

Determinants of utilization of dental services among 20- to 34-year-old Danes

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Our aim was to identify determinants of utilization of dental services among 20- to 34-year-old Danes as outlined in a conceptual framework. Our sample consisted of a sample of 464 individuals who had been interviewed by 10 experienced interviewers from The Danish National Institute of Social Research. Our questionnaire comprised a battery of questions based on our conceptual model. The analysis was done in a hierarchical manner using a framework with three steps: *Predisposing factors* → *Enabling factors* → *Need factors* → Utilization. Associations were evaluated with multivariate logistic regression analysis and expressed as odds ratios. The following factors were significantly associated with *irregular use* of dental services: age, sex, exercise habits, cost of dental treatment, dental anxiety, and perceived condition of teeth. Our findings suggest that a strategy aiming to increase young people's dental attendance should focus on the transition period—that is, when the youngsters leave the public dental health care system and have to make use of the private system. The strategy should also take into account that young men are more likely to become non-users. A concerted effort could be dedicated to the non-negligible group of individuals with dental anxiety and dental phobia. □ *Dental health services; health services research; utilization*

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In Denmark oral health services are provided by a blend of public systems, which are free of charge for children and adolescents, and private systems for adults, with financial support from public and/or private insurance schemes (1). Dental service utilization can be conceptualized in several ways (1), but common measures are annual number of dental visits per person or proportion of persons visiting a dentist within a year, even though these measures do not take into account the quantity or quality of services provided (2).

Nearly all children and adolescents in Denmark make regular use of the public dental service (3). To encourage regular dental visit habits among adolescents when the services offered by the public dental system come to an end, a financial incentive was introduced in 1965 (4). Adolescents who started and continued to visit a private dental practitioner twice a year were rewarded with a larger subsidy from the county than the irregular users. In 1965 this arrangement covered 75% of the costs of basic dental treatments, but since then this arrangement has gradually been eroded, and in 1988 it was terminated. Today, all adult dental patients in Denmark receive the same public subsidy that covers approximately 25% of basic preventive and curative dental services offered by private practitioners. Since it became apparent that the percentage of regular users among adolescents and young persons has steadily and proportionally decreased (5), from 85%–90% to approximately 70%, concern was expressed by the two parties involved, namely The Public Health Insurance and The Danish Dental Association. Both have

always pointed out that an important objective of the tax-funded third-party payment is to encourage people to attend a dentist regularly. The underlying assumption is that use of professional dental services has a positive impact on oral health. This initiated a contact from the two parties asking us to conduct a study on the use of dental services among younger people.

The role of the social environment, the individual, and the delivery system in the use of dental services among Danish youths has been examined in a 10-year follow-up study (6). The most important predictors identified were sex, family type, educational status, pain inflicted, perceived economics barriers, and attitudes toward providers of oral health care. These findings are thus concurrent with the findings in qualitative studies among Danish youths in which the most important factors were identified at the individual, social, and economic level (7, 8). Most models on utilization of dental services have been constructed empirically to explain patterns and mechanisms in the utilization. However, research seeking to identify determinants associated with particular outcomes should preferably be founded in a theoretical framework (9). We decided to base our study on the concepts and framework developed by Andersen & Newman (10) and Aday & Andersen (11). Their contributions have later been used by Petersen (12) to suggest a model of utilization of dental services. This model highlights societal, environmental, structural, and psychological factors as potential determinants for utilization of services (Fig. 1).

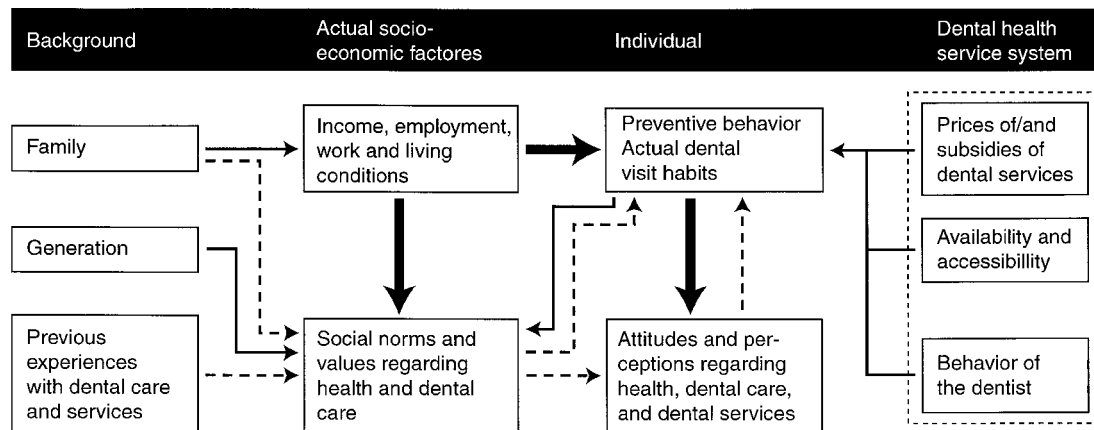


Fig. 1. The conceptual model on which the study was based.

Our study aims were to characterize 20- to 34-year-old Danes who were irregular users of dental services and to identify determinants of utilization of dental services in this age group as outlined in the conceptual framework. The findings should subsequently facilitate the implementation of initiatives purporting to encourage irregular users to become more regular users of dental services.

Subjects and methods

We selected a stratified sample of young adults from Aarhus (300,000 inhabitants) in collaboration with a statistician from The Danish National Institute of Social Research. We chose Aarhus because the official statistics indicated that it has a high percentage of irregular users and demographically a varied population. We considered a doubled risk (odds ratio = 2) of being *irregular user* worth detecting. With an α level of 0.05, a power of $1 - \beta$ of 90%, and a minimum of 10% of exposure among controls in a two-by-two table analysis, we would then need a total sample of 800 individuals.

The aim of the selection procedure was to construct two samples, each consisting of 400 persons born between January 1962 and December 1976. One of the samples was to represent registered users of the dental system in the period July 1995 through January 1997. The other sample had to represent persons not registered as users in this time interval. From the county of Aarhus we obtained the personal ID codes for all persons who had received a regular dental examination between 1 July 1995 and 31 January 1997. This list is referred to as the Regular Attendance List. The statistics from the county indicated a regular examination rate of 60% in the target group. Thus it was calculated that a base population consisting of all inhabitants in the municipality of Aarhus born on 89 evenly distributed dates in the interval from January 1962 to December 1976 would be sufficient material to construct the desired sample.

From the Danish civilian register, ID codes, addresses,

and telephone numbers were obtained for all persons living in the municipality of Aarhus and born on one of the 89 selected dates. The ID code for each person was compared with the codes in the Regular Attendance List, and on the basis of whether the code was found, the person was put in the Attendance List or in the Non-Attendance List. After this filtering, 400 persons were randomly selected from each list. The 800 persons were distributed evenly on the basis of address among 10 experienced interviewers from The Danish National Institute of Social Research. The interviewers tried to contact and interview each individual primarily by phone and, when that was impossible, by visit at the address. Of the 800 persons, interviews were obtained with 680 (85%)—643 by phone and 37 by visit.

An outline of how our study population originated is given in Fig. 2. However, while running the preliminary frequency distributions we observed a discrepancy between the official statistics in the county's health insurance register and the answers given by the participants about their use of dental services. It turned out that the county statistics, which are based on the dentists' invoices used for third-party payment, do not take into account that persons living in one county may seek dental service in other counties. Such a dental visit habit pattern is common in Aarhus, where many young persons pursue their pregraduate studies and many still keep close links with their native home. This had not been recognized by the parties involved and had erroneously given rise to some concern with regard to the dental visit habits in Aarhus and Copenhagen. These, the two largest cities in Denmark, both have a large fraction of persons undergoing training or education. As our objective was to sample *users* and *non-users* of the dental system, we decided to cross-link the information from the county about dental visits and the answers given by the participants about their dental visit habits. Thus only individuals from the Regular Attendance List who confirmed that they had visited a dentist within the last 1.5 years were categorized as *regular users* (332 of 354). Similarly, only individuals from the Non-Attendance

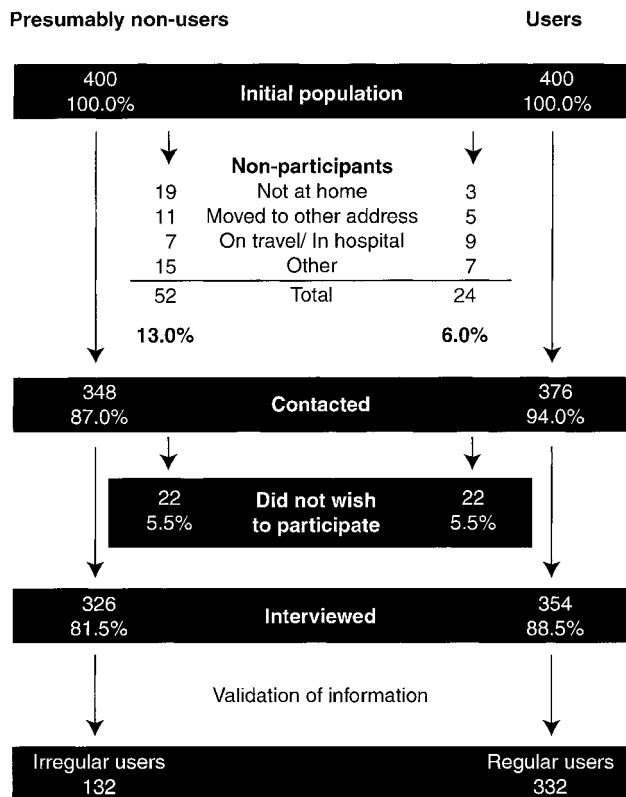


Fig. 2. Flow chart illustrating the sampling of the study population.

List who confirmed that they had not visited a dentist within the last 1.5 years were categorized as *irregular users* (132 of 326) (Fig. 2). The distribution of our study population on the basis of dental visit habits and sex is shown in Table 1.

We pre-tested a preliminary questionnaire in a convenience sample of 40 persons of the same age as our study population. On the basis of our experiences we made a structured questionnaire in collaboration with The Danish National Institute of Social Research (DNISR). Our questionnaire was then tested among the 10 experienced interviewers from DNISR and subsequently slightly revised. It comprised a battery of questions based on our conceptual model (Fig. 1). Categorization of social and demographic information and health-related issues was done as in the national surveys made by The Danish Institute of Clinical Epidemiology (13, 14). The questions

Table 1. Distribution of study participants according to utilization of dental services and sex

Sex	Irregular users n (%)	Regular users n (%)	Total n (%)
Men	82 (33.7)	161 (66.3)	243 (100.0)
Women	50 (22.6)	171 (77.4)	221 (100.0)
Total	132	332	464

about utilization of dental services were detailed, which enabled us to check the consistency of the answers given by the participants. Information about the participants' satisfaction with their dental care was obtained with a revised version of the Dental Visit Satisfaction Scale (DVSS) (15). The DVSS had been tested and translated into Danish. This scale contains cognitive, affective, and behavioral dimensions of patient satisfaction with three items in each dimension. Each of the nine questions contains five positive statements about the dentist ranging from *disagree* to *agree*. The summation score, from 9 to 45, gives an estimate of the person's satisfaction with their dental care. A person with a score of 9 is categorized as a very unsatisfied person, and a person with a score of 45 as a very satisfied person. We used Corah's Dental Anxiety Scale (CDAS) to measure dental fear and anxiety (16). This scale contains four questions and can have a score from 4 (no fear) to 20 (dental phobia). Categorization into four groups was done as recommended by Moore et al. (17).

Table 2. Predisposing factors: risk of being an *irregular user* of dental services expressed as crude odds ratios (OR) and adjusted odds ratios with 95% confidence intervals (CI), using multiple logistic regression analysis (n = 464)

Factor	Type of user*: irregular/regular	Crude OR	Adjusted OR (95% CI)
Age			
30–35 years	34/125		
25–29 years	48/114	1.5	1.6 (0.9;2.8)
20–24 years	50/93	2.0	2.1 (1.2;3.7)
Sex			
Women	50/171		
Men	82/161	1.7	1.8 (1.2;2.9)
Predisposing			
Schooling			
A-level	68/210		
≤10 years	59/117	1.6	1.2 (0.8;1.9)
Education			
Completed	91/282		
None or ongoing	40/49	2.5	2.0 (1.1;3.3)
Alcohol intake			
Below or as recommended	115/276		
More than recommended	15/55	0.7	0.8 (0.4;1.6)
Preventive behavior			
Yes	84/254		
No	48/78	1.9	1.5 (0.9;2.4)
Exercise			
Competitive or fitness level	30/125		
No or little exercise	102/207	2.1	1.8 (1.1;3.1)
Smoker			
No	69/226		
Yes	63/105	2.0	1.6 (1.0;2.5)
Social network:			
often alone			
No	103/252		
Yes	29/80	0.9	0.8 (0.4;1.3)

* Information from some participants missing.
Hosmer–Lemeshow statistic: chi-square = 4.02; 8 df; P = 0.85.

Table 3. Enabling/disabling factors: risk of being an *irregular user* of dental services expressed as crude odds ratios (OR) and adjusted odds ratios with 95% confidence intervals (CI), using multiple logistic regression analysis ($n = 464$)

Factors	Type of user*: irregular/regular	Crude OR	Adjusted OR (95% CI)
Age			
30–35 years	34/125		
25–29 years	48/114	1.5	1.5 (0.8;3.0)
20–24 years	50/93	2.0	2.0 (0.9;4.3)
Sex			
Women	50/171		
Men	82/161	1.7	2.8 (1.5;5.2)
Enabling/disabling factors			
Yearly income (DKK)			
≥250,000	34/123		
200,000–249,999	27/60	1.6	1.1 (0.5;2.6)
150,000–199,999	32/44	2.6	1.7 (0.7;3.9)
100,000–149,999	19/73	0.9	0.4 (0.1;1.0)
<100,000	19/39	2.3	1.7 (0.6;4.8)
Costs of importance			
No	48/274		
Yes	83/58	8.2	7.3 (4.0;13.2)
Private dental insurance			
Yes	29/113		
No	103/219	1.8	1.0 (0.5;1.9)
Problems visiting between 0800 and 1700 h			
No	84/239		
Yes	48/91	1.5	1.3 (0.7;2.3)
Time to get to dental office			
≤30 min	87/310		
>30 min	13/22	2.1	1.9 (0.8;4.8)
Unpleasant dental experiences			
No	83/216		
Yes	49/116	1.1	0.7 (0.4;1.3)
Corah's Dental Anxiety Scale			
4–7	51/200		
8–11	38/86	1.7	2.3 (1.2;4.5)
12–20	36/37	3.8	5.3 (2.5;11.1)
Patient satisfaction (DVSS)			
Yes (score >30)	117/328		
No (score ≤30)	15/4	10.5	2.2 (0.4,11.6)

* Information from some participants missing.

Hosmer–Lemeshow statistic: chi-square = 2.16, 7 df; $P = 0.95$.

Data processing and statistical analysis

Data were keyed in twice in ASCII format and imported to STATA (18). After having corrected data entry mistakes by running the validation program in EPIINFO (19), we corrected the data file for logical errors. Statistical analyses were made using STATA.

Associations between the variables in our model and *irregular use* of dental services were expressed as crude odds ratios. As can be seen in Table 2, we sometimes had to collapse categories in a variable when the numbers in the cells were too small. Finally, associations were evaluated by multivariable logistic regression analysis, which enables control of confounding. During model building we looked for the best combination of independent variables in a non-automated manner by selecting variables that were associated with the outcome and specified in our

conceptual model. Variables with a P value ≤ 0.25 were included. Subsequently, the removed variables were re-entered one by one to assess whether they added to the fit of the model; if not, they were omitted. We carried out the analysis in a hierarchical manner, using a framework developed by Anderson & Newman (10) and in dentistry described by Reisine (20). This framework distinguishes between three steps: *Predisposing factors* → *Enabling factors* → *Need factors* → Utilization. Using this analytical framework, we aimed to determine the relative strengths of the variables for *irregular use* of dental health services in three models. Age and sex were included in all three models. The strength of the associations was presented as odds ratios (OR) and confidence intervals (CI). We checked that coding was done correctly by comparing the point estimates with estimates obtained in the original data file. The aim was models with a good fit tested against the full

Table 4. Need factors: risk of being an *irregular user* of dental services expressed as crude odds ratios (OR) and adjusted odds ratios with 95% confidence intervals (CI), using multiple logistic regression analysis ($n = 464$)

Factors	Type of user*: irregular/regular	Crude OR	Adjusted OR (95% CI)
Age			
30–35 years	34/125		
25–29 years	48/114	1.5	1.8 (1.0;3.1)
20–24 years	50/93	2.0	2.6 (1.5;4.6)
Sex			
Women	50/171		
Men	82/161	1.7	1.9 (1.2;2.9)
Need			
Bleeding gums			
≤Once per month	111/309		
>Once per month	21/23	2.5	1.9 (1.0;3.9)
Satisfied with own teeth			
Yes	96/282		
No	36/50	2.1	1.4 (0.8;2.5)
Perceived condition of teeth			
Good or very good	76/287		
Less good or poor	56/44	4.8	4.5 (2.7;7.5)
No. of teeth present			
>25	127/312		
≤25	5/20	0.6	0.5 (0.2;1.4)

* Information from some participants missing.
 Hosmer–Lemeshow statistic chi-square = 2.16; 7 df; $P = 0.95$.

model—that is, the model containing all independent factors. We looked for all interactions that could be interesting from a theoretical point of view. In particular, we were interested in any effect modification due to differences in yearly income and age. We compared the full models with simpler models by using the log likelihood ratio test and by not removing factors when the coefficient changed more than 10%. We also applied fractional polynomial regression on the final models to determine the best-fitting powers of the covariables (18, 21). The variables that were kept in the three models were candidates for inclusion in the final model. The Hosmer–Lemeshow statistic was used to test the fit of the final model (22). This statistic, which approximates a chi-square distribution, uses the differences between expected and observed deciles of risk to test the model as reflected by the P value. However, as this statistic summarizes considerable information by providing a single number, we also used other measures to examine whether the fit was supported over the entire set of covariate patterns. We used the diagnostic statistics and plots of these statistics versus the estimated logistic probability recommended by Lemeshow & Hosmer (21). These plots enable direct visual assessment of the contribution of leverage to the value of the diagnostic statistic and make it possible to uncover covariate patterns, which do not fit. Removal of such covariates could then be considered by fitting a model with these covariate patterns deleted to obtain the actual change in model (21). A two-sided α level = 0.05 was chosen for hypothesis testing, and its complement $1 - \beta$ as the level of confidence.

Ethics

Approval to carry out the study was obtained from the local ethics committee and The Danish Data Protection Agency. The Danish recommendations with regard to study protocol, data documentation, and storage of data were adhered to (23).

Results

Applying fractional polynomial regression on the final models did not suggest that any non-linear transformations was significantly different from the linear models. Nor did we see any significant change in the models when we included all relevant interactions. During our regression diagnostics of the final model we identified five covariate patterns with outlying values. Deletion of the five subjects responsible for this did bring about a significant change in model fit, and we considered removing these subjects from the analysis. However, we restrained from this because irrespective model, the same factors came out as significant, as indicated by the confidence intervals.

In the model comprising *Predisposing factors* we could drop level of schooling, drinking habits, reported preventive behavior, and social network by using the log likelihood ratio test (Table 2). In the reduced model we found significant associations between youngest age group, sex, education, exercise, and smoking habits and *irregular use* of dental services. In the model with *Enabling/disabling factors* we could drop private insurance, problems visiting a dentist during normal working hours, time to get to dental office, previous unpleasant experiences, and patient satisfaction (Table 3). Once again, young age and sex turned out to be significantly associated with dental attendance, together with the cost of dental treatment and dental anxiety. Income was not linearly associated with visiting habits, but we were, as mentioned, unable to identify a better model when using various powers of the variable. We therefore kept income as it was categorized in the model. In the final version of the hierarchical models comprising *Need factors* satisfaction with own teeth and number of teeth were not associated with dental attendance and could be dropped (Table 4). Once again young age and sex were significantly associated with dental visit habits. But the periodontal condition (bleeding gums) and perceived condition of the teeth also motivated the individuals to visit their dentist.

We could drop a few more variables, such as education, smoking habits, periodontal condition during the final modeling while ensuring that the simpler model was not significantly different from the full model (Table 5). The following factors were significantly associated with *irregular use* of dental services: age, sex, exercise habits, cost of dental treatment, dental anxiety, and perceived condition of teeth. Only 23 (5%) of our sample had dental phobia (CDAS >15), but 20 of these individuals were *irregular users*. Generally, we found only modest confounding from the

Table 5. Final model: variables selected in a hierarchical manner from models containing *predisposing factors*, *enabling/disabling factors*, and *need factors*. Risk of being an *irregular user* of dental services is expressed as odds ratios (OR) with 95% confidence intervals (CI) in full and simpler model using multiple logistic regression analysis ($n = 464$)

Factors	Type of user*: <i>irregular/regular</i>	Full model OR (95% CI)	Simpler model** OR (95% CI)
Predisposing factors			
Age			
30–35 years	34/125		
25–29 years	48/114	1.9 (1.0;3.7)	2.0 (1.0;3.8)
20–24 years	50/93	2.7 (1.3;5.6)	2.8 (1.3;5.8)
Sex			
Women	50/171		
Men	82/161	2.7 (1.5;4.7)	2.7 (1.5;4.7)
Education			
Completed	91/282		
None or ongoing	40/49	1.4 (0.7;2.7)	
Exercise			
Competitive or fitness level	30/125		
None or little	102/207	1.9 (1.0;3.5)	2.1 (1.2;3.8)
Smoker			
No	69/226		
Yes	63/105	1.4 (0.8;2.4)	
Enabling/disabling factors			
Yearly income (DKK)			
≥250,000	34/123		
200,000–249,999	27/60	1.2 (0.5;2.5)	1.2 (0.5;2.5)
150,000–199,999	32/44	1.5 (0.7;3.4)	1.7 (0.8;3.7)
100,000–149,999	19/73	0.3 (0.1;0.8)	0.3 (0.1;0.8)
<100,000	19/30	1.3 (0.5;3.5)	1.3 (0.5;3.4)
Cost of importance			
No	48/274		
Yes	83/58	7.0 (4.0;12.1)	7.4 (4.3;12.7)
Corah's Dental Anxiety Scale			
4–7	51/200		
8–11	38/86	1.4 (0.7;2.7)	1.6 (0.8;3.0)
12–20	36/37	4.4 (2.2;8.6)	4.5 (2.3;8.9)
Need factors			
Bleeding gums			
No	111/309		
Yes	21/23	1.9 (0.8;4.5)	
Perceived condition of teeth			
Good or very good	76/287		
Less good or poor	56/44	4.2 (2.3;7.7)	4.5 (2.5;8.1)

* Information from some participants missing.

** Hosmer–Lemeshow statistic: chi-square = 5.21, 8 df, $P = 0.73$.

various factors, which was expected in view of the sampling procedures.

Discussion

The conceptual model we used was only partly consistent with our empirical findings, which suggests that there is a need to develop a more appropriate model. Our principal findings indicate that the youngest and the men are less likely to adhere to regular dental visit habits. This is in accordance with a Danish study on utilization of dental services during the period from 1975 to 1990 (24) but somewhat in contrast to the findings of another Danish study from 1994 in which only minimal differences were

found (5). In both studies (5, 24) older age groups were included, but the most recent study (5) did not adjust for age. We confirmed what has been shown in several studies (17, 25): that dental anxiety is an important predictor of utilization of dental services and that particularly individuals with dental phobia seldom visit a dentist regularly. The participants' view on the cost of dental services came out as a good predictor, too. This is also to be expected according to economic theory, although the health care sector is not a perfect market. We could, however, not find empirical evidence of any association between the participants' income and use of dental services. An identical restricted significance of the actual cost during a period of increased dental costs has been reported earlier (26). There was no difference in utilization of dental services between those who had a private dental insurance

and those who did not. We did not study the impact of the public dental insurance on utilization of dental services, but studies from other Nordic countries have concluded that public subsidy schemes have no or very little influence on the demand for dental care once copayments have been introduced (27, 28). It is therefore unlikely that economic incentives alone would be effective in reaching the overall goal. A Finnish longitudinal study has reported a decrease in the demand for private services among 19- to 25-year-olds and a stable demand among 26- to 34-year-olds (29), which could be ascribed to decreasing treatment needs. It has been suggested that the major determinant in a country in which the supply of services is abundant is the number of teeth present (29). However, in our sample very few had less than 25 teeth, but we confirmed that a perceived poor condition of the teeth was a good predictor of being a *regular user*. The last proxy variable that had an explanatory value was the participants' *exercise habits*. Individuals who participated in sports on a competitive level or to keep fit were twice as likely to be *regular users*. This indicates that individuals engaged in one type of preventive behavior are likely to show a similar behavior in other areas. Several of the independent variables, such as time to get to a dental office, did not have an effect on utilization. That these variables lacked effect could be due to little variation in the variables originating from samples from a fairly homogeneous city like Aarhus.

We had planned to include more *irregular users* in the study as it could have improved the power of the study. This flaw could, however, not be corrected, as it was not detected until we could compare the participants' reported dental visit habits with those found in the local health insurance register. However, a strength of our study is that we studied a random sample of Danish individuals and that the information we obtained was collected in collaboration with The Danish National Institute of Social Research and its skilled and experienced interviewers. Since we used the same questions as in the regular national health and sickness surveys, used validated questionnaires, and posed simple questions about dental habits and dental health, we have good reason to believe that our study has a high validity. On the other hand, our rigidly structured questionnaire limited the potential of detecting new and interesting aspects. In general, our study confirmed what we already knew. But we failed to detect explanations that satisfied the two parties that had entrusted us with the task of carrying out the study: The Public Health Insurance and The Danish Dental Association. However, as the proportion of regular users was higher earlier, it should not be beyond our powers to increase the proportion of *regular user* again. Given our findings, the strategy should focus on the transition period—that is, when youngsters leave the public dental health care system and have to make use of the private system. The strategy should also take into account that young men are more likely to become non-users. A concerted effort could be dedicated to the non-negligible group of individuals with dental anxiety and dental phobia.

Economic incentives such as increasing subsidies would most likely be ineffective in reaching the overall goal. Finally, on the basis of our data and the information given by the participants, the percentage of *regular users* in Aarhus is close to 80%. This high use of dental services is more in accordance with a recent study among Danish military recruits (30), indicating that the concern expressed by The Public Health Insurance and The Danish Dental Association is not that well founded.

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