the face, use of complete dentures and perceived healthiness; and [3] to estimate the need for TMD treatment in this population based on the presence of reported symptoms and recorded clinical findings.

The research hypothesis was that no significant changes in the prevalence of TMD signs had occurred during the observation period.

Material and methods

Participants

The study material has been based on a series of stratified cross-sectional investigations, the so-called Jönköping studies, performed in 1983, 1993 and 2003. They aimed to evaluate oral health and related factors in the population of Jönköping, Sweden, a medium-sized city which, in 2003, had around 120,000 inhabitants. In each examination year, 130 individuals in the age groups of 20, 30, 40, 50, 60 and 70 years, living in four specific parishes in the Municipality of Jönköping, were selected randomly by the county council and were invited to participate. Among them, 21-25% of the different age groups in 1983, 22-29% in 1993 and 29-36% in 2003 declined participation for reasons that have been presented in previous reports (18-20). The overall participation rate was 77% in 1983, 75% in 1993 and 68% in 2003. A total of 1,704 individuals enrolled in the studies and were examined clinically. Eleven subjects were excluded because of missing data, which meant that the present study material comprised a total of 1,693 individuals. The age and gender distribution of the participants is shown in Table 1.

Written informed consent was obtained from all subjects before the start of each study. The ethical rules for research according to the Helsinki Declaration were followed throughout the investigations. The ethics committee at Linköping University, Sweden, approved the study in 2003.

In each investigation year, a proportion of the sample used complete dentures in one or both jaws

Table 1. Number, gender and age of subjects included in analyses.

	1983			1993			2003		
Age	Women	Men	Total	Women	Men	Total	Women	Men	Total
20	55	45	100	50	50	100	38	46	84
30	47	50	97	62	39	101	50	42	92
40	52	47	99	52	38	90	35	47	82
50	60	43	103	45	52	97	50	41	91
60	47	50	97	48	40	88	45	44	89
70	51	48	99	36	60	96	48	40	88
Total	312	283	595	293	279	572	266	260	526

[13% in 1983, 8% in 1993 and 3% in 2003]. Individuals wearing dentures had a higher median age than non-wearers [65 ± 7.2 years and 43 ± 16.6 years respectively] and their gender distribution was skewed [41% men, 59% women].

Methods

All the participants completed a questionnaire including items on self-perceived healthiness and awareness of bruxism and were interviewed (5) and examined by dentists employed at the Institute for Postgraduate Dental Education, Jönköping, Sweden. In 1983, the subjects had also answered a question relating to previous trauma to the face (5). The dentists were calibrated regarding the registration of the clinical findings of TMD at the beginning of each investigation by an experienced specialist. The registrations were performed in a clinical setting, with the subjects sitting in an upright position in a dental chair.

The TMD signs to be registered were those making up the Clinical Dysfunction Index by Helkimo (16) and are related to five main domains of the function of the masticatory system as follows: A) jaw movement capacity [maximum jaw opening including vertical overbite, maximum laterotrusion to the right and to the left, maximum protrusion]; B) TMJ function [normal function, deflection on jaw opening of > 2 mm, TMJ clicking or crepitations, TMJ locking, TMJ luxation]; C) pain on jaw movement [no pain on movement, pain on one movement, pain on more than one movement]; D) muscle pain [no muscle pain, pain on palpation in 1-3 sites, pain on palpation in > 3 sites]; E) TMJ pain [no joint pain, pain on lateral palpation of one or both joints, pain on posterior palpation of one or both joints].

In 1983, a modified version of the Di [Di*] was used as the criteria for domains C, D and E were partly different compared with 1993 and 2003. For C, the criterion "pain on more than one movement" was altered to "pain on opening ≤ 20 mm or on horizontal movement of ≤ 3 mm". The criteria for muscle and TMJ pain, D*, E*, were "tenderness on palpation or side difference" and "pain provoking a palpebral reflex". Furthermore, in 2003, no separate registration was made for TMJ sounds, but their presence was recorded as non-normal TMJ function. Bilateral digital palpation of the following muscle sites was performed: the anterior origin and the insertion of the temporal muscle, the superficial masseter muscle, the medial pterygoid muscle [extraorally] and the region of the lateral pterygoid muscle.

The clinical registrations were combined to produce a dysfunction score (16) and, according to this score, the Di was calculated in 1993 and 2003. In 1983, the Di was calculated after the aforementioned modifications [Di*]. The results for the modified domains [C*, D*, and E*] and the Di* were analysed and are presented separately. The agreement between the C, D, E, Di and C*, D*, E*, Di* was tested on 32 consecutive patients referred to the Department of Stomatognathic Physiology, The Institute for Postgraduate Dental Education, Jönköping. The registrations were made by one examiner [AAK] applying the criteria for C, D, E and C*, D*, E* in a switching sequence. The dysfunction points were found to agree in 63% [20/32] of the cases regarding pain on jaw movement, in 84% [27/32] for muscle pain and in 72% [23/32] for TMJ pain, whereas the agreement for Di as a whole was 53% [17/32].

In order to focus on only the more severe dysfunction signs, the dysfunction points "0" and "1" were pooled together for all domains in the statistical analyses. Correspondingly, the index degrees "0" and "I" were pooled together and were termed as group "0/I" and the degrees "II" and "III" as group "II/III".

An empirical estimate of the need for TMD treatment was made for each investigation year. Individuals reporting frequent headache or severe symptoms, viz. Ai II (16), who had also been registered with a Di*/Di II/III, were regarded as being in need of TMD treatment [TNest* in 1983 and TNest in 1993 and 2003].

The following outcome variables were finally configured: impaired jaw mobility [A, maximum jaw opening < 30 mm and/or horizontal movement < 4 mm], impaired TMJ function [B, TMJ locking or luxation], pain on jaw movement [C, pain on > 1 movement; C*, pain on opening ≤ 20 mm or on horizontal movement ≤ 3 mm], muscle pain [D, pain on > 3 sites; D*, pain provoking palpebral reflex], TMJ pain [E, pain on palpation posteriorly; E*, pain provoking palpebral reflex], Di/Di* [II/III] and TNest/TNest*.

Statistics

The prevalence of the separate clinical signs, the Di*/Di and TNest*/TNest, for each year of investigation was presented using descriptive statistics. Binary logistic regression analyses were performed in order to evaluate any associations between the seven outcome variables as dependent variables and each of the independent variables: age group, gender, self-perceived health impairment, trauma to the face [1983], reported bruxism, use of complete dentures

and the year of investigation. The independent variables that reached a significant association with dependent variables in univariate regression [UR] were included in forward stepwise multiple regression [MR] analyses. The MR analyses were performed with adjustment for age and gender because of their skewed distribution in individuals wearing complete dentures. The results are presented as the odds ratio [OR] and 95% confidence interval [CI]. A p-value of < 0.05 indicated a statistically significant result. All data analyses were executed in a statistical package [IBM SPSS Statistics version 19].

Results

Prevalence and time trends

According to the Di*/Di, one or more TMD signs were registered in 55% of the participants in 1983 and 2003 and in 68% of the subjects examined in 1993. Impaired TMJ function, impaired jaw mobility and muscle pain were the most common registered signs, whereas pain on jaw movement and on palpation of TMJs was more rarely recorded. The overall frequencies for the dysfunction points regarding the separate clinical signs and for the Di/Di* degrees in the different investigation years are presented in Figures 1 and 2. In 1983 and 2003, women were registered with signs of moderate to severe clinical dysfunction [Di*/Di II/III] more frequently than men. The gender distribution of index groups 0/I and II/III is shown in Figure 3. The rates of Di*/Di II/III generally increased with increasing age to peak in the oldest examined group, that of 70 years (Figure 4).

Comparisons for prevalence changes between the

Figure 1. Percentage distribution of dysfunction points for (A) impaired jaw movement capacity, (B) impaired TMJ function, (C*/C) pain on jaw movement, (D*/D) muscle pain and (E*/E) TMJ pain in the three investigations.

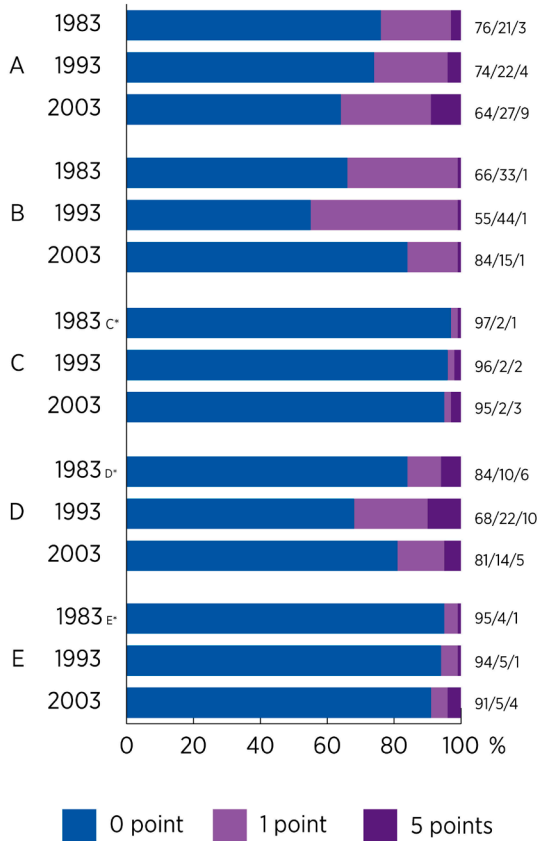


Figure 2. Percentage distribution of the Clinical Dysfunction Index (Di*/Di) degrees by investigation year.

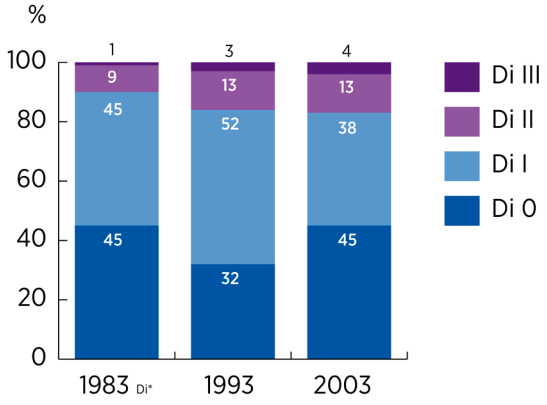


Figure 3. Gender distribution of the Di*/Di 0/I and Di*/Di II/III by investigation year.

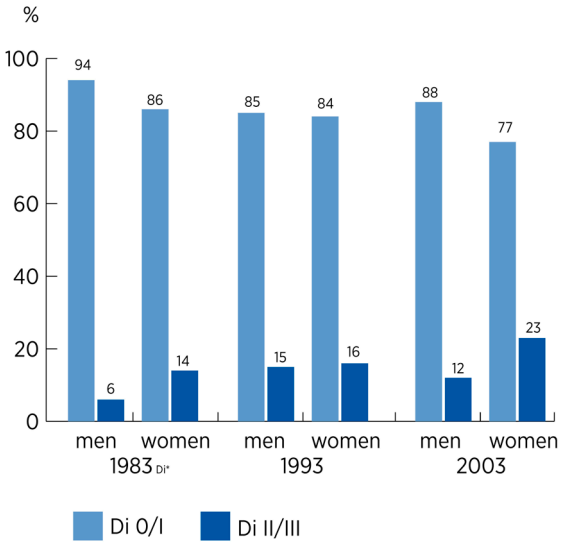
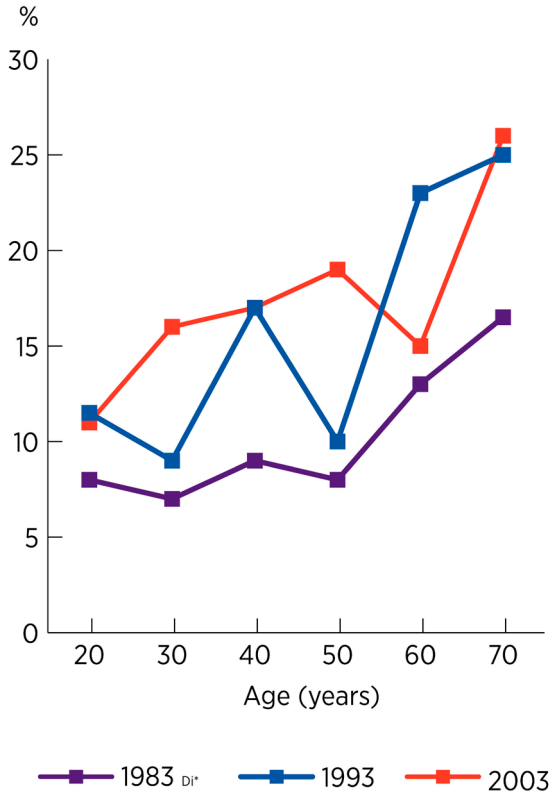


Figure 4. Percentage distribution of the Di*/Di II/III by age group in the three investigation years.



three examination years were possible for domains A and B. Jaw movement capacity was statistically significantly more frequently impaired in 2003 compared with the 1983 investigation (Table 2). Analyses of the subgroups showed that the increase in this sign was only statistically significant for women [OR: 4.0, CI: 1.8-8.5, p <0.001] and that the variance could be primarily explained by differences in the horizontal movement capacity (Table 3). Severely impaired TMJ function was rarely registered, which made statistical comparisons not applicable.

The prevalence figures for domains C, D and E as well as for the Di were tested for changes between the years 1993 and 2003. TMJ pain was found to have increased statistically significantly in 2003 compared with 1993, whereas pain in jaw muscles was more frequently registered in 1993 compared with 2003 (Table 2). Differences across genders were observed for both signs, as the increase in the former was only significant in women [OR: 5.2, CI: 1.7-15.6, p = 0.003], while the variance in the latter was only related to the male population [OR: 0.2, CI: 0.9-0.5, p <0.001]. Statistically significant changes during this 10-year period were found neither for pain on jaw movements nor for the Di.

Associated factors

Clinical signs and the Di*/Di were found to be significantly associated with most of the background factors examined, as shown in Table 2.

Individuals of ≥40 years of age ran a much higher risk of having severely impaired jaw movement capacity than younger subjects. Muscle pain and moderate to severe overall clinical dysfunction [Di II/III] were also related to the oldest age groups.

Female gender was associated with TMJ pain upon posterior palpation and higher index degree. Similar gender dependence was shown for muscle pain upon palpation provoking a palpebral reflex.

Individuals wearing complete dentures ran a higher risk of having impaired jaw movement capacity, muscle pain and Di II/III than non-wearers.

Reported trauma to the face was not related to any TMD signs or the Di*.

Awareness of tooth clenching/grinding was associated with a 2- to 3-fold higher risk of having pain on jaw movements, muscle pain, TMJ pain and a Di II/III.

Subjects perceiving health impairment were more frequently found to have pain on jaw movements, muscle pain and a higher degree of clinical dysfunction.

Estimated treatment need

In 1983, 2.5% of men and 7.5% of women [5% total] met the criteria for estimated TMD treatment need [TNest*]. In 1993 and 2003 respectively, the figures for TNest were 7% for men and 8% for women [7.5% total] and 5% for men and 11% for women [8% total]. The female predominance was significant in both TNest* [OR: 3.2, CI: 1.3-7.5, p = 0.009] and TNest [OR: 1.6, CI: 1.0-2.5, p = 0.047]. After adjustment for age and gender, it was shown that TNest was associated with reported bruxism [OR: 3.7, CI: 2.2-6.1, p <0.001] and self-perceived health impairment [OR: 3.1, CI: 1.9-5.1, p <0.001]. Similar associations were found for TNest* and reported bruxism [OR: 3.0, CI: 1.3-7.3, p = 0.014] and self-perceived health impairment [OR: 3.6, CI: 1.5-8.8, p = 0.004].

Table 2. Associated factors (independent variables) that reached significant associations with clinical signs and the Di*/Di (dependent variables) in univariate (UR) and multiple (MR) regression analyses

Dependent	Independent	UR (OR, 95% CI, p)	MR (OR, 95% CI, p) Adjusted for gender and age
Impaired jaw movement capacity (A) (1983x-2003)	Investigation year	<0.001	<0.001
	2003	3.0, 1.7-5.2, <0.001	3.2, 1.8-5.8, <0.001
	Age group	0.001	
	40	9.6, 2.2-42.0, 0.003	
	50	7.1, 1.6-31.2, 0.010	
	60	12.3, 2.9-52.7, 0.001	
	70	13.4, 3.1-57.4,<0.001	
	Not totally healthy	1.7, 1.1-2.9, 0.030	ns
	Denture wearer	3.6, 2.0-6.2, <0.001	2.4, 1.1-5.3, 0.035
Pain on jaw movement (C) (1993x -2003)	Awareness of bruxism	3.2, 1.5-6.7, 0.002	3.0, 1.3-6.6, 0.008
	Not totally healthy	4.8, 2.3-10.1, <0.001	4.4, 2.0-9.7, <0.001
	Denture wearer	3.3, 1.2-9.0, 0.017	ns
Muscle pain (D) (1993x-2003)	Investigation year		
	2003	0.4, 0.2-0.6, <0.001	0.3, 0.2-0.6, <0.001
	Age group	0.017	
	70	2.0, 1.0-4.9, 0.048	
	Awareness of bruxism	2.0, 1.2-3.3, 0.006	2.5, 1.4-4.2, 0.001
	Not totally healthy	2.4,1.5-3.9, <0.001	1.8, 1.1-3.1, 0.024
	Denture wearer	3.6, 1.9-6.9, <0.001	3.1, 1.3-7.9, 0.015
Muscle pain (D*)	Female gender	3.1, 1.4-7.0, 0.006	
	Not totally healthy	4.5, 2.2-9.1, <0.001	4.0, 1.8-8.8, 0.001
TMJ pain (E) (1993x-2003)	Investigation year		
	2003	3.2, 1.4-7.2, 0.005	3.5, 1.5-8.3, 0.005
	Female gender	2.4, 1.1-5.3, 0.029	
	Awareness of bruxism	2.6, 1.2-5.5, 0.013	2.3, 1.1-5.1, 0.032
Di (1993x-2003)	Age group	0.003	
	60	1.9, 1.0-3.4, 0.043	
	70	2.8, 1.6-4.9, <0.001	
	Female gender	1.5, 1.1-2.1, 0.011	
	Awareness of bruxism	1.8, 1.3-2.7, 0.001	2.1, 1.4-3.1, <0.001
	Not totally healthy	2.6, 1.8-3.8, <0.001	2.2, 1.5-3.2, <0.001
	Denture wearer	4.4, 2.6-7.6, <0.001	3.4, 1.6-7.3, 0.002
Di*	Female gender	2.5, 1.4-4.6, 0.002	
	Not totally healthy	2.5, 1.4-4.4, 0.001	2.0, 1.1-3.7, 0.027
	Denture wearer	2.5, 1.3-4.8, 0.009	ns

UR= univariate regression analysis; MR= multiple regression analysis; ns= not significant;
C*, D*, E* = modified C, D, E domains in 1983; Di* = modified Di in 1983.
Investigation year: "x", Age group: "20", Gender: "male", Awareness of bruxism: "no", Self-perceived health impairment: "totally healthy" and "Denture wearer": "no" were used as referents.

Table 3. Percentage distribution of impaired jaw movement capacity (A) by dysfunction points and investigation year.

	1983 0/1/5	1993 0/1/5	2003 0/1/5
Maximum jaw opening	89.7/9.9/0.3	92.8/6.5/0.7	90.4/9.6/0.0
Maximum laterotrusion, right	94.0/5.5/0.5	90.4/8.1/1.6	85.8/10.7/3.5
Maximum laterotrusion, left	93.8/5.5/0.7	94.4/5.1/0.5	83.2/13.5/3.3
Maximum protrusion	84.1/13.7/2.2	84.6/13.2/2.3	73.1/21.9/5.0

Discussion

To the best of our knowledge, the present study, with its repeated cross-sectional design, is the first to focus on possible changes over time in the prevalence of TMD signs in adults of different ages over a long period of time. Inconsistencies in methodology used in the three investigations limited the comparability of data for some clinical signs in a 20-year perspective [1983-2003]. However, it was found that the prevalence of severely impaired jaw movement capacity had increased during this period, especially in women but only regarding horizontal movements. It was also found that TMJ palpation pain was more frequent in women in 2003 than it was ten years earlier, whereas muscle pain in men was more common in 1993 than it was in 2003. The very low prevalence of locking/luxation of the TMJ was unchanged during the 20-year-period; nor were any significant variations noted in the frequency of pain on jaw movement between 1993 and 2003.

In the same populations during the same 20-year period, an increase in the overall prevalence of subjective symptoms indicative of TMD has also been found and has been discussed in a previous report (5). Similar information relating to possible time trends for clinical signs in different age groups of adults has not been available previously and comparisons with other reports in this respect are therefore inapplicable.

The present finding of increased severely impaired jaw movement capacity, especially in women and only regarding horizontal movements, is difficult to explain, as the vertical jaw movement capacity had not changed to a statistically significant degree during the 20 years [1983-2003] and the prevalence of pain on jaw movement did not vary between the last two examinations [1993 and 2003]. Furthermore, the elapsed period of twenty years is probably too short to allow for hypothetical evolutionary changes in the TMJ anatomy to be expressed as reducing jaw mobility in the population. On the other hand, the present investigations do not provide information on the exact position and function of the articular disc or the function of the ligaments of the TMJs, which are anatomical elements that also regulate jaw mobility. The possible validity of this finding therefore remains to be proved by further research.

The interpretation of the observed increase in the prevalence of pain on distal TMJ palpation in women in 2003 compared with 1993 is also challenging, as no changes were noted in palpation of the TMJ laterally. Likewise, caution is advised when attempting to explain the finding of a higher frequency of muscle pain in men in 1993 than in 2003. It is possible to speculate that both observations represent actual changes, although they may be temporary in relation to the muscles, in the palpation sensitivity of the TMJ and jaw muscles. However, the validity of palpatory findings can also be questioned because of methodological shortcomings related to an unknown observer variation and a probable lack of precision in the examination procedures that were applied. The present changes in the prevalence of TMD signs in the examined populations therefore deserve to be followed up in future investigations.

The age and gender differences reported by other studies were mainly confirmed by the current material. Generally, the frequency of more severe TMD signs, expressed as index group Di II/III, was associated with the age groups of 60 and 70 years, which is in good agreement with reports in both earlier Swedish population studies (32) and later ones from Germany (15) and Finland (31). However, the latter concluded that there was a more complex age effect, due to interactions with gender. *Österberg et al.* (30), on the other hand, in a longitudinal study of three cohorts of 70-year-old subjects, found a decrease in severe dysfunction signs with advancing age from 70 to 83 years. In the present study, a gender depen-

dence towards higher frequencies for women for some, mostly palpation pain-related, signs, which is in accordance with previous reports (12, 32), and for more severe overall dysfunction degree was found. The more recent and extensive population studies by *Gesch et al.* (15) and *Rutkiewizc et al.* (31) showed a general female predominance on all TMD signs which the present material was unable to confirm. Gender differences in several aspects of pain, including perception, have been observed and possible underlying mechanisms have been reviewed (10).

Individuals wearing complete dentures were more frequently registered with a higher degree of dysfunction than non-wearers and an association with some TMD signs was found. Similar relationships have been reported by others (28, 36), but not all studies have been conclusive (17). In a psychometric study (26), it was shown that denture wearers had a higher prevalence of symptoms than the general population, but the symptomatology was not thought to be clinically significant. Recently, *Sipilä et al.* (33) reported an association between edentulousness and "local TMD pain" and discussed the possible role of denture function, i.e. retention and stability, which has not been analysed in the present study.

An awareness of bruxism was associated with pain-related clinical signs and with more severe overall clinical dysfunction. In a study from Pomerania (29), reported bruxism was found to be related to TMJ pain upon palpation. A 20-year longitudinal study from childhood to adulthood concluded that bruxism was related to both symptoms and signs according to the Helkimo index (9). The role of bruxism in TMD pathophysiology has been studied, as either reported or registered, for decades and the complexity of the repeatedly observed relationship has been discussed in extensive reviews (25, 27, 35).

Another distinct association that was found was that between clinical signs and self-perceived health impairment. In agreement with the present results, a Finnish study found an association between TMD signs and intermediate/poor self-rated health and, in particular, multiple pain conditions (33). Various aspects of general health have been considered and accepted as contributing to the dynamic, multifaceted aetiology of TMD (34). Both biological and psychosocial issues are probably involved as mediators in the reciprocal relationship between TMD symptoms and signs and individual health in general.

The issue of the need for TMD treatment is challenging and important for health economics (37). Earlier studies using diverse criteria, some based on the presence of symptoms or signs and others on the clinician's judgment, have pointed to varying treatment need estimates (3). Occasionally, something other than a dichotomised expression of treatment need has been presented (11, 22, 38). On the basis of a combination of the presence of severe symptoms, including frequent headache, and signs indicating moderate to severe clinical dysfunction, the current study attempted to estimate the need for treatment in the populations studied on the three examination occasions. The overall estimates of 7.5% and 8% in 1993 and 2003 respectively are in close agreement with the estimate of a 7-9% need for active treatment that *Alanen et al.* (2) found in a two-year follow-up study. In agreement with the main findings in this study, the same authors found a clear female predominance, with a 2-3 times higher need for treatment in women than in men, but they also reported an age dependence tendency towards younger ages. In a recent meta-analysis of 17 studies based on 9,454 subjects, *Al-Jundi et al.* (3) concluded that 16% of the general adult population was estimated to be in need of TMD treatment. The meta-analysis also indicated no clear gender differences, but age differences were noted, as, in these studies, individuals younger than 45 years were more frequently found to be in need of treatment compared with older ones. This age dependence was not confirmed in the present material, probably reflecting the criteria that were used. The different peak ages for frequent headache, symptoms included in the Ai and clinical signs included in the Di possibly counterbalance one another. However, estimates of treatment need based solely on prevalence figures have been criticised as not being totally valid and other factors, such as the nature of TMD symptoms and concurrent stress experience (23), as well as the individual's own demand (8), have been discussed as additional determinants.

The present study has both limitations and strengths, with methodological inconsistencies being the main reason for the former. Different criteria used for the assessment of clinical signs in 1983 and the under-registration of TMJ sounds in 2003 have, to some extent, limited the comparability of prevalence figures between the three investigation occasions. Nor were any statistical comparisons made between the rates of Di* and Di, as their agreement was found to be fairly low. Moreover, no observer variation analysis was performed. The issue of reliability is an inherent, universal concern for epidemiological studies, especially those on a larger scale.

Previous reports on intra- and inter-observer variability have concluded that some signs, particularly those related to palpation findings, are less reliable than others and have suggested that registrations in longitudinal studies should be performed either by the same observer (7) or by selected examiners undergoing repeated training and calibration (21, 24).

The study also has strengths, as it has a unique design with a series of repeated cross-sectional investigations on a randomly selected population from a certain geographical area, stratified by age and covering almost the whole adult life span. The response rates are comparable to those reported in the studies from Pomerania [69%] (15) and Finland [79%] (31) and the reasons for not responding (18-20) are also similar to those reported in the German study (6). The present material can therefore be regarded as being representative of the populations from which it has been extracted. Furthermore, and despite the abovementioned methodological shortcomings, these investigations have primarily used the same criteria and procedures over the years, factors of importance when considering time trends (13).

The focus on severe signs as outcome variables makes the present study more distinguishing. The main reason for this selection was that mild TMD signs, i.e. TMJ sounds and muscle palpation pain in < 3 sites, are very common in the population and do not always relate to TMD symptomatology and are thereby of less clinical relevance. In addition, these signs are more susceptible to spontaneous fluctuations which can affect the point prevalence derived from the clinical registration on one occasion. However, point estimation is inevitably related to a risk of both an over- and underestimation of signs, an issue that has been discussed by *Rutkiewicz et al.* (31).

To summarise, the study results suggest an increase, in a gender-related manner, in the prevalence figures for certain clinical signs indicative of TMD and for the estimated need for TMD treatment during a 20-year period. Further population investigations using standardised criteria and a random design are necessary in order to prove the validity of the present results and to further explore the challenging issue of plausible time trends in the prevalence of TMD.

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Self-perceived effects of occlusal appliance therapy on TMD patients: an eight-year follow-up

CAROLINE LINNÉ ERIXON, EWACARIN EKBERG

Abstract

◉ There are few long-term follow-up studies of treatment of temporomandibular disorders (TMD). The aim of this questionnaire study was to evaluate eight-year outcomes of appliance therapy in patients suffering from arthralgia/osteoarthritis and/or myofascial pain.

The subjects comprised 120 patients, originally randomly assigned to treatment with an occlusal or a control (palatal) appliance. Eight years later, a questionnaire was sent to 118 eligible patients: 90 (76%) responded. The outcome measures were intensity and frequency of pain, physical and emotional functioning, and overall improvement of pain and headache.

Maximum pain intensity had decreased by > 30% in 54 patients (60%); frequency of pain had also decreased significantly. A majority, 57/90, reported improved physical function. Fifty-nine patients reported moderate to severe depression and 61 reported non-specific physical symptoms. Sixty-eight patients reported an overall improvement in TMD pain and 61 perceived overall improvement in severity of headaches. In the intervening years, 57 patients had undergone further treatment, most frequently in the form of another occlusal appliance.

The majority of respondents reported improvement in TMD pain and headache. However, it is difficult to evaluate the long-term outcome of appliance therapy as more than 60% of the patients had additional treatments during the eight years.

Key words

Craniomandibular disorders, headache, occlusal splint, orofacial pain,

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Självupplevd effekt av behandling med bettskena; åtta års uppföljning

CAROLINE LINNÉ ERIXON, EWACARIN EKBERG

Sammanfattning

◎ Det finns få långtidsstudier som berör behandling av temporomandibular störning (TMD). Syftet med denna enkätundersökning var att utvärdera patienter med artralgi/osteoartrit och/eller myofasciell smärta som åtta år tidigare behandlats med bettskena.

120 patienter hade ursprungligen randomiserats för behandling med en stabiliserings- eller kontrollskena i tidigare studier. Åtta år senare skickades en enkät ut till 118 av dessa patienter: 90 (76 %) svarade. Det ställdes frågor om intensitet och frekvens av TMD-smärta, fysisk och emotionell funktion, samt allmän förbättring av smärta och huvudvärk.

Den maximala smärtintensiteten hade minskat med >30 % hos 54 patienter (60%), frekvensen av smärta hade signifikant minskat. En majoritet, 57/90, rapporterade förbättrad fysisk funktion. Femtionio patienter rapporterade måttlig till svår depression och 61 rapporterade måttlig till svår somatisering. Sextioåtta patienter rapporterade en allmän förbättring av TMD-smärta och 61 upplevde allmän förbättring av svårighetsgraden av huvudvärk. Under åren hade 57 patienter genomgått ytterligare behandling, oftast i form av en annan bettskena.

Majoriteten av de tillfrågade rapporterade en förbättring av sin TMD-smärta och huvudvärk. Emellertid är det svårt att utvärdera långtidseffekten av bettskenebehandling då mer än 60% fått tilläggsbehandling under de 8 åren.

Introduction

A meta-analysis of epidemiological studies has estimated that the treatment need for temporomandibular disorders (TMD) in adults is around 16%; among those seeking treatment, pain seems to be the chief complaint.(1, 8) Many different treatment modalities have been recommended, separately or in combination. Occlusal stabilization appliances, also known as occlusal splints, are used extensively; it is estimated that 10 years ago, when the population of Sweden was around eight million, 30,000-40,000 appliances were issued to Swedish patients in one year (23). However, despite extensive application over many years, the efficacy of this treatment method is still a matter of debate. A recent systematic review of systematic reviews has disclosed only limited evidence of positive long-term effects (24). Two retrospective long-term follow-up studies have concluded that despite the heterogeneity of patients presenting with TMD, most could benefit from conservative treatment, including counseling, occlusal splints and jaw exercises. (28, 37) A prospective study by Behr et al (2) reported that two-thirds of patients treated five to thirteen years earlier with one of three different types of splints reported pain reduction, regardless of the type of splint used.

Epidemiological studies have reported a high frequency of co-morbidity between TMD and headache (5, 26, 27, 34), particularly tension-type headache. It is of interest to note that the use of an occlusal stabilization appliance in patients with TMD and tension-type headache seems to have positive short-and long-term effects on both conditions (13, 16). Co-morbidity also exists between TMD and other conditions such as fibromyalgia, rheumatoid arthritis, depression and somatisation (10). Finally, impaired general health has been found to be a strong risk factor for TMD (20). Awareness of these associations is clinically relevant, because the co-existence of other disorders/diseases has been shown to have a negative effect on treatment outcome (21).

In 1993, our group undertook a study of appliance therapy in patients suffering from TMD pain of both myogenous and arthrogenous origin. The outcomes were evaluated at ten weeks and one year post-treatment (11, 12, 14,15). The short-term results showed that compared to a control appliance, the occlusal stabilization appliance achieved better treatment outcomes.

The aim of this questionnaire study was to evaluate eight-year outcomes of appliance therapy in patients suffering from arthralgia/osteoarthritis and/or myofascial pain.

The hypothesis was that eight years after undergoing appliance therapy, the patients were experiencing less frequent and less intense arthralgia/osteoarthritis and/or myofascial pain and headaches than at baseline.

Materials and methods

The study was approved by the Ethics Committee of Lund University LU 611-03.

Patients

Ninety patients with TMD pain were included in this 8-year follow-up (Fig. 1). These patients belonged to a patient sample comprising 120 patients who had participated in our earlier studies of treatment for TMD pain, undertaken in 1993 to 1996 and 1998 to 2000 (11, 12, 14, 15). They had been selected from 2830 patients referred for treatment of TMD at the Department of Stomatognathic Physiology, Faculty of Odontology, Malmö University, Sweden. The selection procedure has been described previously (14, 15).

Briefly, the inclusion criteria were a history of pain in the temporomandibular joint (TMJ) area and/or the masticatory muscles, maximum pain intensity greater than 40mm on a 100 mm visual analogue scale (VAS), and tenderness to palpation of the TMJ area or the masticatory muscles. The exclusion criteria were complete dentures, acute TMJ pain requiring administration of pharmaceuticals by intra-articular injection, previous treatment for TMD, a history of psychiatric disorder, or symptoms related to diseases in other components of the stomatognathic system (toothache, neuralgia). The flow chart of the study is presented in Fig. 1.

A large number of patients had to be screened in order to identify 120 patients eligible for inclusion. The most common reason for exclusion was previous treatment for TMD, mostly in the form of an occlusal appliance provided by their general practitioner, before referral.

The clinical examination, according to *Okeson* (31), included measurements of mandibular movements, pain during non-guided mandibular movements, registration of TMJ sounds (clicking and/or crepitation), locking and lateral and/or posterior tenderness of the TMJ. The following muscles were palpated: the anterior and posterior temporal muscles, the attachment of the temporal muscle, the deep and superficial portions of the masseter, the medial and lateral pterygoid, and the posterior portion of the digastric muscle. The muscles were palpated manually, by the same examiner, before and after treatment.

The patients were diagnosed according to the Re-

Figure 1. Distribution of patients selected for participation in this study. Patients had participated in earlier studies undertaken in 1993 to 1996 and in 1998 to 2000. Above the line: patient selection during the years 1993 to 2000 (baseline). Below the line: patient selection for the present eight-year follow-up study of appliance therapy.

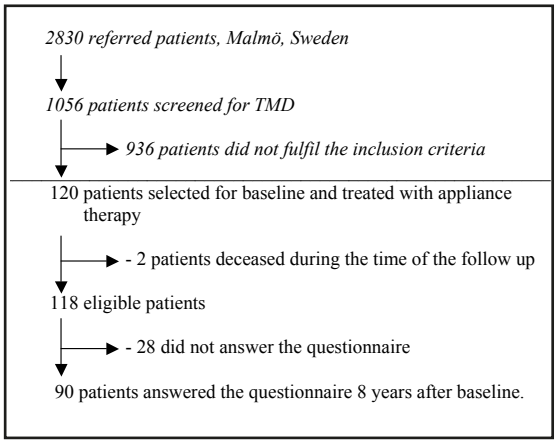
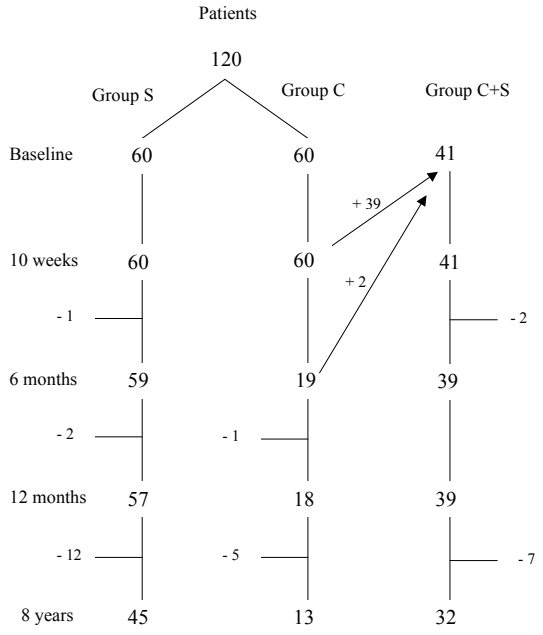


Figure 2. Flow chart showing when the control appliance was exchanged for the occlusal stabilization appliance. Group S: patients given the stabilization appliance only; Group C: patients given the control appliance only; Group C+S: given both appliances. Follow-up at 10 weeks, 6 months, 12 months and 8 years. The outcomes at the 6 and 12 month follow-ups have been reported previously(11,12).



search Diagnostic Criteria for TMD (RDC/TMD) (8). Sixty suffered from arthralgia/osteoarthritis with or without myofascial pain and 60 from myofascial pain. Because of the high percentage of positive treatment outcomes in both diagnostic groups at the one-year follow-up, the two groups were pooled for the present long-term follow-up (11, 12).

Treatment

The patients were randomly allocated to one of two groups: the control group (C), treated with a non-occluding palatal appliance and the test group (S), treated with an occlusal stabilization appliance. Randomization was carried out by an independent person, using 10 series of consecutively numbered sealed, opaque envelopes. Each envelope contained a treatment specification. This procedure was repeated until all patients had been allocated to either test or control group. One specialist in stomatognatic physiology took the history, carried out the clinical examination, and informed the patient about the diagnoses, the benign prognosis and the aim of the study before treatment. Another specialist who was not involved in the examinations at baseline or follow-up inserted and adjusted the appliances. The stabilization appliance had a smooth, flat surface which was in a stable contact with all the opposing teeth, with bilateral cuspid guidance to avoid interference during laterotrusion and protrusion. The appliance was adjusted until even contact was established in centric relationship. Centric relationship was achieved by chin-point guidance. The non-occluding control appliance was designed with palatal coverage and clasps on maxillary teeth, and did not alter the intermaxillary relationship. The design and management of the appliances have been described earlier (14, 15). All patients were instructed to use the appliances every night for a period of at least 10 weeks and as necessary thereafter. The flow chart of patients treated with the two different appliances is shown in Fig. 2. Frequency of appliance use was measured on the following four-point scale: 0 = every night, 1= twice a week or more, 2 = as necessary, 3 = not at all. Thirty-nine of the patients treated with a control appliance requested another appliance after 10 weeks and another two patients after six months. (C+S group)

Outcome measures

The outcome was evaluated eight years after start of treatment, by means of a questionnaire. The questionnaire evaluation had been conducted once a year from 2001 to 2004 and 2006 and 2008. After three weeks, a reminder was sent twice to non-responders. Most of

the questions had a multiple choice format. To evaluate the comprehensibility, the questionnaire was tested on five subjects not involved in oral health care. The final questionnaire was adjusted according to the responses and comments from the participants in this test. The questionnaire included questions on demography such as age, gender, marital status and level of education. Treatment outcome followed the recommendations set by the Initiative in Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) for evaluating the efficacy and effectiveness of TMD pain therapy (6). The questionnaire addressed the following four domains: pain intensity, physical functioning, emotional functioning and global improvement.

Pain intensity
The questionnaire included questions about the intensity of TMD pain by rating the highest level of actual pain on a 100 mm VAS, ranging from 0 = "No pain" to 100 = "Worst pain ever experienced".(19) Frequency of TMD pain was rated according to a seven - point scale: 0 = never, 1 = rarely/once a month, 2 = once a fortnight, 3 = once a week, 4 = twice a week 5 = several times a week, 6 = daily or constant. A primary treatment outcome comprising a reduction in pain intensity of at least 30%, as recorded on VAS, was considered to be clinically relevant (18).

Physical functioning
The impact of TMD pain on physical functioning was assessed on a 7- point scale: 0 = no pain, 1= slight pain which can be ignored, 2 = pain which cannot be ignored, but does not disrupt daily life, 3 = pain which disrupts daily life, 4 = pain which disrupts all activities of daily living except eating or going to the lavatory, 5 = pain which interferes with everything, 6 = intolerable pain. Scores of 0 - 2 were regarded as "negligible to mild" impacts.

Emotional functioning
Depression and non-specific physical symptoms according to RDC/TMD Axis II were evaluated only at the eight year follow-up (9).

Global improvement
Improvement of arthralgia/osteoarthritis and/or myofascial pain and headache was measured according to a six - point verbal rating scale: 0 = symptom free, 1 = much improved, 2 = improved, 3 = unchanged, 4 = worse, 5 = much worse.

General health was assessed only at follow-up and recorded as excellent, very good, good, reasonable or poor. In order to evaluate the extent of distribution of pain, the patients were instructed to indicate the sites of pain in other parts of the body on a human body figure without divided regions.

Additional outcomes
Frequency of appliance use was measured on a four - point scale: 0 = never, 1 = as necessary, 2 = twice a week or more, 3 = every night.
The frequency of headache was rated according to a five - point scale: 0 = never/rarely, 1 = once a forth night, 2 = once a week, 3 = several times a week, 4 =daily.

Statistical analysis
For within-group comparisons, McNemar's test was used for categorical variables and Wilcoxon's signed-rank test for ordinal variables. Chi-square analysis was used to test differences between groups on a nominal scale and the Mann-Whitney U test for ordinal variables. Comparison was also undertaken between primary outcome and sub-diagnoses of TMD pain, the type of initial appliance therapy, and whether or not the patient had undergone additional treatment. The alpha level of $p<0.05$ was used to indicate statistical significance. Data were collected and analyzed using the Statistical Package for the Social Sciences (SPSS) version 13.0 for Windows (SPSS Inc., Chicago, IL, USA)

Results
Of the original 120 patients, two had died during the eight years. The questionnaire was sent to 118 patients, 90 of whom (76 %) responded (Fig.1). The mean age was 39.7 years at the follow-up (SD ±14 years); the majority (85 patients) were women. Most patients were married (60 patients). The highest level of education reported was college/university (39 patients), high school (36) and elementary school (7 patients)(Table 1). Eight patients reported another type of education as their highest. At the eight-year follow-up, the responders did not differ from the non-responders regarding age, intensity of worst pain, frequency of pain and headache at baseline. Thus the group of respondents can be considered to be representative of the initial sample.

Pain intensity
The primary treatment outcome showed that overall, 54 out of the 90 patients (60 %) experienced a 30 % improvement in the most severe pain intensity.(Table 3) A positive primary treatment outcome was observed in 31 of 48 patients with a combination of arthralgia/osteoarthritis and myofascial pain, and in 23 of 42 pa-

Table 1. Demographic data

	Total (n=90)
Gender	
Female	85
Male	5
Age (year)	
Mean	39,7
Min-Max	22-81
<20	0
20-40	56
>40	34
Marital status	
Married	60
Divorced	3
Never married	24
Widow/widower	3
Highest level of education	
Elementary school	7
High school	36
College	39
Other type of education	8

Table 2. Frequency and intensity of TMD pain and headache frequency at baseline and at the eight year follow-up.

	Baseline (n=120)	8-years (n=88)
TMD pain		
Frequency		
Never	0	20
Rarely / once a month	5	28
Once every second week	3	8
Once a week	0	7
Twice a week	4	0
Several times a week	19	14
Daily or constant	89	11
Intensity(mean, SD)		
At worst		
(VAS) mm	75(±)	36(±28)
Headache		
(n=120)		
(n=90)		
Frequency		
Never/rarely	20	35
Once every second week	9	17
Once a week	29	23
Several times a week	33	9
Daily	29	4

tients with only myofascial pain. The difference between groups was not significant. Before treatment, all 120 patients had rated the most intense pain as at least 40 mm on the VAS, compared with only 36 patients (30%) at the eight-year follow-up. At baseline, 89 out of the 120 patients(74%) had reported daily or constant pain, compared with 11 out of the 90 patients(12%) at the eight-year follow-up (P<0.000).

Table 3. Distribution of improvement of pain intensity, physical functioning, global improvement and headache in 90 TMD patients at the eight year follow-up.
Group S treated with an occlusal stabilization appliance. Group C treated with a non-occluding palatal appliance. Group C+S= treated with a control appliance that requested another appliance after 10 weeks and another two patients after six months.

	Group S (n=45)	Group C+S (n=32)	Group C (n=13)
Pain intensity (at worst, 30%)	24	19	11
Physical functioning	26	20	11
Global improvement	33	23	12
Additional outcomes headache	28	21	12

Physical functioning

Improved physical functioning was registered by a majority of patients. There was a significant increase in the number of patients reporting moderate to negligible impacts from the most severe TMD pain at follow-up (57/79), compared with 39/113 at baseline (P=0.000). (Table 3).

Emotional functioning

At follow-up, the mean (SD) values for depression and non-specific physical symptoms in patients were 1,060(moderate) and 1,043(severe). Fifty-nine patients scored moderate to high scores for depression and 61 for non-specific physical symptoms (Figure 3). Among patients with negative primary outcomes, 21 had high scores for depression and 22 had high scores for non-specific physical symptoms.

Global improvement

On the verbal scale, 68 of 90 patients (76 %) reported an improvement in TMD pain (Table 3). However, 62 (69%) out of all patients reported that they still experienced some TMD symptoms and 40 of these experienced pain once every second week or more (Table 2).Sixty-nine patients perceived their general health to be good to excellent at follow-up. More than 40 % of the patients had TMD pain in combination with pain in other parts of the body. At baseline, none of the included patients had been diagnosed with a systemic musculoskeletal disease, but eight years later, four had been diagnosed with fibromyalgia.

Figure 3. Distribution of number of patients indicating normal, moderate, and severe scores for depression and non-specific physical symptoms (n = 88) according to SCL-90-R in Axis II of RDC/TMD. Two patients did not register their scores on the SCL-90-R scale at follow-up.

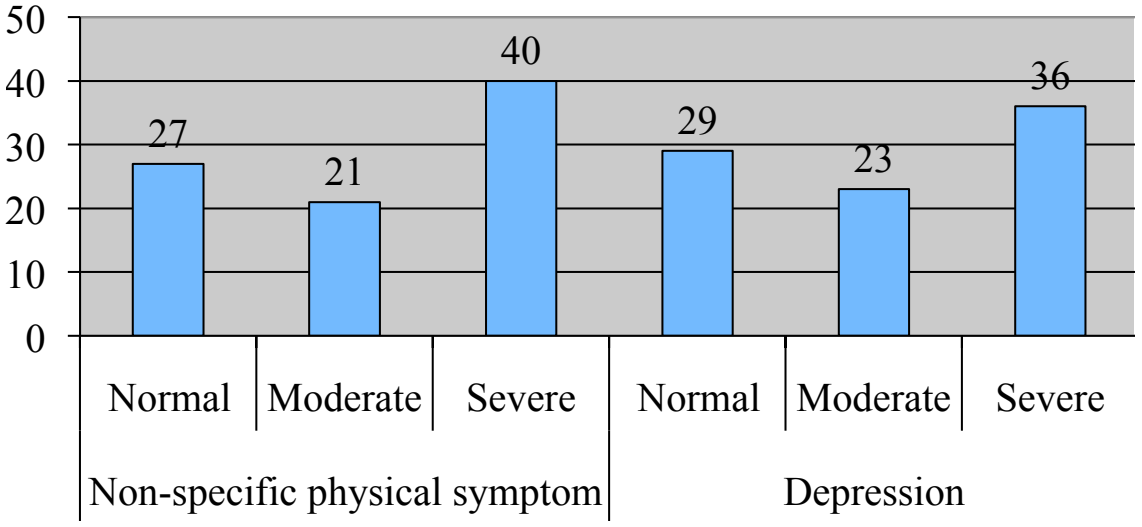
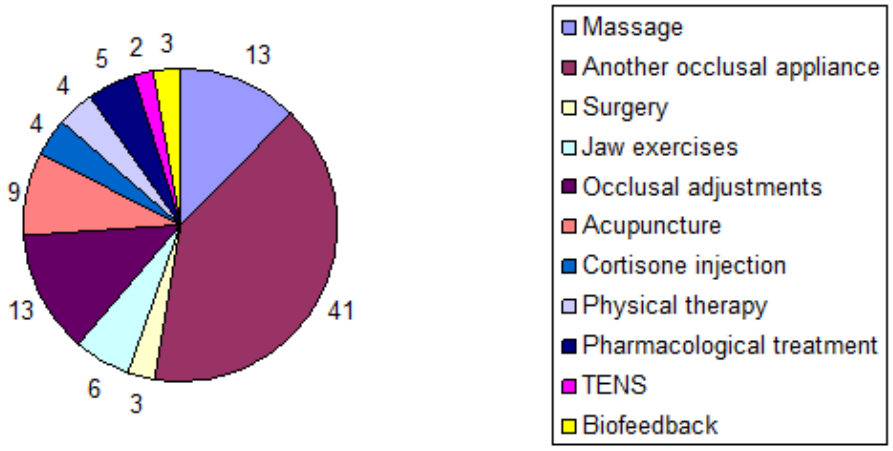


Figure 4. Additional treatment modalities provided for the patients. Number of patients.



Additional outcomes

At baseline, 91/120 (76%) of the patients had reported headache at least once a week (Table 2). Eight years after treatment, significant improvement had occurred (P<0.000): at follow-up, 61 perceived an overall improvement with respect to headache and the number of patients reporting headache several times a week or more had decreased (P<0.000)(Table 3). Thirty-seven patients who had a 30 % improvement in the most severe intensity of TMD pain reported that with respect to headache, they were slightly better, much better or symptom free.

Treatment groups

Initially, 60 patients had been treated with an occlusal stabilization appliance and 60 with a non- occluding control appliance. At the 8-year follow-up, a positive treatment outcome was recorded for 24 of those initially treated with stabilization appliances (S-group), 11 treated with control appliances (C-group) and 19 in group C+S, respectively (Fig. 2). At follow-up, 37 (41%) patients reported still using their appliance, and 16 used it every night. Fifty-three did not use the appliance at all.

Prior to the initial 10 weeks of appliance therapy,

none of the patients had undergone treatment for TMD. At the 8-year follow-up, 57 (63%) patients of all patients reported undergoing further treatment for TMD pain in the intervening years, usually in the form of another occlusal appliance. Most of these patients had previously been treated with non-occluding (control) appliances. Many kinds of different additional treatments had been undergone by the patients (Fig. 4).

Fifty-seven patients reported additional treatment and 24 patients of these had a positive primary treatment outcome. Among the 33 patients with non-additional treatment, 30 patients had a positive primary treatment outcome.

Discussion

In this 8-years follow-up study the majority of the patients report less frequent and less intense TMD pain.

A primary treatment outcome of at least 30 % improvement in the most severe pain intensity was reported by 60 % of all patients, whereas at baseline, the majority of all patients had chronic (≥ 3months) pain (14, 15). By studying 10 RCTs on pain reduction, Farrar et al (18) concluded that a 30 % reduction in pain, corresponding to "much improved", represented a clinically relevant difference in patients with chronic pain. The IMMPACT meeting in 2003 recommended that in chronic pain trials, a clinically relevant result would require at least 30 % reductions in pain intensity from baseline, as assessed by VAS or NRS(6). The question arises as to whether improvement in pain intensity can be reliably measured after eight years: memory of pain is poor and patients may tend to overestimate the level of pain they experienced at baseline (17, 25, 28).

In the present study, the primary treatment outcome was the difference in scores for TMD pain at its worst at baseline and at follow-up, not an estimation of the grade of improvement over the eight years. IMMPACT recommend using a verbal scale combined with NRS or VAS in order to minimize the risk that some patients might have difficulty in understanding a single scale. However, our study showed comparable results on VAS and verbal scales.

Our results are in accordance with those of with Behr et al, reporting reductions in TMD pain in 73 % of patients after one year, 66 % after 5 years and 69 % after 13 years (2). Our results are also in accordance with those of a RCT comparing acupuncture with appliance therapy reporting lasting improvement in most of the patients at follow-up, 18-20 years after therapy (3). Rammelsberg et al evaluated muscles disorders defined by RDC/TMD in an epidemiological study over 5 years; at follow-up, patients with myofascial pain still suffered from their disorder, 33 % of patients were in remission and 36 % had suffered recurrence. However, the study failed to identify any predictors for remission vs. recurrence (32).

In the present study, the eight-year outcome may have been influenced by other factors such as placebo, spontaneous remission and regression to the mean. A limitation of the study was the low response rate: no more than 76 % of the patients answered the questionnaire. As the non-respondents did not differ from the respondents, this rate of attrition can be regarded as acceptable, given the considerable time interval between initial treatment and follow-up. Thus attrition should not have had a negative effect on the reliability of the results.

At baseline, more than 70 % of the patients with TMD pain also reported headache once a week or more (13, 16). This is much higher than a Swedish epidemiological survey reporting 10 % for men and 22 % for women (30). This may be attributable to differences in study design. Two-thirds of the patients in our study reported an improvement of their headache at the eight-year follow-up. This result is in accordance with short- and long-term results of previous studies on patients with TMD pain and headache (13, 16, 19, 32, 36).

Thirteen patients still had a control appliance at follow-up and 11 of these had a positive treatment outcome. At the 10-week follow-up, approximately 50 % of patients in the control group had reported a positive treatment outcome on a verbal scale. Apart from the placebo effect, the control appliance may have exerted other effects. It is difficult to compare outcomes for the test and control groups at follow-up, because of the small number of patients in the control group. Moreover, 57 patients had undergone additional treatment, and this might have influenced the outcomes.

Forty-two percent of the patients in this study reported that they still used their appliance and 26 % used it frequently. This is in agreement with another long-term study showing that 27 % were still using appliances 18-20 years later (3). Kreiner et al concluded in their review that many of the authors suggested that the appliances could lead to behavioral interventions as well as physical changes (22). This could explain the frequent use of appliances in our study. Furthermore, the frequent use of appliance, and that 57 patients needed additional treatments

during the eight years and that 40 patients still experienced pain once a week or more indicate that this material consisted of patients with severe TMD.

Türp et al concluded that patients without major psychological issues do not require more than simple therapy, but those who do have major psychological issues require multimodal, interdisciplinary therapeutic strategies (37). In our study 40 patients had high scores for non-specific physical symptoms and 36 had high scores for depression. This might explain why some patients in our study did not report any improvement in TMD pain. Even moderate to high scores on the SCL-90R have been shown to have a negative effect on treatment of patients with orofacial pain and TMD. *Rantala et al* found that an increase of just one step in somatisation level increased more than threefold the likelihood of having chronic myofascial pain (34). *Carroll et al* reported that depression was a strong and independent predictor for the onset of an episode of intense and/or disabling neck and low back pain (4). Two-thirds of the patients in our study had moderate to high scores for depression and non-specific physical symptoms at follow-up. Unfortunately, we did not evaluate scores on SCL-90-R at baseline, thus it was impossible to evaluate how it could have influenced the outcome. Dworkin et al showed that patients with two or more pain conditions had an elevated risk of depression, according to the SCL-90-R; they also found an association between the number of pain conditions and higher values of non-specific physical symptoms (10). In this context, it is of interest to note that approximately 40 % of the patients in our study had reported pain in other parts of the body at baseline.

It has been reported that 97 % of TMD patients who seek care do so because of pain (7). All the patients in our study presented with pain and most of them had chronic pain. Chronic pain interferes with activities of daily living, and it has been assumed that relief of pain is accompanied by improvement in function. According to IMMPACT recommendations, evaluation of interventions in chronic pain patients should include not only relief of symptoms but also physical functioning in daily life (6). At the follow-up, 72 % of the patients reported negligible to mild impacts of their pain on activities of daily living, compared to 35 % at baseline. A shortcoming of our study is that we have not reported the functional status of the jaw according to IMMPACT. However, we have measured functional impacts of TMD pain according to RDC/TMD, which is more like a coping scale than a functional status scale.

Other shortcomings which might have influenced the results are that we did not use SCL-90-R, we did not record general health at baseline, and we did not record at what stage during the eight-year observation period the patients underwent additional treatment.

Conclusions

The results confirm the hypothesis that compared with baseline values, eight years after undergoing appliance therapy; most patients were experiencing less frequent and less intense TMD pain and headaches. It is remarkable that 41% of the patients still used their appliance at the follow-up. However, it is difficult to evaluate the long-term outcome of appliance therapy as more than 60% of the patients had additional treatments during the eight years.

The study provides further evidence of the positive long-term effects of simple occlusal appliance therapy in alleviating the discomfort of TMD of myogenous and arthrogenous origin.

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Evaluation of preventive programs in high caries active preschool children

Anna Lena Sundell, Christer Ullbro, Göran Koch

Abstract

◎ Although caries prevalence in preschool children has dramatically decreased during the last decades it is still a large problem for a minor group of these children. Great efforts have been invested in finding effective preventive programs for the high caries active preschool children. However, few studies have evaluated and discussed which approach will give the best effect.

The aim of the present study was to compare the effect of a "standard" preventive program with a series of programs with more extensive measures during a two-year period.

At start one hundred and sixty high caries active preschool children (mean age 4 years) were included in the study. The children were randomly distributed to four groups. All groups were exposed to the basic program composed of dietary counselling, oral hygiene instructions and fluoride varnish application. Three groups were exposed to one additional preventive measure e.g. 1% chlorhexidine gel in trays, 0.2% NaF gel in trays or daily tooth brushing with 1% chlorhexidine gel. The programs were repeated seven times during the two-year study period and were executed by trained dental hygienists. Caries examination and saliva sampling for Streptococcus mutans measurements were performed at start of the study and after two years. The mean defs at start was between 10.8 and 12.6 for the four groups (NS).

After two years the caries increment was 1.9 ds in the basic preventive group and between 1.9 and 2.6 (NS) in the other groups. Numerically there were more children in the chlorhexidine groups that showed reduction of Streptococcus mutans counts compared to the other groups, but the differences were small.

The mean caries increment of about 1 ds per year in all groups indicate that all programs were effective taken into account that the children had about 11 defs at start. There were no differences in caries increment between the basic preventive group and the other groups. The conclusion was that addition of preventive measures on top of an effective basic program is a waste of resources. The effect on oral health of individual re-instruction and motivation, by a dental hygienist, seven times during the two-year study period should not be underestimated

Key words

Caries active, prevention, children, preschool

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Jämförelse av kariesförebyggande program på högkariesaktiva förskolebarn

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Sammanfattning

◎ Trots den dramatiska kariesminskningen bland förskolebarn under senare decennier finns det fortfarande en mindre grupp bland dessa barn som har en avvikande och hög kariesförekomst. Stora insatser har gjorts för att söka finna effektiva förebyggande program för denna utsatta barngrupp. Emellertid är det få studier som sökt jämföra effekt och praktikabilitet av olika program riktade mot förskolebarn med hög kariesaktivitet.

Syftet med föreliggande undersökning var att jämföra effekten av ett etablerat standardprogram för högkariesaktiva förskolebarn med ett antal profylaxprogram där olika förebyggande åtgärder lagts till utöver standardprogrammet. Studien planerades pågå i två år.

Etthundrasextio högkariesaktiva förskolebarn (medelålder 4 år) ingick i studien vid start. Barnen fördelades randomiserat på fyra grupper. Alla grupper tog del av basprogrammet som bestod av kostinformation, munhygieninstruktion och fluorlackning. Tre av grupperna erhöll dessutom tilläggsprofylax bestående av antingen. 1% klorhexidingel i skena, 0,2% NaF-gel i skena eller daglig tandborstning med 1% klorhexidingel. Programmen övervakades och genomfördes av tandhygienister och upprepades sju gånger under den två-åriga försöksperioden. Kariesundersökning och salivprovtagning för bedömning av förekomst av Streptococcus mutans utfördes vid försökets start och efter två år. Vid starten var defs mellan 10,8 och 12,6 för de fyra grupperna (NS).

Efter två år var kariesökningen 1,9 ds i basprogramgruppen och i de andra tre grupperna 1,9 - 2,6 (NS). Streptococcus mutans förekomst minskade numeriskt mest i klorhexidingrupperna men skillnaderna var små. En kariesutveckling av en ny karierad tandyta per år bör kunna betraktas som låg ställt mot bakgrund att barnen i genomsnitt hade 11 defs redan vid fyra års ålder. Detta tyder på att alla program var i stort lika effektiva och att de ökade insatserna utöver basprogrammet inte gav någon tilläggseffekt. Man kan inte bortse från den effekt på orala hälsan som de sju besöken hos tandhygienist, innebärande reinstruktioner och information, har haft under tvåårsperioden.

Introduction

Dental caries in children has dramatically decreased in most industrialized countries during the last decades (19, 22). However, it is still a significant problem for a minor group of children (9, 10). These high caries active children have great treatment needs often in combination with pain, which together have negative impact on their quality of life. They are also a heavy burden for dental health services and society as a whole. Furthermore, young children with caries in the primary dentition have been found to be at risk for further caries development in the primary and the permanent dentition (1, 2, 13, 17, 21). It has also been documented that present caries prevalence is the strongest predictor for further and future caries development (20). Factors contributing to high caries activity are extensive plaque accumulation on tooth surfaces in combination with frequent intake of sucrose containing products (7, 26) while improved oral hygiene supported by topical fluoride applications such as frequent applications of fluoride varnish (8, 12, 18) and the use of fluoride gels (6) are known to reduce caries activity (4, 24, 25). Some studies have reported that antimicrobial treatment with chlorhexidine (14, 27) often in combination with fluoride (5, 15) is successful in controlling caries development in children. In addition, since attitudes to oral health, oral hygiene habits, and dietary patterns are established in early childhood it is important to start caries preventive programs at an early age (3, 16, 23).

In Sweden, most of the basic preventive programs for high caries active preschool children are based on oral hygiene instructions, dietary counselling, application of fluoride varnish and a recommendation to use fluoride toothpaste. However, we do not know if this programme could be improved in effectiveness by adding more preventive measures.

The aim of this study was therefore to evaluate if the addition of further different measures to the basic preventive program could increase the caries preventive effect in high caries active preschool children. It was emphasized that such an evaluation should run for at least two years.

Materials and methods

Participants

One hundred and seventy-one preschool children (mean age 4 years; range 2-5 years) referred to the Departments of Paediatric Dentistry in Jönköping and Värnamo, Sweden, for high caries activity were invited to take part in a two-year-study on the effect of different preventive programmes. The inclusion criteria were for children younger than 3 years at least one caries lesion involving the dentin and for children aged 4-5 years two or more caries lesions involving the dentin. One hundred and sixty children/parents accepted to participate in the study

Caries examination

All tooth surfaces were examined for caries by well-trained specialists in Paediatric Dentistry at start of the study and after two years. Clinical caries was defined as loss of tooth substance that had reached the stage of cavitation into the dentin on a tooth surface not previously restored. If the proximal tooth surfaces could not be clinically examined posterior bitewing radiographs were taken. A proximal caries lesion was, in the radiograph, defined as a lesion that clearly extended into the dentin (11). Restored tooth surfaces and teeth extracted due to caries were also recorded. Extracted incisors and canines were registered as four decayed tooth surfaces and extracted molars as five tooth surfaces. Caries data were presented as defs (decayed, extracted and filled tooth surfaces).

Salivary sampling for mutans streptococci measurements

Stimulated saliva was collected at start of the study and after two years.

Restorative treatment

Necessary restorative treatment and extractions were performed before start of the preventive programs. Twenty-five percent of the children had to be treated under general anaesthesia and 63 percent under nitrous oxide/oxygen sedation due to poor cooperation, fearfulness and extensive treatment needs. Prior to the restorative treatment the mean number of decayed tooth surfaces was 11.8 (SD 8.7). After treatment the mean number of tooth surfaces without caries and restorations (surfaces at risk) was 70 (SD 13.6). Caries prevalence and tooth surfaces at risk at start of the study are presented in the Table 1. If new caries lesions were detected during the study period they were treated with restorations or if indicated the tooth was extracted.

Preventive programs

The children were randomly distributed to one of four preventive programs which they followed for the next two years. Each programme was repeated every 2-4 month which means that each child was exposed to seven sessions of their respective program during the two-year-study period.

I Basic preventive program (Positive Control): The children (and parents) received information about oral health , dietary counselling, oral hygiene instruction, fluoride varnish application and were recommended to daily use fluoride dentifrice (250 ppm F) at home. Before application of the fluoride varnish (Duraphat) the teeth were cleaned and dried with compressed air. After application the child was advised not to eat or drink for at least two hours. The total program was repeated seven times during the two-year-study period.

II Basic preventive program and in addition the application of 1% chlorhexidine gel in individual trays (three applications for five minutes) at the dental clinic. The latter was repeated a second time within the following five days

III Basic preventive program and in addition application of 0,2% sodium fluoride gel (five drops) in individual trays , five minutes per day at home for one month.

IV Basic preventive program and in addition tooth brushing with 1% chlorhexidine gel once a day at home throughout the two-year study period.

The preventive programs were introduced consecutively and were continuously supervised by specially trained dental hygienists and assistants. If a child wanted to leave the study he/she was sent back to its ordinary dental clinic and was then included in the clinic´s preventive program for high caries active children. This was also the case when the study was terminated after two years.

Statistics and sample size calculation

Unbalanced analysis of variance with Sheffé´s test and T-Test were used to test for differences between the groups (the SAS system). The sample size calculation was based on the assumption that a difference between the means of 2.5 or more decayed surfaces should be shown with a probability of 0.05 and a power of 80 %. To meet these requirements about 35 individuals in each group is sufficient. P-values below 0.05 were considered statistically significant.

Results

Caries prevalence in the four groups at start of the study

Caries prevalence, before and after restorative treatment, and surfaces at risk at start are presented in Table 1 for the four groups. There were no statistically significant differences between the groups for any of the parameters.

Drop-outs

Forty-five children (I=0, II=10, III=9, IV=26) were lost during the study period or could not properly fulfill the respective program. The caries prevalence

Table 1. Caries prevalence, mean and ± SD, at start of the study in the different groups
d = decayed, e = extracted, f = filled, s = surfaces

	Caries prevalence in the different groups					
	I	II	III	IV	II+III+IV	P
n	41	37	36	46	119	
ds at first examination	10.7 ± 8.3	8.9 ± 6.5	10.2 ± 7.9	9.5 ± 7.9	9.5 ± 7.5	NS
defs after restorative treatment	12.6 ± 9.2	10.8 ± 6.8	12.7 ± 9.4	11.4 ± 8.6	11.6 ± 8.3	NS
Surfaces at risk after treatment	67.6 ± 17.2	72.4 ± 9.8	70.1 ± 12.5	70.4 ± 12.9	70.9 ± 11.8	NS

I Dietary counselling, oral hygiene instruction, fluoride varnish application
II I+ 1% Chlorhexidine gel in trays
III I+ 0.2% NaF gel in trays
IV I+ Daily tooth brushing with chlorhexidine gel

Table 2. Caries data, mean and ± SD, at start and after 2 years in children who completed the study
d = decayed, e = extracted, f = filled, s = surfaces

	Groups					P
	I	II	III	IV	II + III + IV	
n	41	27	27	20	74	
defs at start	12.6 ± 9.2	11.0 ± 6.1	12.2 ± 9.2	12.1 ± 8.9	11.7 ± 8.3	NS
New ds during the 2-year study	1.9 ± 1.9	2.6 ± 2.8	1.9 ± 2.1	2.0 ± 2.3	2.2 ± 2.4	NS

I Dietary counselling, oral hygiene instruction, fluoride varnish application
II I+ 1% Chlorhexidine gel in trays
III I+ 0.2% NaF gel in trays
IV I+ Daily tooth brushing with chlorhexidine gel

at start of the study for the children who completed the two-year-period in the different groups are presented in Table 2. At start there were no differences in caries prevalence between the four groups of children who completed the study (Table 2)

Caries increment during the two-year-study period

Baseline caries prevalence for the four groups of children who completed the study ranged between 11.0 and 12.6 defs. The caries increment for the four groups varied between 1.9 and 2.6 new ds (Table 2).

A comparison between the caries increment in the Positive Control Group (I) and a combination of all the groups which were exposed to additional prevention (II,III,IV, n=74) revealed caries increments of 1.9 and 2.2 respectively (Table 2).There were no statistically difference between the groups concerning caries increment.

Twenty-seven percent of the children developed no new caries lesions. Nineteen percent of the children developed 1 new caries lesion, thirty-two percent 2-3 new ds, 18 percent 4-8 lesions and 1.8 percent of the children developed more than 9 lesion during the two-year-period .

Salivary mutans streptococci

At start of the study 80 percent of the children had more than 1 million Streptococcus mutans per ml saliva. After two years preventive activities the number of Streptococcus mutans had decreased in 45 percent of the children, was unchanged in 38 percent and had increased in 17 percent. The percentages of children who showed a reduction of the Streptococcus mutans were 38, 50, 46 and 52 in the groups I, II, III, and IV respectively.

Discussion

The results of the present study were somewhat unexpected. Although there were differences in intensity between the preventive programs the four groups showed a similar and low caries increment during the two-year study period. Clearly, the addition of further preventive measures to the basic program (Group I) did not increase the preventive outcome. It might be speculated if not the main cause for the caries control was the frequent and regular visits to the dental hygienists (and the dental clinic) where the preventive measures were reinforced and not the specific content of the programs.

It is remarkable that intensive fluoride programs such as daily fluoride gel treatment in trays for seven months or frequent exposure to chlorhexidin did not have any additional caries preventive effect on top of a good basic preventive program. Thus, on a group level, there seems to be an upper limit for the caries preventive effect of a preventive program.

For ethical reasons no true control group was used. All involved children were referred for high caries activity and thus needed prevention. The positive control group in this study was therefore exposed to the normal program for caries active children (Program I). Against this program the other programs with additional measures were evaluated concerning effect on caries increment.

The design of the present study was based on the assumption that high caries active preschool children will continue to develop a high number of caries lesions in the future. This is supported by a large number of studies (20). In our group of high caries active children the caries, prevalence at approximately four years of age was almost 10 decayed tooth

surfaces. This has to be accepted as a clear risk group for further caries development. In the present study it was possible to limit the caries development to an annual mean caries increment of one decayed tooth surface. This indicates that the programs used in the present study must be looked upon as effective on a group level.

One weakness of this study is the limited number of participants. To try to compensate for this the data from groups II, III, and IV (n=74) were combined and compared to group I (n=40). As can be seen from Table 3 there was no difference in caries increment between these two groups.

The drop-out rate was rather high. As the aim was to test the different programs effect on caries increment, only children who completed the respective program in an acceptable way were included in the evaluation. This might explain the great variance in drop-out rates in the groups. In Group I there was zero per cent and in group IV about 50 percent. It also shows that the more time consuming and complicated the programs were, the more demanding they were to be accepted by the children and parents.

The main conclusions and recommendations are that preventive programs for high cariesactive preschool children should be based on oral hygiene instructions, dietary counseling, fluoride varnish application and recommendation to use fluoride toothpaste at home. The programs should be repeated preferably every third month at a visit to the dental clinic to reinforce the message. There seems to be no need for additional preventive measures to enhance the outcome on a group level.

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Common experiences of pain in children and adolescents – an Exploratory Factor Analysis of a questionnaire

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Abstract

◎ The aim of the study was to reduce everyday and dental treatment pain items included in the extended Children's Pain Inventory (CPI), used in a prior study on Swedish children and adolescents. Another aim was to, by means of exploratory factor analysis (EFA), expose hitherto undiscovered dimensions of the CPI pain variables and thus to improve the psychometric properties of CPI.

As some pain items are relevant merely to some individuals, a new and more useful questionnaire construction would enhance the internal validity of the instrument in observational surveys. EFA was applied on the extended CPI instrument. 368 children, 8-19 years old, had answered a questionnaire comprising 10 dental and 28 everyday pain variables. These pain items were analysed using a series of sequentially implemented EFA. Interpretations and decisions on the final number of the extracted factors was based on accepted principles; Kaiser's Eigenvalue >1 criterion, inspection of the scree plot and the interpretability of the items loading. The factors were orthogonally rotated using the Varimax method to maximize the amount of variance. Of all tested EFA models in the analysis, a two, three, four, and five factor model surfaced. The interpretability of the factors and their items loading were stepwise examined; the items were modulated and the factors re-evaluated. A four factor pain model emerged as the most interpretable, explaining 79 % of the total variance depicting Eigenvalues >1. 014.

The factors were named indicating the profile of the content: Factor I cutting trauma to skin/mucosal pain, Factor II head/neck pain, Factor III tenderness/blunt trauma pain, Factor IV oral/dental treatment pain.

Key words

Children, adolescents, pain, dentistry, exploratory factor analysis

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Vanliga smärtupplevelser hos barn och ungdom – Explorativ Faktoranalys av en smärtenkät

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Sammanfattning

◎ Syftet med studien var att reducera antalet smärtvariabler i ett utökat frågeformulär, Children's Pain Inventory (CPI) för svenska barn och ungdomar, vilket ingått i en tidigare studie. Formuläret behandlar vardagsrelaterad smärta och behandlingssmärta i tandvården. Eftersom det visat sig att en del smärtvariabler endast upplevts av ett fåtal barn och ungdomar, var målet att skapa ett mer adekvat mätinstrument. På så sätt kunde mätinstrumentet bli kliniskt hanterbart, representativt för en större grupp av barn och ungdomar och därmed uppvisa en större validitet. Den statistiska metoden Explorativ Faktoranalys (EFA) användes vilken både kan reducera antal variabler och upptäcka möjliga kluster och nya mönster i ett datamaterial. En ny, distinkt konstruktion av mätinstrumentet CPI kan därigenom bli mer användbart, generera hypoteser som kan prövas i kliniska studier, på andra och specifika populationer, som t.ex. barn och ungdomar vilka uppvisar tandvårdsrädsla och/eller andra diagnoser.

I den tidigare genomförda studien besvarade 368 barn och ungdomar, 8-19 år gamla, formuläret bestående av 38 frågor (10 med oral anknytning och 28 allmänna smärtor) . Genom att stegvis applicera EFA på de 38 smärtvariablerna kunde olika modeller granskas intermittent och utvärderas. Utvärderingen följde vedertagna principer och kriterier som t.ex. Kaiser's Eigenvalue >1, inspektion av scree plot, items laddning, Varimax rotation och förklarbarheten hos den bildade faktormodellen.

Av alla testade EFA-modeller utkristalliserades en två-, tre-, fyra- och en femfaktorsmodell som alla bedömdes adekvata för vidare analyser. I de efterföljande EFA beaktades laddningen för items och faktorernas tolkbarhet. I dessa processer exkluderades eller inkluderades items i syfte att öka förklarbarheten hos modellen. Förfarandet resulterade i en fyrfaktorsmodell som förklarar 79 % av variansen med Eigenvalues >1.014. Denna modell som innehåller 12 items visar en hög tolkbarhet. Fyrafaktorsmodellen med dess goda tolkbarhet och höga förklaring av variansen bedöms utgöra god grund för vidare hypoteser och tester i kliniska studier. Faktorerna benämndes utifrån sitt innehåll/relevans för respektive område, Faktor I, skärande trauma mot hud/slemhinnor relaterad smärta, Faktor II huvud/hals relaterad smärta, Faktor III ömhet/trubbigt trauma relaterad smärta, Faktor IV oralt/dentalt relaterad smärta.

Introduction

Dental injections and other invasive dental treatments such as drilling are, from clinical practice, known to generate pain. These pain experiences may provoke dental anxiety (6, 7,12,14) that may cause and consolidate negative dental behaviour and attendance for the patient (3). The overall knowledge of dental treatments and the pain they initiate is limited. Regarding the young Swedish population, there have been few reports in this field. Bergius et al. found that adolescents undergoing orthodontic treatment ranked 'tooth drilling' and 'dental injection' as the most painful dental treatments (2). This result was confirmed in another Swedish survey of 8 to 19 year-olds, to be among the most painful dental experiences (6).

Swedish children's pain rankings have been previously measured using the extended Children's Pain Inventory (CPI) (6) and the results resemble the pain rankings of that of Canadian children (6,9,12). Still, a limitation of the CPI instrument is that it is too complex and time-consuming in its existing form and difficult to apply in both clinical and observational research projects. Questionnaires that have been constructed to measure a certain concept such as pain or well-being must be evaluated for their underpinning theoretical and statistical properties. Are the items included sufficient to capture the area under study? Are the complex interrelationships between items acceptable? Are some of the pain items too identical and could be excluded? In order to analyse these kinds of questions, Exploratory Factor Analysis (EFA; a procedure belonging to a family of statistical methods) can be performed (1,4). Apart from reducing basic variable data for practical reasons, EFA can reveal tendencies in the material that are not obviously discovered with other statistical methods. Consequently, the supplementary dental questions of the CPI, used on Swedish children and adolescents (6), as well as the extended CPI, needs to be scrutinised and further analyzed in order to evaluate theoretical and practical issues of CPI.

The aim of the present study was thus to reduce the number of pain variables in the extended CPI instrument (for psychometric analysis of the pain variables) in a Swedish population in order to propose a short version of CPI that also includes items related to dental treatment. Further, by means of EFA, to expose hitherto undiscovered dimensions of the CPI pain variables and thereby improve the psychometric properties of CPI.

Materials and methods

Respondents

In the previously performed survey, 383 respondents were recruited from three Public Dental Service clinics in the city of Gothenburg, Sweden, to fill out the extended CPI at the clinics before scheduled visits for dental check-ups (6).The clinics were selected to reflect different social and economic backgrounds, as well as different levels of oral health and the respondents were enrolled consecutively. Due to incomplete answers, 15 questionnaires were omitted, wherefore the final sample consisted of 368 respondents aged 8-19 years. The gathered data represented 184 girls (mean age 13.8 and SD ± 3.6) and 184 boys (mean age 13.4 and SD ± 3.2) who answered the extended CPI regarding their everyday and dental pain experiences.

Questionnaire

A questionnaire containing 38 pain related variables was assessed. It comprised a Swedish extended version of the original CPI (6). In the extended CPI, the events referred to acute and everyday events, specific medical diagnoses and procedures, and to ten dental treatment experiences. All 23 original CPI items (12), from the acute trauma/disease form, were kept when the extended CPI was created. Further, four items from the acute treatment-related pain list were added, and also the item vaccination (9,11,12). Additionally, in order to create a questionnaire more applicable to the dental treatment situation, ten questions were constructed and added to the original CPI form (6). The extended questionnaire was then presented according to McGrath's CPI concept, duly translated and tested in a pilot study. The translation was made in two steps. First, the CPI was translated into Swedish (forward translation) by two independent researchers. Then, the instrument was tested in a group of 5 children to make sure that they fully understood the questions. After that the questionnaire was translated back to English (backward translation) by an independent bi-lingual interpreter and researcher and the questionnaire was checked for errors (6). All pain items are shown in Table1. The intensity of pain was recorded on a Visual Analogue Scale in accordance with the prime CPI concept. Figure 1 shows the answering format. Thirty-two children (16-19 years) answered the questionnaire twice, one week apart. In addition 14 children 8-14 years old from another cohort performed the same task. These two groups were used in

a pilot to study the test-retest properties by means of Cohen's Kappa and Intraclass Correlation Coefficient (ICC). A Cohen's Kappa coefficient for the everyday pain items ranged from 0.65-0.91 and for the dental pain items from 0.68-1.0. The test-retest with the ICC revealed a result of 0.95 (95% confidence interval 0.85-0.98).

Statistics

Prior to performing EFA on the modulated CPI, the items were checked concerning gender linkage and low response frequencies. Thus 12 pain items were removed from analyses due to low response frequencies; <80% and gender aspects. This decision resulted in eighteen remaining items marked with an asterisk * in Table 1.

By means of the statistical program SPSS 18.0, the EFA was subsequently tested on these eighteen pain items. In this way, further possible factor solutions were tested and stepwise evaluated. During testing EFA:s, the interpretability of every item and factor model, and the amount of explained percentage of the variance were evaluated. Thus, as a part of the test, pain items were either excluded or included in the EFA in order to expose the most rational factor model. (Thereby, different models emerged which were stepwise accepted or rejected.) All factor models were thoroughly discussed with regard to the formed items/factors and the corresponding related factor loadings. All interpretations and the decision on the final numbers of the extracted factors were consistently based on accepted principles; Kaiser's Eigenvalue > 1 criterion, inspection of the scree plot and the interpretability of the item loadings. The factors were orthogonally rotated using the Varimax method in order to maximize the variance.

Results

18 of 38 pain items met the criteria ≥ 80% response frequency regarding the different questions in CPI. By applying EFA on the 18 items, four models emerged containing two, three, four or five factors. All tested models except for the five factor model were rejected. This decision was made based on the general low loading of the items, similar double loadings and the poor interpretability of the models. The next step was a deeper analysis of the remaining most rational five factor model. The insufficiency of the five

Table 1. Pain items included in the questionnaires. 23 items from the Children's Pain Inventory (CPI) (12), 4 items from the acute treatment-related pain list (incl. vaccination), and 10 dental pain items (6,9,11). * Represents the 18 items used in the Exploratory Factor Analyses.

Everyday pain items Item No.	from CPI (12)
1.	fallen and scraped your skin *
2.	cut your finger with a knife
3.	burned your hand
4.	got a bee/wasp sting
5.	got a sliver *
6.	stubbed your toe *
7.	bitten your tongue *
8.	been scratched *
9.	had the flu
10.	had a cold *
11.	had sore muscles *
12.	had menstrual cramps
13.	had an earache
14.	had a toothache
15.	had a paper cut *
16.	had a sunburn
17.	had a headache *
18.	had a stomach/tummy ache *
19.	had an ache in your arms or legs
20.	had a pain in your chest
21.	had a serious accident/injury
22.	been pinched on the arm *
23.	been hit by a ball *

Acute treatment-related pain items and added everyday pain items Item No.	(6,9,11)
24.	nettle sting *
25.	a bruise *
26.	had a sore throat *
27.	vaccination *
28.	experienced some other great pain
Item No.	Added dental pain items (6)
29.	teeth polished by the dentist
30.	teeth checked with a probe
31.	had tarter removed
32.	had braces tightened
33.	a dental injection *
34.	a tooth drilled
35.	a tooth restored
36.	a tooth extracted
37.	a dental X-ray *
38.	rinsed your mouth with water

Figure 1. Examples of questions and answering format in the questionnaire.

Pain item	Experience	Painful or not	Pain intensity
Have you ever? 1. fallen and scraped your skin?	1. Yes 2. No 3. Don't know	Did it hurt? 1. Yes, always 2. Yes, sometimes 3. No, never 4. Don't remember	If yes, how painful was it? Mark your answer on the line (100mm Visual Analogue Scale)
Have you ever? 29. had your teeth polished by the dentist?	1. Yes 2. No 3. Don't know	Did it hurt? 1. Yes, always 2. Yes, sometimes 3. No, never 4. Don't remember	If yes, how painful was it? Mark your answer on the line (100mm Visual Analogue Scale)

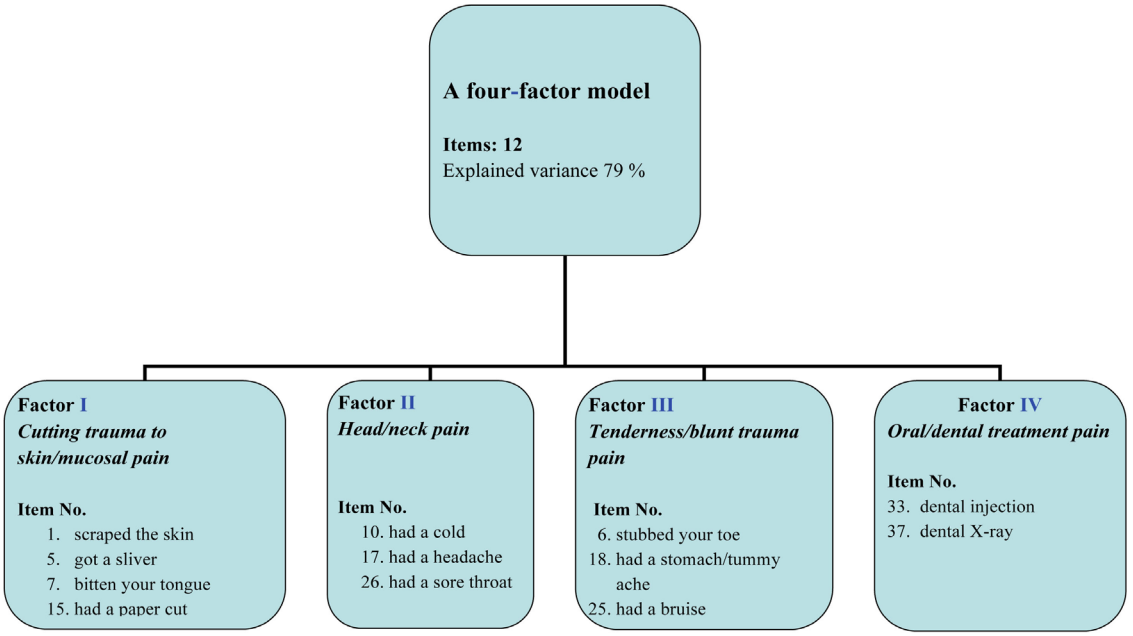
Table 2. The suggested four factor model is presented. All 12 pain items and their loadings are shadowed as they are interpreted to form the factors, respectively.
The item stubbed your toe is interpreted to best represent Factor III.

Item	Factor I	Factor II	Factor III	Factor IV
fallen and scraped your skin	.894	.096	.094	.095
got a sliver	.846	.040	-.111	.319
stubbed your toe	.572	.474	.526	.065
bitten your tongue	.759	.178	.208	.110
had a paper cut	.692	.524	-.006	.068
had a headache	.367	.751	.145	.253
had a stomach/tummy ache	.271	.529	.695	-.075
a bruise	-.038	-.059	.939	.113
had a sore throat	.127	.865	.156	.121
a dental injection	.090	.233	.021	.799
a dental X-ray	.281	.172	.089	.795
had a cold	.047	.851	-.047	.293

factor model was that one of its factors contained only one item. Therefore, this model was additionally modulated and tested in four subsequent steps. By the first step, the one item factor, No.27 vaccination was excluded and the EFA was again run on the remaining 17 items. This resulted in a four factor model, followed by a new evaluation and modulation of the items. By the second step, the items No.8 been scratched, No.22 been pinched on the arm, No.23 been hit by a ball, were excluded due to low interpretability which may be seen is as a heuristic decision. Simultaneously, No.27 vaccination was again included in the model. The EFA was again run, now on 15 items. Since the resulting interpretability was still judged as not high enough, No.11 had sore muscles and No.24 nettle sting, were excluded and the EFA was run on 13 items, as a third step. The resulting four factor model showed a fairly good interpretability, but still not acceptable. By means of the fourth step, No.27 vaccination was removed for the second time and the EFA was run on the remaining 12 items. A four factor model was extracted as seen in the Rotated Component Matrix in Table 2. This model showed a high interpretability, explaining 79% of the existing variance. The final evaluation of the clustering of the items and their loadings in the four factor model are shown shadowed, in Table 2.

The loadings were interpreted as well-correlated, forming four distinct factors. Regarding item No.6 stubbed your toe, it was seen that it loaded highly in Factor 1 (0.572), Factor 2 (0.474) and Factor 3 (0.526), (Table 2). In the EFA, an interpretation was made that item No.6 stubbed your toe was most suited to load into Factor 3 together with the items No.18 had a stomach/tummy ache and, No.25 a bruise, forming the most reasonable entity (Table 2). This interpretation reinforced at the same time the interpretability of the Factor 1 and 2, containing four items with the loadings (0.69-0.89), and three items with the loadings (0.75-0.87) respectively. Factor 3 contained three items with the loadings (0.53-0.94). Factor 4 contained two items, a dental injection and a dental

Figure 2 The suggested four factor-model consisting of pain 12 items is shown. The explained variance of the model is 79%. The well-defined factors are labelled;
Factor I Cutting trauma to skin/mucosal pain, Factor II Head/neck pain, Factor III Tenderness/blunt trauma pain, Factor IV Oral/dental treatment pain.



X-ray (0.80) and (0.80) respectively. Based on the item content, the four factors were suggested to be labelled as follows: Factor I cutting trauma to skin/mucosal pain, Factor II head/neck pain, Factor III tenderness/blunt trauma pain, and Factor IV oral/dental treatment pain (Figure 2).

Discussion

This study has shown a four factor pain model with a high interpretability. The step by step applied EFA on the 38 pain variable questionnaire resulted in 12 pain variables, forming four well-defined factors. This 12 pain item model may thus be applicable for further investigations in different clinical and epidemiological projects.

The factor consisting of the everyday pain items scraped your skin, got a sliver, bitten your tongue and had a paper cut, was interpreted as a laceration to the outer mucosa or skin. Factor I was thus labelled; cutting trauma to skin/mucosal pain. Factor II for its part, represented by had a headache, had a sore throat and had a cold was comprehended as a neck and head pain related unit. Factor III, which contained three items; stubbed your toe, had a stomach/tummy ache and a bruise was understood as homogenously inflicted trauma/pain without lacerations.

In the clinic as well as during research, it is desirable to reduce the number of pain variables and simultaneously retain as much adequate data as possible. This is achievable when using EFA.

In relation to all other tested models in this study, the four factor model was the most interpretable solution. The four factor model also accounted for the maximum variance of the examined everyday and dental treatment pain variables in the CPI. The explained variance of the model is considered high, 79% (5). All loadings of the items in the model were above 0.5, demonstrating a strong cohesiveness to the corresponding factor (5). In favour of the suggested four factor model is that it produced a distinct dental treatment pain factor, Factor IV oral/dental treatment pain, containing the invasive item;

a dental injection, and the non-invasive item; a dental X-ray. Commonly, dental clinicians observe that children experience intraoral X-ray as painful (16), contradictory to this intervention's simple performance. In the four factor model, a non-invasive item together with the highly invasive dental injection, fall out as a decisive entity, stressing the complexity of pain.

In comparison to the final four factor model, the prior tested models in this analysis accounted for less explained variance and the interpretability of the factor loadings were not straightforward. The discussed outcomes are reasonable however a limitation in the context is the scarcity of data from other factor analyses, which is lacking in the literature, evaluating dental treatment pain. It is important to find a short questionnaire containing items experienced by the majority of the respondents. The emerged four factor model in the study resulted from respondents aged 8-19 years. According to this wide age span, it is assumed that inter-individual pain experiences differed greatly. Nevertheless, the four factor model seemed to cover the most significant pain items, representative for all respondents in this study. Likely, in the general population the experiences also vary greatly in the age span 8-19 years (12). Although, probably a compromised form consisting of these 12 items could help outline patients pain history and thus be informative for an adequate treatment.

A crucial matter in the discussion of pain is how pain is understood and its psychological aspects related to the individual's mental developmental stage. The interpretation of pain is generally related to various stable factors such as age, cognitive level, gender, temperament and cultural background. By contrast, behavioural, emotional and cognitive factors are changeable over time. The latter represents the uniqueness of the child and the interplay with the environment in every single event (10). Generally, acute pain intensity, as experienced by children with invasive medical interventions, has been shown to decline with increasing age (9,10). This age effect is probably more a reflection of the child's previous experiences of pain, rather than an expression of a mental developmental stage and the specific ability to communicate (10). The similarity between an earlier experience and current pain is probably the strongest and most subtle factor in determining the experience of pain. Situational factors that intensify acute pain may be inaccurate expectations of uncontrolled pain, or inappropriate responses from staff or a parent during dental procedures (15). Therefore, a myriad of situational and individual issues that influence the child's experience of pain may not be revealed by means of a questionnaire. Possible drawbacks in this study were that not all the questions were answered by all of the children, which is why some items were excluded. This may have had an effect on the outcome of the EFA. However, the data originates from a large and well-defined patient material identified to represent urban Swedish children.

There have been conflicting opinions regarding the credibility of the conclusions made by the EFA. The interpretation of this method's results is heuristic, i.e. more than one interpretation can be made from the same data, due to different methods such as rotation of the factor matrix (5). Though this EFA model is based on statistical properties and criteria, the clinical interpretability of the four factor model was compared to other competing models. When using EFA, it is crucial to bear in mind that this method does not explain causalities. However, the operation of EFA can be thought of as revealing an internal structure of the data in a way which best explains its variance, including a reduction in the number of variables. An advantage of applying EFA is that the emerging factors may be extra informative, although delimited, and can even appear more explanatory compared with the variables as such. Thus, the EFA method contributes to a more substantial summarising and understanding of the data. Finally, in order to communicate, confirm and re-evaluate the pain experiences of the patients a shorter form of the CPI, consisting of 12 questions, is presumably faster, easier and more adequate way to use in different study designs, e.g. observational and epidemiological surveys. Additional dental clinical studies and observational projects of the four factor model could prove the strength of the internal validity of this model. Therefore, it is suggested that the 12 items reduced model be further tested in other samples and specific populations, such as dentally anxious individuals and/or individuals exhibiting different diagnoses, etc.

Acknowledgements

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Marginal bone loss in the adult population in the county of Skåne, Sweden

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Abstract

◎ The aim of this study was to investigate the prevalence and extent of periodontal disease registered as marginal bone loss and subject characteristics in the adult population in the county of Skåne in Sweden.

One thousand individuals, 20-89 years old, were randomly selected and 451 subjects agreed to participate in the study. They answered a questionnaire and in conjunction with the clinical and radiological examination the subjects answered questions about their medical history. The examiners were co-ordinated regarding the diagnostic criteria through comprehensive written instructions, practice and discussions of clinical cases. One observer estimated marginal bone loss around the teeth on digital panoramic radiographs and bitewings. The individuals were classified regarding periodontal disease experience according to the following criteria: PD- = loss of supporting bone tissue <1/3 of the root length, PD = loss of supporting bone tissue ≥1/3 of the root length in <30% of the teeth and PD+ = loss of supporting bone tissue ≥1/3 the root length in ≥30% of the teeth.

Subjects with no or minor bone loss, i.e. PD- constituted 69% of the population. Twenty percent of the study population had marginal bone loss corresponding to localised periodontal disease (PD) and 11% exhibited generalised periodontal bone loss (PD+). The periodontal treatment need, defined as probing pocket depth ≥6 mm and bleeding on probing ≥20%, was 53% in the PD+ group. An interesting result was that there were no differences in periodontal disease experience between the genders.

Conclusions: The prevalence and extent of periodontal disease in this study correlates well with recent other studies. Eleven percent of the population has experienced generalised periodontal disease, and 53% of them have a periodontal treatment need defined as 1 or more site with PPD ≥6 mm and BoP ≥20%.

Key words

Epidemiology, periodontal disease; periodontitis, prevalence, marginal bone loss

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Parodontala skador hos vuxna i Skåne

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Sigvard Åkerman, Ola Norderyd

Sammanfattning

◎ Syftet med studien var att undersöka förekomst och omfattning av parodontala skador samt individuella bakgrundsfaktorer i den vuxna befolkningen i Skåne.

Ett tusen slumpmässigt utvalda individer, 20-89 år och registrerade som boende i Skåne, erbjöds att delta i studien. Fyrahundrafemtioen individer besvarade en enkät och efter anamnestagning utfördes en klinisk och radiologisk undersökning. Observatörerna hade koordinerats avseende diagnostiska kriterier genom skriftliga instruktioner, kliniska övningar och falldiskussioner. En observatör skattade förlust av marginalt ben med hjälp av digitala panoramaröntgen och bitewings i bettets sidopartier utan annan information om individerna utöver röntgenbilderna.

De undersökta individerna delades in i 3 grupper beroende på omfattning av förlust av marginalt ben: PD- = förlust av marginalt ben omfattande <1/3 av rotlängden, PD = förlust av marginalt ben omfattande ≥1/3 rotlängden hos ≥30% av bettets tänder och PD += förlust av marginalt ben omfattande ≥1/3 rotlängden hos ≥30% av bettets tänder.

I den undersökta populationen hade 69 % av individerna ingen eller ringa förlust av marginalt ben (PD-). Tjugo procent av personerna hade lokalt förlust av marginalt ben (PD), och 11 % uppvisade generell benförlust i bettet (PD+). Parodontalt behandlingsbehov, definierat som fickdjup ≥6 mm och blödning vid sondering ≥20 %, uppgick till 53 % av individerna i PD+ gruppen.

Ett intressant fynd var att skillnad mellan män och kvinnor avseende parodontal benförlust inte kunde påvisas i denna population.

Sammanfattningsvis korrelerar prevalens och omfattning av parodontala skador i denna population väl med andra studier. Elva procent av populationen har eller har haft avancerad generell parodontit, och 53 % av dessa individer har behov av parodontal behandling, definierat som en eller flera fickor ≥6mm och BoP ≥20%.

Introduction

Periodontitis is defined as an infectious disease that causes inflammation in the supportive tissues of the tooth, which leads to loss of the periodontium and surrounding alveolar bone. Gingivitis and periodontitis used to be considered as an expression of the same disease entity. Today periodontitis is seen as separate from gingivitis due to the destruction of supportive tissues of the tooth (16).

Periodontitis is a result of an imbalance between the oral biofilm in the dento-gingival area and the host response. This will result in loss of supporting periodontal ligaments and alveolar bone (6, 16). Loss of supportive tissues around the teeth of varying degree is common in an adult population. In the latest survey in the Jönköping studies 39% of 50-year olds show some degree of periodontal bone loss. In this Swedish population subjects with advanced alveolar bone loss comprise 11% of all examined adults (14, 19, 21, 22).

Improved oral health in the adult population has resulted in a decreased number of edentulous individuals and concomitantly in an increased number of individuals with more remaining teeth. However, despite these improvements approximately 10% of the population suffers from severe periodontal disease (19, 21, 22). Men exhibit more advanced periodontal disease in several studies in different populations. They exhibit more marginal bone loss compared to women and also more pronounced attachment loss (1, 15, 18). When planning for health care resources, the treatment need in a population, needs to be documented.

The aim of this study was to investigate the prevalence and extent of marginal bone loss and subject characteristics in the adult population in the county of Skåne, Sweden.

Materials and methods

Study subjects

The outline and results of the clinical examination, radiographs and questionnaires are previously published by *Lundegren et al* 2012 (25). One thousand individuals were randomly selected from the Governments Person Address Register (SPAR), and were recruited for the study. They were 20-89 years old and registered as living in the county of Skåne in the southern part of Sweden in 2007. Skåne had a population of 907 702 individuals in the age group 20-89 years, in 2007. Of the original sample 11 had moved from the region, 14 had an unknown address and 9 were deceased, thus leaving 966 subjects as the final sample. 451 individuals agreed to participate in the clinical study and were examined both clinically and radiographically.

Eight individuals were excluded from this study for the following reasons: two subjects were edentulous, one individual was edentulous but restored with dental implants, radiographs were missing in four subjects and one individual were excluded due to poor quality of the radiographs, resulting in 443 individuals in the present study.

Questionnaire

All study subjects, except one, answered a questionnaire. The questionnaire contained 58 questions regarding patient's perception of oral health, need of oral health care, pain in the head, neck and oral region, use of dental health care, dental materials and background factors (25).

In the present study we focus on questions regarding gender, ethnicity, level of education, demographic status, self-reported cardiovascular disease and tobacco use.

Clinical examination

The clinical examinations were performed in standard dental surgeries from March 2007 to November 2008, the majority (83%) at the Faculty of Odontology, Malmö University, Sweden. As reported by *Lundegren et al* (25) the majority (91%) of the examinations were performed by eight dentists all employed at the Department of Oral Diagnostics. All examiners were co-ordinated regarding the diagnostic criteria through comprehensive written instructions, clinical practice and discussions of clinical cases. A standardised examination protocol was used. Subjects unable to come to Malmö for the examination were examined at clinics of the Public Dental Health Service in Helsingborg, Kristianstad or Ystad.

All clinical periodontal measurements were recorded at 4 sites (buccal-mesial-lingual-distal) on each tooth. Third molars, root remnants and dental implants were excluded in all measurements. Presence of visible plaque was recorded. Probing pocket depth (PPD) was measured parallel to the tooth with a periodontal probe with 1 mm grading (Hu-Friedy PCPUNC157). The deepest pocket ≥4mm was registered. Bleeding on probing (BoP) was recorded after probing of the pockets.

Radiographic examination

Digital panoramic radiographs were taken on all subjects. Bilateral bitewings were performed on all dentate subjects. In the present study the digital radiographs

were analysed regarding marginal bone loss by one calibrated examiner (ÅW), as described by *Jansson et al* (23). Except for the digital radiographs the examiner did not have access to any information regarding the study subjects. All other information, regarding the individuals, had been removed prior to the reading. The number of teeth was recorded, excluding third molars and root remnants. All measures were conducted on the computer screen using a digital ruler. The teeth were measured mesial and distal, parallel to the long axis of the tooth, from the cement-enamel junction to apex and from the most coronal marginal bone level. The site having most pronounced bone loss represented the tooth as a whole.

The individuals were classified regarding periodontal disease experience according to the following criteria:

PD- = loss of supporting bone <1/3 of the root length.
PD = loss of supporting bone tissue ≥1/3 the root length in < 30% of the teeth.
PD+= loss of supporting bone tissue ≥1/3 the root length in ≥ 30% of the teeth.

Non-response

A non-response analysis were performed and described in detail by *Lundegren et al.* (25). The non-respondents were contacted by telephone and were invited to be part of a non-response analysis. One hundred seventy five individuals answered the same questionnaire as the subjects participating in the clinical study.

Statistical analyses

Descriptive analyses, mean values and standard deviations were calculated based on the subject as the unit. For numerical variables the comparisons between different PD-groups were analysed using a General Linear Model. For binary variables the analyses were logistic regressions, using the likelihood-ratio test. All group comparisons were adjusted for differences in age, gender and smoking habits. A significance level of α=5% were used in all tests (two-tailed). All analyses were made using the statistical software SPSS (version 20, USA).

Reproducibility of radiographic measurements

In order to calculate intra observer agreement, the assessments of the marginal bone level were repeated in 100 randomly selected individuals. A Kappa value of 80% was calculated, on individual level.

Results

Subjects with no or minor bone loss, i.e. group PD-, comprised 69% of the examined population. The PD group, i.e. individuals with localised periodontal bone loss, consisted of 20% of the examined population, and the group with generalised periodontal bone loss consisted of 11% of the examined population (Figure 1).

The mean age in the different groups was 42 years (PD-), 60 years (PD) and 64 years (PD+). The individuals with no or minor marginal bone loss (PD-) were significantly younger than the groups with a more pronounced periodontal bone loss (PD and PD+) (Table 1).

There was no difference in presence of marginal bone loss or PPD ≥6mm between the genders. However, differences between females and males were

Figure 1. Distribution of periodontal bone loss in adult individuals in the county of Skåne, Sweden (n = 443).

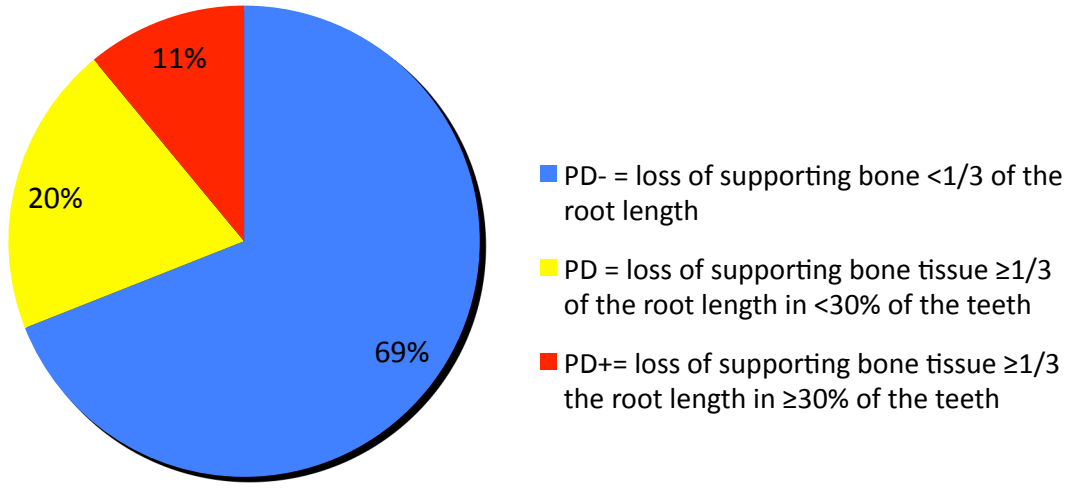

Table 1. Subject characteristic of individuals distributed in three groups, PD-, PD and PD+, based on marginal bone loss in radiographs.

		PD- n=304	PD n=90	PD+ n=49	P-value
Mean age	n=443	42*	60	64	≤0.001
Gender (%)					
Female	n=228	52	56	41	ns
Male	n=215	48	44	59	
Ethnicity (%)					
Nordic countries	n=374	86	85	78	ns
Non-Nordic countries	n=66	14	15	22	
University degree (%)	n=149	39*	28	17	≤0.001
Demographic status (%)					
Malmö	n=129	30	26	29	ns
Skåne	n=314	70	74	71	
Self-reported cardiovascular disease (%)	n=443	4*	14	25	≤0.001
Smoking (%)	n=443	16	13	29	ns
Moist snuff (%)	n=442	11	7	2	ns

* PD- significantly different compared to PD and PD+
** Significant difference between PD- and PD+

Table 2. Clinical characteristics of individuals distributed in three groups, PD-, PD and PD+, based on marginal bone loss in radiographs (n=443) adjusted for age, gender and smoking. Plaque index (PlI), Bleeding on Probing (BoP) and Probing Pocket Depth (PPD).

	PD-	PD	PD+	P-value
Mean number of teeth	26 (sd±4)*	25 (sd±3)*	22 (sd±5)*	≤0.001
PlI (%)	20 (sd±18) **	23 (sd±23)	31 (sd±29) **	0.025
BoP (%)	29 (sd±20)	28 (sd±20)	31 (sd±25)	ns
PPD 4-5mm (%)	5 (sd±7) *	9 (sd±8) *	17 (sd±14) *	≤0.001
PPD ≥ 6mm (%)	0.2 (sd±0.6)	0.6 (sd±1.5)	4 (sd±5.5) ***	≤0.001
PPD ≥ 4-5mm and BoP ≥ 20% (%)	49	59	61	ns
PPD ≥ 6mm and BoP ≥ 20% (%)	11*	24*	53*	≤0.001

* Significant differences between all three groups
** Significant difference between PD- and PD+
*** PD+ significantly different compared to PD and PD-

seen in mean dental plaque (18 versus 27 %, p≤0.001) and in mean bleeding on probing (27 versus 31 %, p=0.018). There was no difference in marginal bone loss between subjects born in the Nordic countries compared to individuals born outside the Nordic countries. A comparison between the population of the city of Malmö, where approximately one third of the population have a non-Nordic background, and the rest of the county of Skåne showed no difference in periodontal disease experience (Table 1).

In the total sample 34% of participants had a university education. The percentage of individuals with a university degree was significantly higher in the group PD- than in groups PD and PD+ (p=≤0.001). Thirty-nine percent of the PD- group had a university education, compared to 28% of the PD group and 17% of the PD+ group. The percentage of individuals reporting cardiovascular disease was significantly higher in the PD and PD+ groups than in the PD- group (p≤0.001). When looking at tobacco habits, there was no significant difference between groups PD-, PD and PD+ in percentage daily smokers. There were no difference in periodontal disease experience between subjects using Swedish moist snuff and subjects not using moist snuff (Table 1).

The mean number of teeth in the examined individuals was 26, 25 and 22 in the periodontal disease groups PD-, PD and PD+ respectively. These differences were statistically significant between all groups (Table 2). Regarding oral hygiene in the study population, the mean percent plaque scores were 20, 23, and 31 in PD-, PD and PD+ groups, respectively. The

PD- group had significantly less plaque than the PD+ group. The degree of gingival inflammation expressed as bleeding on probing (BoP) did not differ between individuals with different levels of periodontal disease experience.

There were significant differences between all groups regarding mean percentage of probing pocket depths (PPD) 4-5mm. The PD+ group had significantly more PPD ≥ 6mm compared to both PD and PD-. The mean percentage of PPD 4-5mm and ≥ 6mm were 5, 9, 17 and 0.2, 0.6, 4 in the PD-, PD and PD+ groups, respectively. Clinical periodontal treatment need defined as at least one site with PPD 4-5mm and full mouth BoP ≥20% was 49% in the PD- group, 59% in the PD group and 61% in the PD+ group, there were no statistical difference between the groups.

The periodontal treatment need defined as PPD (≥1 pocket) ≥ 6mm and bleeding on probing ≥ 20% was significantly different between all three groups. The percentage of examined individuals with a periodontal clinical treatment need were 11%, 24% and 53% in the PD-, PD and PD+ groups, respectively.

Non-response

One hundred and seventy five of the non-respondent individuals answered the same questionnaire as the participants in the clinical study for a non-response analysis. There were a significant difference in participation due to age (p=0.002); individuals in the age group 80-89 were less likely to participate. There were no significant differences between the genders. Twenty-four percent of the individuals in the group only answering the questionnaire had a university degree compared to 34% in the clinical study. In the non-response group 11% reported that they were missing >10 teeth compared to 4% of those participating in the clinical study (p=0.014). There were significantly more smokers in the group that only answered the questionnaire compared to the clinical study (p=0.039) and there were significantly more subjects born in Sweden in the group only answering the questionnaire (p=0.023).

Of those who did not participate in the present study or answer the non-response questionnaire, 48% were women and 52% men. Men in the age group 30-39 were the largest non-participating group.

Discussion

The prevalence of pronounced periodontal bone loss, defined as marginal bone loss on radiographs, was 11%. This is in agreement with previous findings of the incidence of severe periodontal disease in Sweden (14, 19, 21). *Hugoson et al.* (19) reported a prevalence of severe periodontal disease of 11%. They used another classification of periodontal disease according to *Hugoson & Jordan* (20). In that classification group 4 had alveolar bone loss around the majority of the teeth ranging between 1/3 and 2/3 of the length of the roots and group 5 had alveolar bone loss around the majority of the teeth exceeding 2/3 of the length of the roots; presence of angular bony defects and/or furcation defects. These groups can be considered comparable to the PD+ group in the present study. *Edman et al* (14) reported a prevalence of advanced periodontitis of 9.2% in 2008, in the county of Dalarna in Sweden. They defined advanced periodontitis as alveolar bone loss exceeding more than 1/3 of the length of the roots, furcation defects II and III and/or angular bony defects on >3 teeth in the molar and premolar regions.

The PD- group had a mean age of 42 years, the corresponding age for the PD and PD+ group were 60 and 64 years respectively. The PD+ and the PD group were significantly older than the PD- group. This is in accordance with other studies (8, 15, 17) that have shown increased marginal bone loss with increasing age. The difference in periodontal disease experience can to some degree be explained by age.

Regarding the number of remaining teeth there was a statistical significant difference between all three groups. The mean number of teeth in the study groups was 26 teeth in the PD- group, 25 teeth in the PD group and 22 teeth in the PD+ group. These numbers are comparable to the number of remaining teeth in the different study groups in the Jönköping studies. The difference in the number of remaining teeth can largely be explained by periodontal disease progression. *Holtfreter el al.* (17) found that increasing tooth loss was associated with increased attachment loss values. In a recently published study from Germany (18), the mean remaining number of teeth was 25 teeth in the age group 35-44 years and 14 teeth in the age group 65-74 years. The higher number of remaining teeth reported in the different Swedish studies might be explained by the preventive work that has been performed in Sweden for several decades. It is difficult to make comparisons with other studies due to different classifications of the population.

Periodontitis has been shown to be the main cause of tooth loss after the age of 45 (24). Other explanations can be caries, endodontic problems and technical failures, especially in the older age groups. The mean plaque score was 20% in the PD- group compared to 31% in the PD+ group, and this difference was statistically significant. The results regarding

mean plaque score is in accordance with the Jönköping study. The plaque score is presented as a mean for the individual. Presence of bacterial plaque is necessary for periodontal disease development. However, plaque as a diagnostic variable is not very useful in epidemiological studies due to general presence of proximal plaque in a population regardless of their level of periodontal health/disease (12).

In the present study there was no difference in periodontal bone loss or presence of PPD ≥ 6mm between the genders. However, significant differences between females and males were seen in the mean dental plaque and in mean BoP, males having more plaque and BoP. *Norderyd & Hugoson* (27), *Norderyd et al.* (28) reported no differences in periodontal disease experience, in a Swedish population, between male and female gender. There were no differences in oral hygiene and dental-visit behaviour between the genders (28). *Bahrami et al.* (4) showed no differences between male and female gender in marginal bone level in an adult Danish population when looking at radiographs nor were there any difference between the genders in the county of Dalarna in Sweden regarding marginal bone loss (14). This is in contrast to many other studies, for example *Albandar et al.* (1), *Holtfreter et al.* (17), *Bourgeois et al.* (8), that report deeper probing depths and more clinical attachment loss in males than females in the United States of America, Germany and France, respectively. As discussed previously the difference between the present study and the others could be due to a long tradition of preventive dental care in Scandinavia (2, 19, 21, 22, 30).

In the PD+ group 17% stated that they had a university education. This was significantly fewer than in the PD and PD- groups, and is in agreement with another study from Sweden (29). *Paulander et al.* (29) reported a significantly higher proportion of subjects with a low educational level in the group with the most extensive probing attachment loss (PAL). The difference in having a university degree has to be interpreted with care. A low number of the study subjects answered the question about education level (n=149). The PD- group was significantly younger than the other two groups and thus had less accumulated periodontal bone loss.

In the present study there was no difference with regard to periodontal disease experience between subjects who were born in Sweden-Denmark-Norway-Finland-Iceland and subjects from countries outside the Nordic countries. A comparison between individuals with Nordic background and individuals with non-Nordic background showed no difference in marginal bone level. Due to the low number of individuals with a non-Nordic background, it is difficult to interpret these findings.

Clinical periodontal treatment need defined as full mouth BoP ≥20% and at least one site with PPD 4-5mm was 49% in the PD- group, 59% in the PD group and 61% in the PD+ group. When the definition of clinical treatment need was full mouth BoP ≥20% and at least one site with PPD ≥6mm, 11% in the PD- group, 24% in the PD group and 53% in the PD+ group needed periodontal treatment. In the total sample 18% of the individuals were defined as having full mouth BoP ≥20% and at least one site with PPD ≥6mm. This means that a relatively high number of individuals are in need of some degree of periodontal treatment. *Claffey & Egelberg* (11) reported that high numbers of deep residual periodontal pockets in individuals treated for periodontitis were associated with higher risk for disease progression.

When planning for dental health care on a national level it is important to maintain periodontal health but also to allocate resources to the large group of individuals with periodontits. Despite better periodontal health in the population at large (14, 19, 21, 22) still more can be done for individuals most sensitive to periodontal disease.

Several cohort and case-control studies have reported an association between cardiovascular disease (CVD) and periodontitis (5, 13, 26). Individuals with severe periodontitis have elevated levels of known risk markers for atherosclerosis and with periodontal treatment some of the risk marker levels are reduced (9, 10). In this study there was more self-reported CVD experience in the PD+ group compared to the PD and PD- groups. If it is a causal relation or a co-variation due to age difference between the groups is not known.

There were no differences in the number of daily smokers between the three groups in this study, however a non-significant tendency with more marginal bone loss in smokers could be seen (p=0.058). This is in contrast to many other studies showing a relationship between smoking and periodontal disease (3, 7). A statistical significant difference cannot be out ruled due to the limited numbers of individuals in the PD+ group in this study.

Strengths

The study sample was randomly selected from the

adult population living in the county of Skåne in 2007 (n=907 702).

The non-response analysis shows a similar distribution in gender and ethnicity compared to the responding group. Regarding age the only difference between the groups were in the oldest age group (80-89 years).

The distribution of marginal bone loss in the present study is in accordance with other studies (4, 14, 21) with a lower degree of non-respondents.

The reading of radiographs is done without knowledge of clinical status of the study sample.

Limitations

The group of non-respondents was large; this can cause a misinterpretation of the true distribution of marginal bone loss in the population. In the non-responding group answering the questionnaire fewer individuals had a university degree and more were smokers. These are factors considered to be associated with periodontal disease (15, 29).

Conclusion

Eleven percent of the population has experienced generalised periodontal disease, and 53% of them have a periodontal treatment need defined as 1 or more site with PPD ≥6 mm and BoP ≥20%. The prevalence and extent of periodontal disease in this study correlates well with other recent studies in Sweden and other countries. An interesting finding is that there were no differences in periodontal disease experience between males and females. This finding is in contrast to the majority of epidemiological studies reporting more periodontal disease in males.

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Knowledge of periodontitis and self-perceived oral health: a survey of periodontal specialist patients

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Abstract

◎ The aim of this study was to investigate changes in knowledge of periodontal disease among patients referred to periodontal specialist clinics. A further aim was to investigate the patients´ self- perceived oral health before the treatment. Patients referred to five specialist clinics in periodontology for comprehensive periodontal treatment were consecutive sampled. The study was based on a questionnaire in a before and after design. The first questionnaire was sent to the patients before visiting the specialist clinic and the second was sent after six months. Four questions were analysed, two to measure knowledge about periodontitis and two to measure the patients self- perceived oral health. The first questionnaire was sent by post to 273 patients with a response rate of 31%. The second questionnaire was sent to 85 patients with a response rate of 73%.

The results of the study showed a statistically significant improvement of correct answers on the knowledge questions after six months was found for scaling (p=0.006), X-ray examination (p=0.001) and increased space between the teeth (p=0.001). The most frequent self- perceived trouble from the mouth was bleeding gum (70%) and sensitive teeth (51%). In conclusion knowledge of periodontitis improved after visiting the specialist clinic of periodontology. Many of the patients experienced some problems of the mouth.

Key words

Periodontitis, knowledge, self- perceived oral health

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Kunskap om parodontit och självupplevd munhälsa hos patienter remitterade till specialistklinik i parodontologi

Carina Mårtensson, Björn Söderfeldt, Björn Axtelius, Pia Andersson

Sammanfattning

◎ Syftet med studien var att undersöka om patienters kunskap om parodontit ökade efter behandling på specialistklinik i parodontologi. Ett ytterligare syfte var att undersöka patienternas självupplevda munhälsa före behandling på specialistklinik.

Patienter som remitterats till specialistklinik i parodontologi för fullständig parodontalbehandling inkluderades i studien. Studien genomfördes med enkäter i före och efter-design. Den första enkäten skickades till patienterna i samband med att de kallades för undersökning till specialistkliniken och den andra enkäten skickades hem till patienterna efter sex månader. Fyra frågor från enkäten analyserades, två för att undersöka kunskap om parodontit och två om självupplevd munhälsa. Den första enkäten skickades per post till 273 patienter och hade en svarsfrekvens av 31%. Den andra enkäten skickades till de patienter som besvarat den första enkäten. På denna enkät svarade 73% av patienterna.

Resultatet visade att det fanns en statistiskt signifikant ökning av rätt svar på kunskapsfrågorna efter besöket på specialistkliniken när det gällde ”scaling” (p=0.006), röntgenundersökning (p=0.001) och ”ökade mellanrum mellan tänderna” (p=0.001). De mest frekventa rapporterade besvären från munnen var ”blödande tandkött” (70%) och ”känsliga tänder” (51%). Sammanfattningsvis ökade kunskapen om parodontit efter besöket på specialistkliniken i Parodontologi när det gäller rätt svar på kunskapsfrågorna. Många av patienterna upplevde något besvär från munnen.

Introduction

In Western countries improvement in oral health has occurred during the last decades (45). However, periodontitis is still a prevalent disease in adult populations, even if decreases have been reported (3, 17). Periodontitis is an infectious disease, influenced by several factors, such as genetic, demographic and socioeconomic factors (2) or lifestyle factors such as smoking and poor oral hygiene (5, 31). Psychosocial factors, e.g. stress (6, 19, 37) also seem to have an impact. Furthermore, the disease seems to increase with age (32, 39). Currently, there has also been focus on the association between periodontal health and general health, especially cardiovascular disease (25, 36) respiratory disease (33) and diabetes (43).

Lacking knowledge of oral health could be a barrier to effective oral preventive efforts. It is shown that knowledge about prevention of periodontitis is related to oral health behaviour (12). Therefore, oral health education aimed at improving knowledge could be important to prevent periodontal problems (26). Furthermore, the patient's knowledge of periodontitis and level of education can influence the severity of the disease. *Paulander et al.* (35) reported that people with higher education had less need for periodontal treatment. It has also been reported that high education, frequent care utilization, and perceived importance of oral health are related to higher knowledge of periodontitis (28).

Oral health can be described from the profession's view based on clinical examinations, and from the patient's view based on experience and satisfaction. From the profession's view, the severity of periodontitis is usually documented by clinical findings, for example bleeding on probing and pocket depth (1). From the patient's view, experience and satisfaction together with symptoms such as bleeding when brushing and bad breath, can affect the individual's well-being and quality of life (25). Associations between oral health and quality of life have been reported. In patients with periodontitis, deeper periodontal pockets indicated poorer oral health-related quality of life (29, 30). The experience and satisfaction of oral health is based on self reports and can be valid to identify periodontal conditions (35). It can also be used as an epidemiological tool in studies of periodontal health (10).

Periodontitis can be characterised by a slow progression and the signs are seldom obvious for the patient in the beginning of the disease. Therefore, patient's awareness and knowledge of the disease are important. To our knowledge, no studies in these areas have focused on patients referred to specialist clinics.

Aim

The aim of this study was to investigate changes in knowledge of periodontal disease among patients referred to periodontal specialist clinics before and after treatment. A further aim was to investigate the patient's self- perceived oral health before visiting the periodontal specialist clinic.

Material and method

Study base

The study was based on a mail questionnaire in a before and after design. Patients referred to five public specialist clinics of periodontology in southern Sweden for comprehensive periodontal treatment were consecutive sampled for the study. Periodontology is a recognized speciality in Sweden with specialist clinics both in the public and private dental health services. The specialist clinics in Periodontology perform examinations of periodontal tissues, diagnose, prevent and treat periodontal diseases. This includes procedures as information and instruction to prevent periodontal diseases and sub and supra gingival scaling, often assessed by a dental hygienist (18). The treatment can also include gingival surgery performed by the dentist.

The questionnaires were coded with a number and only persons working with the study could link the code with a name. The respondents were given written information about the study, how the sample was selected, that the questionnaire was coded, and how they could be given further information about the study. They were also asked to give a written consent. The study was approved by the Regional Research Ethics Board in the Southern region (Dnr 435/2007).

The first questionnaire included 12 questions concerning knowledge of symptoms and treatment of periodontitis, self- perceived oral health, quality of life, expectations about treatment of periodontitis, questions about health in general, as well as about oral health. There were also questions about marital status, ethnicity, work and education. The second questionnaire included 10 questions concerning knowledge of symptoms and treatment of periodontitis, and satisfaction with periodontal treatment. Age and gender were given from the sampling frame.

The first questionnaire was sent by mail to the patients during December 2007 until January 2009

before their first appointment at the specialist clinic. This questionnaire was distributed by the staff at the different clinics of periodontology. A second questionnaire was sent after approximately 6 months to those patients who answered the first questionnaire. For the second questionnaire, a reminder was sent after four weeks with a letter explaining the importance to respond. After another four weeks, a reminder with a new questionnaire and a stamped envelope was sent to the non-respondents.

Response

From five different Departments of Periodontology, 273 questionnaires were sent by regular mail to patients in connection to their first appointment at the clinic. The response rate to the questionnaire was 31% (n=85). Patients answering were 64% (n=54) women and 36% (n=31) men. Gender and age were known for the non-respondents. In a bivariate analysis, no difference was found either in age (p=0.122, t-test) nor in gender (p=0.176, Chi2-test) between the respondents and non-respondents. The second questionnaire was sent by mail to the 85 respondents answering the first questionnaire. The response rate was 73% (n=62), 68% were women and 32% were men. There was no difference in age (p=0.095, t-test) or gender (p=0.055, Chi2-test) between the respondents and non-respondents as to the second questionnaire.

The mean number of the patients (n=62) visiting the clinics of Periodontology during the six months was 4.27. The mean number visiting a dental hygienist was 3.53 and visiting a dentist was 2.53. 40% of the participants (n=62) visited the dental hygienist and 20% visited the dentist more than four times during the six months.

Data collection

In this paper, two questions were selected to evaluate knowledge of periodontitis. Another two questions were selected to indicate self- perceived oral health, one to evaluate troubles in the mouth, and one to evaluate the impact of oral conditions on everyday well-being.

Two questions were used for evaluating knowledge of periodontitis focusing on symptoms and treatment. The response alternatives were to be linked with periodontitis (response alternatives were "caries", "periodontitis", "both caries and periodontitis", "neither caries nor periodontitis" and "I don't know"). The first question was: "You can note in various ways that you are suffering from a dental disease, such as caries and periodontitis. Do you know which of the following troubles and symptoms that might indicate that you suffer from caries or periodontitis"? Alternatives for answering were: "black and brown plaque on the teeth", "gingival bleeding", "sensitive teeth", "toothache", "mobile teeth", "bad breath", "aching mouth", "coated tongue", and "increased space between the teeth". Gingival bleeding, mobile teeth and increased space between the teeth were chosen as correct answers. The second question was: "Dental diseases can be treated in many ways. There are also many types of examinations in dentistry. Do you know which of the following types of treatments and examinations that is intended for caries and periodontitis?" The variables for answering were: "scaling", "gingival surgery", "careful dental hygiene", "cleaning between the teeth", "pocket probing", "X-ray examination", "filled teeth", "polishing of discoloured teeth", "sealing with fluoride" and "fluoride tablets". Pocket probing, X-ray examination, scaling, gingival surgery, careful dental hygiene and cleaning between the teeth were chosen as correct answers. Careful dental hygiene and cleaning between the teeth was regarded as correct answer in connection to "both caries and periodontitis". These questions have earlier been used by *Mårtensson et al.* (27).

In combining the two knowledge questions, the number of possible correct answers was nine. The combination was used for three variables "knowledge before" (A), "knowledge after" (B) and "knowledge differences" (B-A).

To evaluate self- perceived oral health, the first question was: "One can have many different troubles from the mouth and teeth. Do you for yourself experience that you have one or more of the following troubles or worries"? The items for answering can be seen in table 3. Each item could be answered by using the alternative "no troubles" regarded as 1, "some troubles" regarded as 2, "quite many troubles" regarded as 3 "and big troubles" regarded as 4. The total score ranged from 17 (no troubles) to 68 (maximum of troubles). This question has earlier been used by *Unell* (44) and *Ståhlnacke et al.* (42).

The second question to evaluate self- perceived oral health was aiming to assess the impact of oral conditions on everyday well-being. The Oral Health Impact Profile 14 (OHIP) questionnaire was used (41). All the items began in the same way: "How often have you as result of your oral cavity, teeth, jaw or prostheses during the past year experienced the following situations"? The items were divided into

seven dimensions, "functional limitation "physical pain", "psychological pain", "physical disability", "psychological disability", "social disability" and "handicap". The answers were rated, "all the time" = 5, "very often" = 4, "fairly often" = 3, "sometimes" = 2, "hardly ever" = 1, "never" = 0 and "not applicable to me" rated as no response. The total score for the index (range 0-70 points) was obtained by adding the individual points for each question.

Social attributes, age and gender, were given from the sampling frame. Marital status was assessed by the question: "What marital status do you have"? Response alternatives were: "married/live together", "living alone" and "another". It was used as a binary variable with the two alternatives "married" (married/live together) and "single" (living alone and another). Ethnicity status was measured by the question: "How long have you been living in Sweden"? Response alternatives were: "always", "grown up in Sweden" and "arrived to Sweden as an adult". It was used as a binary variable with the alternatives "born in Sweden" (always) and "born outside Sweden" (grown up in Sweden/arrived to Sweden as an adult).

Education was measured by the question: "What education do you have"? The response alternatives were: "elementary school/nine year compulsory school", "junior secondary school/folk high school/ two years high school", "three or four year high school", "university education", and "other education". Also, this question was used as a binary variable with the alternatives "primary education" (elementary school/nine year compulsory school, junior secondary school/folk high school/two years high school) and "secondary education" (three or four years high school, university education and other education). Work was measured by the single question: "How many hours per week do you work"? Response alternatives were: "full time job" (more than 35 hours /week), "part time job" (between 15-34 hour/week), "between 1-14 hours per week" and "not working at all". This was used as three variables: "full time job" (more than 35 hours /week), "part time job" (between 15-34 and 1-14 hours per week) and "not working at all".

Statistical method

Cross tabulation and Chi2-test were used to analyse consistency in responses (4). To test
changes in correct answers, Cohen's Kappa was used (41) in the before and after measurement.

To analyse common self- perceived characteristics of troubles from the mouth, Principal Component Analysis (PCA) was used with varimax rotation based on a correlation matrix. Internal consistency was calculated with Cronbach´s alpha. The OHIP items were analysed with additive scores for each item. Spearman correlation analyses were used to measure correlations between question about troubles from the mouth and the OHIP additive score.

To analyse bivariate relations in correct answer and social attributes (marital status, ethnicity, gender and education), Mann-Whitney U-test and an ANOVA test (work) were used. A post hoc pair-wise comparison for "work" was adjusted by the Bonferroni method (30). Data analyses were performed by SPSS (Statistical Package for the Social Sciences version 17.0) Statistical significance was defined as $p<0.05$.

Results

Knowledge questions

For the first questionnaire, before visiting the specialist clinic, the percentages of giving correct answers to the knowledge questions ranged between 42% and 70%. As to the second questionnaire, the percentages of correct answers varied between 60% and 88%. Thus, there was an improvement among the respondents concerning correct answers to the knowledge questions between the first and the second questionnaire. Some of them were statistically significant (Table 1). The differences in correct answer between the first and second questionnaire were calculated in quota. To examine the consistency in the responses, Kappa values were calculated varying between 0.15 and 0.72 (Table 1).

Statistically significant differences in correct answers in relation to gender were found ($p=0.044$) before the first appointment at the specialist clinic (A). Females had better knowledge than males. After six months (B), there was a statistical difference in "ethnicity" ($p=0.019$). No statistically significant differences were found in difference (B-A) in the bivariate analyses.

Self- perceived oral health

The items aimed to measure the respondent's self-perceived oral health regarding troubles in the mouth were summarized and resulted in a score between 17 ("no troubles") and 55 ("big troubles"), with a mean value of 24 (Sd 7.4) and a median value of 23. Five percent of the patients had a score of 17. The most common self- perceived trouble was "bleeding gums" (70%) and "sensitive teeth" (51%) (Table 2).

Table 1. Percentage distributions, quota and Kappa values of the respondents giving correct answer before visiting the specialist clinic (t0) and after six mounts (t1).

	Correct answer before (t0) (%)	n	Correct answer after (t_1) (%)	n	p-value	Quota (t_1/t_0)	Kappa value
Gingival bleeding	54	84	71	56	0.073	1.31	0.23
Mobile teeth	60	83	76	59	0.141	1.27	0.18
Increased space between the teeth	44	84	66	58	0.001	1.50	0.43
Scaling	42	83	60	57	0.006	1.35	0.36
Gingival surgery	64	83	82	55	0.193	1.28	0.72
Pocket probing	67	83	84	57	0.147	1.26	0.19
X-ray examination	52	82	64	59	0.001	1.23	0.43
Careful dental hygiene *	70	83	88	58	0.224	1.25	0.15
Cleaning between the teeth *	67	84	74	57	0.104	1.10	0.21

* These alternatives were linked with "both caries and periodontitis"

Table 2. Percentage distribution of experience regarding troubles from the mouth

	No troubles %		Some troubles %	Quite many troubles %	Big troubles n %
Tooth colour	56	29	9	6	84
Tooth shape	68	21	7	4	84
Tilted/angulated teeth	69	24	5	2	84
Gaps between the teeth	77	14	8	5	84
Lack of space between the teeth	56	33	6	5	84
Burning sensation in the mouth	84	11	5	0	84
Wounds or blisters in the mouth	76	18	4	2	84
Change in sense of taste	84	13	1	1	84
Pain from the jaw	80	16	1	2	85
Clicking or crackle sounds from jaw	80	14	5	1	85
Problem to open your mouth	81	14	3	1	85
Squeaking or squeezing	69	18	2	10	82
Bleeding gum	30	50	13	7	85
Bad breath	56	33	5	6	85
Problems from tooth filling material	79	16	4	1	83
Troubles from crowns and bridges	83	12	5	0	82
Sensitive teeth	48	34	12	5	85

The items were analysed by a PCA. After exclusion of items with low communalities, 10 items remained, and revealed two factors, factor one (F1) named as "trouble" and factor two (F2) named as "aesthetics". Explanation of variance was 41% for the first factor and 22% for the second factor (Table 3). The internal consistency was tested with Cronbachs`s alpha and was 0.87 for the first factor and 0.78 for the second factor.

Analysing the impact of oral condition on everyday well-being, as measured with the OHIP14 questionnaire, the mean additive score for the respondents was 7.40 (sd 9.0), median score 4.0 and ranged from 0 to 43. Thirty-one percent of the participants had a score of 0 indicating "no troubles" and 54 % had a score between 0 - 4. Regarding the separate items in the OHIP questionnaire the most frequent problems were in the dimension "Physical pain" (Table 4).

To measure if there was a correlation between the summarized score of troubles from the mouth, the factor "trouble", and "aesthetics" were related to the summarized OHIP. The factor "aesthetics" correlated with the summarized OHIP score ($r = 0.384$, $p<0.001$ There was no correlation as to "trouble" ($r=0.229$, $p=0.064$). A correlation analysis was also made between the additive score of OHIP and the knowledge questions. No correlations were found between OHIP additive score and the two questions about knowledge.

Table 3. Principal Component Analysis for troubles in the mouth (minor loadings <0.20 not stated)

Items	Communality	F1 (trouble)	F2 (aesthetics)
Burning sensation in the mouth	0.772	0.87	
Wounds or blisters in the mouth	0.735	0.85	
Pain from the jaw	0.720	0.84	
Clicking or crackle Sounds from the jaw	0.675	0.82	
Troubles from crowns and bridges	0.433	0.66	
Change in sense of taste	0.505	0.70	
Tooth colour	0.470		0.67
Tooth shape	0.825		0.90
Tilted/angulated teeth	0.717		0.83
Lack of space between the teeth	0.511		0.71
Variance explanation		41%	22%

Table 4. Percentage distribution for each item on the OHIP questionnaire in percent

	Never %	Hardly ever %	Some-times %	Fairly often %	Very often %	All the time	Total n
Functional limitation							
1. Trouble pronouncing words	77	10	12	0	1	0	77
2. Sense of taste has worse	79	5	7	5	3	0	77
Physical pain							
3. Painful aching in the mouth	53	9	28	9	0	1	81
4. Uncomfortable to eat food	59	9	13	10	4	5	80
Psychological discomfort							
5. Been self-conscious	60	11	15	4	8	1	78
6. Felt tense	61	11	15	1	10	2	79
Physical disability							
7. Diet been unsatisfactory	59	9	14	10	4	5	80
8. Had to interrupt meal	87	4	2	2	4	0	79
Psychological disability							
9. Difficult to relax	63	10	13	3	1	0	79
10. Been embarrassed	76	8	10	4	0	1	76
Social disability							
11. Been irritable with others	63	6	23	6	1	0	78
12. Difficulty doing usual jobs	81	4	10	2	1	1	79
Handicap							
13. Felt life less satisfactory	74	7	12	1	5	1	76
14. Totally unable to function	83	10	4	3	0	0	78

Discussion

There was an improvement in correct answers after visiting the specialist clinic in periodontology regarding to the knowledge questions about periodontitis. In the separate items of troubles from the mouth, 50% or more reported no troubles, except for bleeding gums and sensitive teeth. Furthermore, in the OHIP measure, over 31% of the respondents stated that they never had troubles from the mouth affecting everyday well- being.

The improvement in correct answers on the knowledge questions before and after six months

was significant in some variables in accordance with a previous study evaluating a mass media campaign (27). In the present study, the improvement of correct answers may relate to the personal contact between the caregivers and patients. *Karlsson et al.* (20) reported that knowledge related to periodontal disease came from information given in relation to treatment at dental clinics. The patients in our study most likely visited a dental hygienist and received information about periodontitis and its treatment. The dental hygienist has a key position to promote and prevent oral health (18) for improving knowledge and thereby influencing the patient's ability to change oral habits. However, increasing knowledge does not necessarily result in behavioural change. *Kay & Locker* (21) suggest that oral health education can lead to improved knowledge, but there is little evidence for behavioural change. That was not evaluated in this study.

There was a statistically significant gender difference in correct answers to the knowledge questions before visiting the specialist clinic of Periodontology. After six months, the only significant difference according to the knowledge questions was found between patients born in Sweden compared to those born outside Sweden. In an earlier study *Mårtensson et al.* (28) the level of education was a determinant for knowledge, which was not found in this study.

A lot of the respondents in our study experienced their oral health as rather good, despite the referral to a clinic of Periodontology for comprehensive periodontal treatment. For some of the variables measuring troubles from the mouth, 80% or more reported no troubles. Variables in the assessment tool related to periodontal disease showed, however, a higher degree of troubles. Regarding bleeding gums, as many as 70% reported "some" to "big troubles". Gingival bleeding may be obvious for the patient when brushing their teeth which is in accordance with *Gilbert & Nuttall* (16) reporting bleeding gum as a predictor.

The validity of self- perceived oral health can be regarded as a consensus between expressions used in the dental clinic and in self- reported questionnaires. *Blicher et al.* (8) showed lesser validity in a self- reported question asking about "gum disease" than asking about "periodontal disease". Nevertheless, Unell (44) reported good validity for questions about changing position on the front teeth and problems with gingival bleeding, but less congruence for periodontitis. Dietrich et al. (13) found that individual questions of self- reported periodontal disease had low predictive power and low sensitivity. The self reports can depend on the understanding what is normal for oral health and the specific symptoms for different diseases. It can also be influenced by cultural values (11) and the past experience of the health care system (14, 38). Therefore, it is important that oral health information is understandable when it is given.

A common used instrument to measure self- perceived oral health is the OHIP questionnaire. The OHIP mean additive score (7.40) in our study was higher than reported by *Bernabé and Marcenes* (7) who had a mean score of 5.3. Furthermore, *Einarson et al.* (15) reported a mean score of 6.4 when assessing the periodontal disease and quality of life. However in both those studies the participants were from the public population, while ours were patients referred for comprehensive periodontal treatment.
The questionnaires were analysed in a cohort design and the same respondents received the questionnaire before visiting the department of periodontology and after six months. The strength in a cohort design is the relation between earlier events and outcome during time (22). During the six months, the patients have had possibilities to receive repeated information that may result in change in knowledge.

The high drop-out is an obvious weakness in this study since the representativeness in a study my be depending on the response. In this study, only 23% of the sampling frame answered with complete data on both questionnaires. The first questionnaire was sent to the patients by the staff at the different departments in Periodontology. Due to routines at the departments the distribution could not be controlled. Furthermore chronic periodontitis can be without symptoms in the early stage (16) and it is not certain that the patients were informed that they had the disease before referral. Thus, the patients felt that the questionnaire did not concern them.

Those patients who did not respond may be different in other aspects compared to those who did. Reasons for non-response could be lack of time, lack of interest, education (9) or behavioural and socio demographic factors (23). In a study (28) higher education was a predictor for answering. Our data about the drop-out only includes information about age and gender where no differences were observed. As a lot of factors influence the response rate, and the fact that only 23% answered with complete data, indicates that the results in this study must be interpreted with caution.
In summing up this study showed that correct

answers to the knowledge questions improved after visiting a specialist clinic of Periodontology. The patients rated their self- perceived oral health as rather good although many reported some troubles from the mouth.

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