Prevalence of dental and occlusal anomalies in Swedish conscripts

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The number of teeth, the frequency of dentitional, space and occlusal anomalies and the need of orthodontic treatment was studied in 301 Swedish men from the west and south of Sweden with a mean age of 18 years 8 months. Dentitional anomalies (abnormal number and morphology of the teeth and positional anomalies of front teeth) as well as crowding, spacing of the teeth and occlusal anomalies were noted. The objective need of treatment was judged according to a 5-grade scale. The number of missing teeth (exclusive of third molars) was, on the average, 0.8 per individual. Dentitional anomalies were recorded in about 35 % of the individuals and space anomalies in 52 %, while the frequency of occlusal anomalies was about 65 %. About 60 % of the individuals were judged as beeing in need of some form of orthodontic treatment. The need of treatment was small in about 30 %, while about 20 % had a more substantial need and almost 10 % severe need.

Key-words: Tooth; dentition; malocclusion

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In recent years a number of investigations have been published on the frequency of malocclusion in Scandinavian child-populations (*Rølling*, 1966; *Helm*, 1968, 1970; *Björk & Helm*, 1969; *Myllärniemi*, 1970; *Ingervall, Seeman & Thilander*, 1972; *Thilander & Myrberg*, 1973). Only one extensive investigation of malocclusion in adults has been performed in Scandinavia (*Seipel*, 1946), which means that our knowledge of the frequency of malocclusion in adults is less complete as that in children. It was therefore decided to asses the frequency of malocclusion in young men.

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MATERIAL AND METHODS

The investigation was carried out on 301 recruits from the west and south of Sweden. The ages of these men ranged from 17 years 8 months to 20 years 9 months (mean 18 years 8 months). 82 % of the men were between 18 and 20 years of age. The men were examined when they were mustered for military service and constituted a random sample of a large contingent. The school education they had received is given in Table I.

The majority of the men were able to give information about earlier dental treatment: number of visits to dentist

Table I. *Percentage distribution of men (n=301) among different forms of school education*

Type of school	Frequency
Elementary school (7—12 years)	4.3
Comprehensive school (7—15 years)	10.7
Grammar school, lower stage (students aged 11—15), Folk high school	2.0
Vocational school	23.1
Grammar school, upper stage, 2-year course	15.4
Grammar school, upper stage, 3-year course	44.4

(periods of treatment) after they had left school dental service, the time of last period of treatment and whether they had received orthodontic treatment. These informations were obtained from a questionnaire sent to 287 of the participants after the examination.

Reports by 260 of the men showed that 26 % had not visited a dentist since they had left school dental service, that 27 % had visited a dentist once, 25 % twice, and a decreasing frequency had visited a dentist up to 10 times. Of 276 men, 20 % had visited a dentist in the year in which the present investigation was carried out, 50 % the year before, and 13 % 2 years and 13 % 3 years before the present study.

Almost 16 % of 278 men reported that they had received orthodontic treatment with appliances and 22 % that they had had a permanent tooth extracted because of crowding.

At the examination alginate impressions and wax records were obtained for preparation of dental casts. Malocclusion was recorded from the stone casts. The recording was made according to the definitions given by *Björk, Krebs & Solow* (1964). The following modifications of the methods described by these authors were made: radiographic examination of the dentition was not performed, registration was done also in subjects with extractions and previous orthodontic treatment, overjet and overbite were measured according to *Lundström* (1948), the type of occlusion according to Angle was recorded. The registration instrument devised by *Björk et al.* (1964) was not used. Measurements were instead made with a steel ruler, sliding calipers and a special measuring instrument used for judging the degree of rotation and tipping.

Notes were made of the following items:

Teeth and dentitional anomalies

A. Number of existing permanent teeth, excluding third molars.
B. Number of erupted third molars. A tooth was recorded as erupted as soon as any part of the crown had broken through the gingiva.
C. Teeth missing (excluding third molars).
D. Supernumerary teeth.
E. Malformed teeth (teeth of abnormal shape or size).
F. Persistent deciduous teeth.
G. Rotated front teeth (upper and lower canines and incisors). The recording was made if the malposition was more than 15°.
H. Tipped front teeth. Notes were made of teeth tipped more than 15° mesially or distally.
I. Inversion of incisors. Notes were made of any upper incisors that occluded lingually to the incisal edges of the lower front teeth.

Space anomalies

J. Crowding and spacing in the upper and lower incisor and canine-premolar

segments. The relative space of the segment (difference between space available and space required by the teeth) was measured with a caliper and crowding or spacing was noted if the difference was at least 2 mm.

K. A maxillary medial diastema was recorded if the diastema was at least 2 mm.

Occlusal anomalies

The intermaxillary relation was recorded with the mandible in intercuspal position and comprised:

L. Overjet and overbite measured according to *Lundström* (1948) at the central incisor in the most extreme position. If the positive overjet was 6 but less than 9 mm, it was recorded as »extreme maxillary overjet» grade 1; if it was 9 mm or more, as grade 2. A negative overjet of 0 but less than 2 mm was recorded as »mandibular overjet» grade 1, and 2 mm or more as grade 2. A deep bite grade 1 was recorded if the positive overjet was 5 but less than 7 mm and grade 2 if it was 7 mm or more. Frontal open bite grade 1 was recorded if the overjet was 0 but less than minus 2 mm, grade 2 if it was minus 2 mm or more.

M (a) Molar occlusion was inspected at the first molars on both sides and classified as: distal or mesial molar occlusion grade 1 (½ but less than 1 cuspwidth), and distal or mesial molar occlusion grade 2 (1 cuspwidth or more).

M (b) On the basis of the intermaxillary relation at the incisors and molars the type of occlusion was judged according to Angle, with due consideration to the effect of tooth migration, if any.

N. An open bite in the molar and the canine-premolar segments on either side was recorded if one or more teeth in the segment was not in contact with it's antagonist.

O. Crossbite or scissorsbite was recorded in the molar and the canine-premolar segments on either side if one or more teeth in the segment was not normal. The occlusion was classified as crossbite if the buccal cusps of the upper teeth occluded lingually to the buccal cusps of the lower teeth and as scissorsbite if the lingual cusps of the upper teeth occluded buccally to the buccal cusps of the lower teeth. Such recordings were made only if the cusps passed one another.

P. Midline displacement in the lower jaw was noted if the displacement in relation to the midline of the upper jaw was at least 2 mm.

Need of treatment

Q. The objective need of treatment, *i.e.* as judged by the examiner, was recorded according to the following 5-grade scale issued by *Socialstyrelsen* (1966):

Grade 4 (very urgent need). Cosmetic and/or functionally handicapping anomalies, *e.g.* cleft lip and palate, extreme post- and prenormal occlusion, retained upper incisors, extensive aplasia.

Grade 3 *E.g.* prenormal forced bite, deep bite with gingival irriation, extremely open bite, crossbite causing transverse forced bite, scissorsbite interfering with articulation, severe frontal crowding or spacing, retained canines, cosmetically and/or functionally disturbing rotations.

Grade 2 *E.g.* cosmetically and/or functionally disturbing proclined or retroclined incisors, deep bite with gingival contact but without gingival irritation, severe crowding or spacing, infraocclusion of deciduous molars and permanent teeth, moderate frontal rotations.

Grade 1 (little need). Minor deviations from so-called normal (ideal) occlusion, *e.g.* prenormal occlusion with small negative overjet, postnormal occlusion without other anomalies, deep bite without gingival contact, open bite with little frontal opening, crossbite without transverse forced bite, less marked crowding and spacing, inversion of single teeth without forced bite, mild rotations of only little cosmetic and/or functional significance.

Grade 0 No need of treatment.

Error of the method

The error of the method for recording malocclusion with the technique used has been studied previously by *Solow & Helm* (1968) and *Helm* (1970). Therefore, in this investigation only the error of the method of classification of the need of treatment was studied. For this purpose double determinations were made of the need of treatment (recording Q) in 30 randomly selected cases. The two determinations were concordant in 80 % of the cases and in the remaining 20 % the difference was only 1 grade of the scale.

Differences between frequencies were tested with χ^2-test.

RESULTS

Teeth and dentitional anomalies

The number of permanent teeth (excluding third molars) was, on the average, 27.2 (range 20—28) and the mean number of erupted third molars 0.9 (range 0—4). The distribution of the men according to number of teeth is given in Tables II and III.

Table II. *Number of teeth (excluding third molars) in the 301 men examined*

Number of teeth	Number of individuals	Frequency
20	1	0,3
21	1	0.3
22	0	0.0
23	1	0.3
24	23	7.6
25	11	3.7
26	31	10.3
27	46	15.3
28	187	62.1

The numbers of missing teeth are given in Table IV. No difference was found in this respect between the left and the right side. The figures found on either side were therefore pooled.

None of the men were found to have supernumerary teeth and only 9 had malformed teeth. Of the 10 malformed teeth, 4 were upper second molars, 4 upper laterals, 1 a lower premolar and 1 a lower central. A persistent deciduous tooth, an upper canine, was found in each of 2 individuals.

The frequency of men with rotated, tipped and inverted teeth is given in

Table III. *Frequency distribution of men (n=310) among different numbers of erupted third molars*

Teeth	Number of third molars				
	0	1	2	3	4
18, 28	71.8	11.0	17.3		
38, 48	74.1	9.6	16.3		
18, 28, 38, 48	63.1	10.3	11.6	5.6	9.3

Table IV. *Number of missing teeth in the 301 men examined*

Teeth	Number	Teeth	Number
17, 27	6	37, 47	4
16, 26	17	36, 46	29
15, 25	34	35, 45	46
14, 24	65	34, 44	36
13, 23	3	33, 43	0
12, 22	10	32, 42	2
11, 21	1	31, 41	0
Total	136		117

Table VI. *Number of rotated, tipped and inverted teeth in the 301 men examined*

Teeth	Rotation	Tipping	Inversion
13, 23	22	12	—
12, 22	28	8	14
11, 21	16	3	6
Total	66	23	20
33, 43	47	9	
32, 42	12	4	
31, 41	5	2	
Total	64	15	

Table V and the number of malposed teeth in Table VI.

It is clear from Table V that almost 29 % of the men had rotated teeth in one or both jaws, that the corresponding figure for tipping was 9 %, and that inversion of 1—3 upper incisors was found in about 4 %.

Rotated teeth were equally common in the upper and lower jaws (Table VI). In the lower jaw it was mostly the canines that were rotated, while in the upper jaw the rotated teeth were more evenly distributed. In both jaws it was the canines that were most often tipped, while inversion had involved the laterals twice as often as the centrals.

Table V. *Percentages of men (n=301) with rotated, tipped and inverted teeth*

	Number of teeth				
	0	1	2	3	4
Rotated front teeth					
Upper teeth	83.7	11.3	4.3	0.7	
Lower teeth	83.3	12.3	4.0	0.3	
Upper and/or lower teeth	71.4	17.9	7.6	2.0	1.0
Tipped front teeth					
Upper teeth	94.4	3.7	1.9		
Lower teeth	95.7	3.7	0.7		
Upper and/or lower teeth	91.0	6.0	2.3	0.7	
Inverted upper incisors*	95.7	2.7	1.0	0.7	

* = individuals with all four upper incisors inverted were recorded under the heading of »mandibular overjet».

Space anomalies

The frequencies of crowding and spacing are given in Tables VII and VIII.

The frequency of individuals with crowding in one or more segments was almost 30 % and with spacing about 25 %.

Table VII. *Percentages of men (n=301) with crowding and spacing in different segments*

	Number of segments						
	0	1	2	3	4	5	6
Crowding							
Upper jaw	87.0	11.3	1.7				
Lower jaw	78.4	17.3	3.0	1.3			
Upper and/or lower jaw	70.4	21.3	5.6	1.3	1.3		
Spacing							
Upper jaw	84.4	11.0	3.3	1.3			
Lower jaw	84.4	9.6	5.6	0.3			
Upper and/or lower jaw	74.4	14.3	7.3	2.3	1.0	0.3	0.3

Table VIII. *Number of segments with crowding and spacing in the 301 men examined*

Segment	Crowding	Spacing
Upper jaw		
right	7	22
incisor	28	23
left	9	20
Total	44	65
Lower jaw		
right	24	28
incisor	34	8
left	24	30
Total	82	66

Both crowding and spacing occurred most often in only one segment, but spacing tended to be more generalized than crowding. Crowding was more common in the lower jaw than in the upper, while spacing was equally frequent in both jaws.

Crowding in the upper jaw was much more common in the incisor segment than in the lateral segments ($P < 0.001$) while in the lower jaw the distribution between the segments was more even (Table VIII). As for spacing the distribution between the segments was even in the upper jaw while in the lower jaw it was most common in the lateral segments ($0.001 < P < 0.01$).

Maxillary medial diastema was noted in only 3 of the men.

Table IX. *Frequency of occlusal anomalies in the region of the incisors in the 301 men examined*

	Grade 1	Grade 2
Extreme maxillary overjet	10.3	0.7
Mandibular overjet	2.0	0.3
Frontal open bite	3.0	0.7
Deep bite	9.3	0.7

Occlusal anomalies

The frequency of various types of occlusal anomalies in the region of the incisors is given in Table IX.

Overjet and overbite were equally common (Table IX). Deviations from normal values were found mainly in the form of extreme maxillary overjet and deep bite. The anomalies were, as a rule, less pronounced, only few of the men having a grade 2 anomaly.

The frequencies of men with uni- or bilateral anomalies in molar occlusion are given in tables X and XI, respectively.

Unilateral distal molar occlusion was

Table X. *Percentages of men (n=301) with unilateral distal or mesial molar occlusion*

	Grade 1	Grade 2
Distal molar occlusion		
right	8.0	4.0
left	5.6	3.0
Total	13.6	7.0
Mesial molar occlusion		
right	3.0	1.0
left	1.7	0.7
Total	4.7	1.7

Table XI. *Percentages of men (n=301) with bilateral distal or mesial molar occlusion*

Side and grade	Distal molar occlusion	Mesial molar occlusion
Right 1, left 1	2.7	2.3
Right 2, left 2	6.3	2.0
Right 1, left 2	2.0	0.7
Right 2, left 1	2.3	0.7
Total	13.3	5.7

Table XII. *Number of anomalies in molar occlusion in the 301 men examined*

	Grade 1	Grade 2
Distal molar occlusion		
right	38	38
left	32	34
Total	70	72
Mesial molar occlusion		
right	18	11
left	14	10
Total	32	21

recorded in almost 21 % of the men and bilateral distal molar occlusion in about 13 %. The frequencies of uni- or bilateral mesial molar occlusion were each about 6 %.

Anomalies of the molar occlusion were roughly equally common on the right side as on the left.

The distal molar occlusion was equally often grade 1 as grade 2 while the frequency of mesial molar occlusion grade 1 was somewhat higher than that of grade 2 (Table XII).

Grouped according to Angle's classification, almost 83 % were class I, about 12 % class II, div. 1 and 1 % class II, div. 2 and 4 % class III.

The frequencies of crossbite, scissorsbite and open bite (frontal and lateral) are given in Table XIII.

Crossbite was noted in about 19 %, scissorsbite in 8 % and open bite in almost 24 %. The distribution of these malocclusions among the various segments are given in Table XIV.

Scissorsbite and open bite were more common in the canine-premolar segments than in the molar segments ($0.001<P<0.01$ and $P<0.001$, respectively) while crossbite was equally common in the

Table XIII. *Frequency of crossbite, scissorsbite, and open bite in various number of segments in the 301 men examined*

Anomaly	Number of segments 0	1	2	3	4	5
Crossbite	81.4	8.0	7.3	0.7	2.6	
Scissorsbite	92.0	7.0	1.0			
Open bite	76.1	12.9	6.6	2.6	1.3	0.3

molar segments as in the canine-premolar segments. The frequencies of the above mentioned malocclusions did not differ with side.

Midline displacement in the lower jaw was found in about 24 % of the men. In 38 % of these the displacement was to the right and in the remaining 62 % to the left. The difference in frequency between displacement to the right and to the left was probably significant ($0.01<P<0.05$).

Frequencies of the various main groups of anomalies

The anomalies fall into three main groups, *viz.* dentitional anomalies (malformed teeth, persistent decidous teeth, rotated and tipped teeth and inverted incisors), space anomalies and occlusal anomalies.

Table XIV. *Number of lateral segments with crossbite, scissorsbite, and open bite in the 301 men examined*

Segment	Crossbite	Scissors-bite	Open bite
Right molar	27	3	11
Right canine-premolar	32	10	47
Left canine-premolar	25	11	43
Left molar	22	3	14
Total	106	27	115

Table XV. *Frequency of different degrees of need of treatment recorded with a 5-grade scale (4 = severe need, 0 = no need) in the 301 men examined*

Grade	Number	Frequency
4	2	0.7
3	27	9.0
2	58	19.3
1	87	28.9
0	127	42.2

One or more dentitional anomalies were found in about 35 % of the men, space anomalies in 52 % and occlusal anomalies in almost 65 %.

Need of treatment

The need of orthodontic treatment is given in Table XV.

About 60 % were considered to need orthodontic treatment. In almost 30 % the need was mild (grade 1), it was substantial in about 30 % (grades 2, 3 and 4) and severe (grades 3 and 4) in 10 %.

DISCUSSION

For practical reasons the present investigation was carried out on men because a large group of men, representing an unselected sample of the population can be readily obtained among men being mustered for military service. To collect a corresponding group of women would have been difficult. The use of men alone cannot be regarded as any substantial disadvantage because differences with sex have only been demonstrated for a minor number of types of anomalies (*Helm*, 1968; *Ingervall et al.*, 1972; *Thilander & Myrberg*, 1973).

The use of such army recruits also means that the range of variation of their ages was very small. At the ages in question the permanent dentition, with the exception of the third molars, is complete and, as a rule, not affected by changes due to loss of teeth. The material has been shown to be representative of the male population of the ages in question regarding physical variables (*Lewin*, 1973) and regarding school education on comparison with available statistical data (Statistical reports, 1973).

The number of missing teeth, exclusive of third molars, was only 3 % of the total possible number of teeth. The number of missing teeth includes teeth missing because of hypodontia, extraction for orthodontic reasons and trauma. The majority of the front teeth and premolars have probably been lost for one or other of the above three reasons, while the majority of the missing molars had probably been extracted because of pathologic changes. Only about 2 % of the first and second molars were missing. This shows that even if it be assumed that all missing molars had been extracted because of pathological changes, the conservative treatment had effectively helped to save the permanent teeth. On comparison with earlier investigations of army recruits it was found that the number of missing teeth per man had fallen, on the average, from 2 per individual in 1942 (*Westin & Wold*, 1943) and 1.2 per individual in 1958 (*Andersson*, 1961) to 0.8 in the present investigation.

In the registration of anomalies it was decided to use the method described by *Björk et al.* (1964). This permits comparison with recent investigations on Danish and Swedish children where the same or similar methods have been used (*Helm*, 1968, 1970; *Ingervall et al.*, 1972; *Thilander & Myrberg*, 1973). The frequencies of the different types of anomalies largely agreed

with these investigations in children but some differences were observed. These differences may for some characters be explained by age changes in frequency of malocclusion but may in other cases be due to the fact that in many of the men teeth had been extracted for orthodontic reasons or orthodontic treatment had been given.

A possible example of the effect of previous treatment was the low frequency of crowding compared to some of the series of children (*Helm*, 1968) but the much higher frequency of spacing than in the investigations of *Helm* (1968) and *Thilander & Myrberg* (1973). The distribution of crowding, however, agreed with earlier results (*Seipel*, 1946; *Helm*, 1968) with crowding more common in the lower jaw than in the upper jaw. In the above-mentioned investigations spacing was found to be more common in the upper jaw than in the lower, while in the present investigation it was found to be equally common in both jaws. The distribution of crowding and spacing in the incisor and lateral segments, however, showed the same pattern in the present investigation as in the Danish children in the dental stage DS 4 (*Helm*, 1970).

The frequency of occlusal anomalies in the region of the incisors was roughly the same as that found in children (*Ingervall et al.*, 1972; *Thilander & Myrberg*, 1973) except regarding the anomaly »extreme maxillary overjet», which was less common in the 18-year old men than in 10-year old boys (*Ingervall et al.*, 1972). Such a reduction of this anomaly was expected because the growth of the mandible during the latter part of the growth period is relatively larger than that of the maxilla, which becomes apparent, among other things, as an average reduction in overjet and overbite (*Björk*, 1953) and as a change in the frequency of postnormal and prenormal occlusion (*Helm*, 1970). In accordance with this situation, the frequency of distal molar occlusion was somewhat lower and mesial molar occlusion somewhat higher than in boys in dental stage DS 4 (*Helm*, 1968). On comparison with 10-year old children (*Ingervall et al.*, 1972) the frequency of Angle class II malocclusion was lower, but that of Angle class III malocclusion was higher.

The frequency of lateral open bite was much higher than in children (*Helm*, 1968; *Ingervall et al.*, 1972; *Thilander & Myrberg*, 1973). The difference in the frequency of lateral open bite between children and that in the present series of adult was so large that the frequency in adult deserves investigation also in other adult series. The diagnosis lateral open bite includes cases where the upper canines did not make contact with their antagonists. *Seipel* (1946) found this to be the case in about 6 % of canines in 21-year old men which is in line with the high frequency of lateral open bite in the present investigation.

The frequency of the main groups of anomalies in Danish boys has been reported by *Helm* (1968). As for dentitional anomalies and space anomalies, the frequencies were of the same size in this study and the above mentioned Danish investigation. The frequency of occlusal anomalies, on the other hand, was higher in the present material than in the Danish series (65 % and 53 %, respectively).

The high frequencies of anomalies are reflected in the larger need of treatment (about 60 % of the individuals were judged as requiring some sort of orthodontic treatment). Though not quite comparable the need of treatment may be taken as a rough estimate of the total frequency of

anomalies. The need of treatment in the present material was lower than the 75 % found in 10-year old children (*Ingervall et al.*, 1972) which may be explained by the fact that about 16 % of the individuals had received orthodontic treatment and about 20 % reported that teeth had been extracted because of crowding. For comparison it may be mentioned that *Helm* (1968) and *Thilander & Myrberg* (1973) in their series of children found the total frequency of anomalies to be 78 % and 74 %, respectively.

Compared with earlier classifications according to the need of treatment of children (*Ingervall et al.*, 1972; *Myrberg & Thilander*, 1973), the frequency of the need of treatment grades 2, 3 and 4 in the present investigation was lower, but that of grade 1 was roughly the same as in children. The treatment given therefore had reduced the number of individuals with a severe need of treatment, while the frequency with mild need was unchanged. Such a change in the need of treatment was expected because of the priority which must be given because of insufficient resourses for orthodontic treatment by the public orthodontic services.

The investigation showed that after the individuals had reached the age of 18, *i.e.* an age at which they no longer receive free school and youth dental service including orthodontic treatment, about 30 % of the individuals were still in substantial need of orthodontic treatment. Whether this persisting need of treatment is associated with an equally extensive desire of treatment will be elucidated in a further study of the awareness of the individuals of their anomalies and of their desire of orthodontic treatment.

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REFERENCES

Andersson, T. 1961. Undersökning av kariesutbredningen hos 18-åriga män i Malmöhus södra inskrivningsområde år 1958. Odont. Revy 12, 45

Björk, A. 1953. Variability and age changes in overjet and overbite. Amer. J. Orthodont. 39, 779

Björk, A., Krebs, Aa. & Solow, B. 1964. A method for epidemiological registration of malocclusion. Acta Odont. Scand. 22, 27

Björk, A. & Helm, S. 1969. Need for orthodontic treatment as reflected in the prevalence of malocclusion in various ethnic groups. Acta Socio-med. Scand. Suppl. 1, 209

Helm, S. 1968. Malocclusion in Danish children with adolescent dentition; an epidemiologic study. Amer. J. Orthodont. 54, 352

Helm, S. 1970. Prevalence of malocclusion in relation to development of the dentition. Acta Odont. Scand. 28, suppl. 58

Ingervall, B., Seeman, L. & Thilander, B. 1972. Frequency of malocclusion and need of orthodontic treatment in 10-year old children in Gothenburg. Svensk Tandläk.-T. 65, 7

Lewin, T. 1973. Body build of young adult males. Report FMI-73-1, Institute of Aviation Medicine, Malmslätt, Sweden

Lundström, A. 1948. Tooth size and occlusion in twins. S. Karger, Basel, p. 62

Myllärniemi, S. 1970. Malocclusion in Finnish rural children. Suom. Hammaslääk. Toim. 66, suppl.

Myrberg, N. & Thilander, B. 1973. Orthodontic need of treatment of Swedish schoolchildren from objective and subjective aspects. Scand. J. Dent. Res. 81, 8

Rølling, S. 1966. Registrering av okklusionsforhold. Akademisk Forlag, København

Seipel, C. M. 1946. Variation of tooth position. Svensk Tandläk.-T. 39, suppl.

Socialstyrelsen 1966. Kungl. Medicinalstyrelsens cirkulär den 21 februari 1966 angående anvisningar för journalföringen inom folktandvårdens tandregleringsvård. Stockholm

Solow, B. & Helm, S. 1968. A method for tabulation and statistical evaluation of epidemiological malocclusion data. Acta Odont. Scand. 26, 63

Statistical reports 1973. Statistiska meddelanden Nr Be 1973:13. National Bureau of Statistics, Stockholm

Thilander, B. & Myrberg, N. 1973. The prevalence of malocclusion in Swedish schoolchildren. Scand. J. Dent. Res. 81, 12

Westin, G. & Wold, H. 1943. 1942 års tandmönstring av inskrivningsskyldiga. Odont. Tskr. 51, 487