

Dental treatment provided to young adult Danes enrolled in alternative dental programs during a 3-year period

Eli Schwarz

National Board of Health, and Institute for Community Dentistry and Graduate Studies,
Royal Dental College, Copenhagen, Denmark

Schwarz E. Dental treatment provided to young adult Danes enrolled in alternative dental programs during a 3-year period. *Acta Odontol Scand* 1989;47:159-165. Oslo. ISSN 0001-6357.

From age 16 to 19 years three groups of young adults received alternative dental programs on termination of the Public Child Dental Health Service (PCDHS) in different municipalities: public group, $n = 386$; mixed group, $n = 161$; and private group, $n = 261$. During the entire study information on dental service use by the participants was taken from the records and National Health Insurance files. All dental services were calculated relative to a standardized Dental Service Unit defined by the value of a dental examination. During the entire study a mean of 30.53 Dental Service Units were provided, corresponding to 10.18 per year. More than half were of a diagnostic preventive character, and well over one-fourth were fillings. Irrespective of dental program, differences in dental services were noted with regard to utilization of dental services and to initial caries status. Users with high caries experience also received more fillings, but fewer preventive services. No association was found between gingival status and dental services provided. □ *Dental care; dental caries; dental health services; periodontal diseases; public health dentistry*

Eli Schwarz, National Board of Health, 13 Amaliegade, Postbox 2020, DK-1012 Copenhagen K, Denmark

Planning and evaluation of dental services to different population groups might seem to belong to the administrative side rather than the scientific side of community dentistry. However, as pointed out by Hausen (1), both scientific (theoretic) and particular (administrative) information is needed when decisions are made on innovations in dental care. To assess the resource implications of creating new dental programs, it may therefore be useful to evaluate dental health needs and demands and also how these variables are translated into provision of dental services in the real world.

Among other things, this study addressed the feasibility of offering young adults preventive and curative dental care within the framework of the Public Child Dental Health Services, in contrast to the prevalent mode of dental care delivery by private dental practitioners, with regard to determinants for utilization of dental services and dental health status.

The purpose of the present report was to describe and analyze the amount and types of dental services provided to three different young adult populations who were offered alternative dental care programs for 3 years. Further, this pattern was related to utilization of dental services during the study and caries status at the start of the study. An earlier publication has given details of the dental health status of the same populations (2).

Materials and methods

Study population

Earlier reports have given detailed descriptions of the study outline and the study population (2, 3). Three groups of young adults who had completed Public Child Dental Health Services (PCDHS) in three different municipalities were offered dental care under alternative conditions. In

one municipality the group ($n = 386$) received dental care within the PCDHS, free of charge (public group). In another municipality the group ($n = 161$) received dental care from private dental practitioners free of charge; the PCDHS administered recalls and so forth, and the municipality and the National Health Insurance (NHI) covered the charges (mixed group). In the third municipality the group ($n = 261$) received dental care from private dental practitioners under the general conditions for the Young Adult Dental Care Program under the NHI, implying part payment by the insured (approximately 25% of most of the service fees; private group).

The three groups were studied from about age 16 to about age 19 years. From the onset, minor age deviations existed in that the mixed group was somewhat older than the other two groups.

Data on dental services

Owing to the different organizational settings, data on provision of dental services had to be collected in different ways. The public group was on record with the PCDHS. The record of each individual was examined at regular intervals during the study, and information on dental visits and type and amount of dental services was extracted and transferred to a coding sheet. The mixed group had their dental care administered by the PCDHS in their municipality of residence. Dentists therefore returned dental bills on the young adults in question to the office of the PCDHS for reimbursement, and the bill was filed with the record of each individual. From the bills, information on dental services rendered was transferred to the coding sheet at regular intervals. The private group received dental care from dental practitioners who returned their bills to the regional NHI office for reimbursement. Information on which dentists were used by the group was collected partly from the municipality when the group left the PCDHS and partly from the young adults themselves in a questionnaire at the start of the study (E. Schwarz, D. Kronborg. Unpublished observations). Four times a year computer

lists from the NHI were checked to establish whether each individual still resided in the municipality, which was one of the conditions for staying in the project. The same lists contained information on each individual's status in the Young Adult Dental Program. At the NHI office information on each patient's dental visits and the dental services rendered at the visit by each dentist in the county was stored in a computer and was retrieved at regular intervals to obtain all necessary information on each individual. The information was transferred to the coding sheet. This sheet was designed to reflect all dental service items under the NHI agreement plus services which might be rendered outside the agreement. A list of dental service items is given in Table 1.

Utilization of dental services

Utilization of dental services was recorded continuously during the study, which has been described in detail elsewhere (3). For this analysis, utilization was dichotomized into users and non-users. In accordance with Antoft (4), users comprise a) regular users who continue to participate in the Young Adult Dental Program directly after termination of the PCDHS, and b) irregular users who alternately enroll and discontinue participation in the program. Non-users comprise a) dropouts who discontinue for good after a period of enrollment in the program, and b) persons who never enroll or participate after termination of the PCDHS.

Statistical analysis

Information on utilization and dental caries status was used as independent variables, analyzing the variation in amount of dental services in the three dental programs. Since no salient differences seemed to exist from year to year, the amount of dental services was analyzed for the entire study period together.

Dental services are not routinely recorded in the PCDHS, since the focus is on the dental health status of the children. Conversely, dental service items are registered in detail in private practice as a basis for

Table 1. List of dental services recorded. For each service, a conversion factor for calculation of Dental Service Units (DSU) is given together with respective mean number of dental services provided (DS) and mean of DSU for the entire study period ($n = 808$)

Types of dental services	DSU factor	\bar{x} DS	\bar{x} DSU
Diagnostic/preventive			
1. Dental examination	1.00	4.77	4.77
2. X-ray	1.17	3.16	3.69
3. Scaling	2.17	1.86	4.04
4a. Dental health education	2.17	1.79	3.87
4b. Control visit	1.00	1.06	1.06
Fillings			
5a. One-surface	2.08	1.01	2.11
5b. Two-surface	2.67	0.90	2.41
5c. Three-surface	3.50	1.01	3.54
5d. Silicophosphate/compos.	2.33	0.23	0.54
Other treatments			
6. Root-filling	2.75	0.11	0.30
7. Extraction	1.80	0.43	0.78
8. Operation	9.17	0.03	0.28
9. Local anesthesia*	1.40	0.96	1.34
10. Crown etc.	50.00	0.036	1.80
Total		17.40	30.53

* Not connected with extractions.

reimbursement from the NHI, whereas the dental health status of the patients is not registered uniformly. Furthermore, comparisons of different types of services cannot easily be done in a meaningful manner. Therefore, it was chosen to use a standardized measurement for dental services, termed the Dental Service Unit (DSU), which has previously been used in the planning of the Danish dental care system (5, 6). The DSU is defined as the *money value of a dental examination*, which therefore is assigned a factor 1.0. All other dental service items are weighted in relation to this unit in accordance with their money value and are hence assigned a conversion factor, as shown in Table 1. The underlying values of the factors are those agreed on by the NHI and the Danish Dental Association and form the monetary basis of adult dental care in the country. The relative factors refer to the period of the study, 1976–1980. During this period the money value of the DSU increased from DKR 32.50 (October 1976) to DKR 40.33 (April 1980).

The amount of dental services rendered has been expressed as the mean number of DSUs under the headings shown in Table 1. Analysis of variance was used to test differences in DSUs between dental programs and between caries severity zones. These severity zones have been defined previously (2), and a very strong correlation between the DMFS score and severity zone was established: the higher the DMFS score, the higher the zone. That article also described the use of the gingival bleeding index (GBI) and the GBI-% groups presented here. In short, the higher the GBI-%, the more gingival bleeding. Association between caries severity zones/GBI groups and amount of dental services was evaluated with the Spearman correlation coefficient.

Results

The mean number of dental service items received and the corresponding DSUs for the total population for the entire study

Table 2. Mean number of Dental Service Units (\pm standard deviation) and median in accordance with type of services provided during the entire study, by dental program

Type of service	Delivery group											
	Public (n = 386)			Mixed (n = 161)			Private (n = 261)			Total (n = 808)		
	\bar{x}	SD	Med.	\bar{x}	SD	Med.	\bar{x}	SD	Med.	\bar{x}	SD	Med.
Diagnostic/preventive*	18.38	(5.79)	17.36	11.06	(7.18)	10.68	19.97	(9.18)	20.02	(7.99)	17.43	17.19
Fillings [†]	9.83	(10.93)	7.00	7.81	(9.04)	4.16	7.25	(8.44)	4.66	(9.88)	8.59	5.58
Other treatments [‡]	2.85	(4.21)	1.40	2.50	(4.94)	0.00	2.62	(4.23)	1.80	(4.37)	1.60	1.60
Crowns etc. [§]	3.11	(17.00)	0.00	1.55	(10.34)	0.00	0.00	—	—	(12.69)	1.80	0.00
Total [¶]	34.17	(26.52)	27.93	22.92	(21.54)	17.44	29.84	(13.41)	28.62	(22.44)	30.53	27.18

* $F = 80.17$; $df = 2$; $p = 0.00$.† $F = 6.01$; $df = 2$; $p = 0.003$.‡ $F = 0.42$; $df = 2$; $p = 0.65$.§ $F = 4.76$; $df = 2$; $p = 0.009$.¶ $F = 14.97$; $df = 2$; $p = 0.00$.

period are shown in Table 1. A mean total of 17.40 different dental service items corresponding to 30.53 DSUs was recorded.

In Table 2 the mean number of DSUs and measures of central tendency are given for the different types of services and delivery groups. Less diagnostic/preventive DSUs were provided to the mixed group, and more fillings were given to the public group, which is also reflected in the different mean total DSUs. Noting the standard deviations and the medians for the different subgroups, it was evident that ranges between minimum and maximum number of DSUs were large.

Because of the logical interdependence between the amount and type of dental services and dental visits and the present state of dental health, respectively, these two aspects were included in the analysis (Table 3). Splitting the populations in accordance with user status showed that users in all three dental programs received similar amounts of DSUs, while the variation came especially from the non-users. Including the caries severity zone in the analysis gave one more possibility for interaction and added further to the explanation of the variation of the DSUs. One-way analysis of variance within each dental program with regard to severity zone showed significant differences in the public group between zone 0 + 1 versus the others and zone 4 + 5 versus the others, respectively (for the total, $F = 22.89$; $df = 3$; $p = 0.00$). No differences were found in the mixed group ($F = 0.72$; $df = 3$; $p = 0.54$). In the private group zone 0 + 1 differed significantly from the others (for the total, $F = 7.78$; $df = 3$; $p = 0.00$). The 12 persons in severity zone 4 + 5 in the public group had more than 80 DSUs, due mostly to a large number of crowns and a considerable number of two- and three-surface fillings.

Among users who were examined in the epidemiologic survey previously described (2) a tendency towards an inverse relationship between DMFS scores at the start of the study and the number of diagnostic/preventive DSUs provided subsequently was noted (Table 4): the higher the caries severity zone—and also higher DMFS scores—the smaller the number of diagnostic/preventive DSUs. Conversely, a significant direct

Table 3. Mean number of total Dental Service Units (\bar{x} DSU) in relation to user status by delivery group, and in relation to caries severity zone at start of the study by dental program

	Dental program											
	Public			Mixed			Private			Total		
	\bar{x} DSU	<i>n</i>	%	\bar{x} DSU	<i>n</i>	%	\bar{x} DSU	<i>n</i>	%	\bar{x} DSU	<i>n</i>	%
Utilization*												
User	34.57	378	97.9	33.84	82	50.9	32.46	204	78.2	33.83	664	82.2
Non-user	15.23	8	2.1	11.59	79	49.1	20.47	57	21.8	15.30	144	17.8
Severity zone†												
0 + 1	26.79	149	38.6	19.95	44	27.3	25.36	105	40.2	25.28	298	36.9
2	34.65	162	42.0	22.61	69	42.9	32.16	114	43.7	31.42	345	42.7
3	40.79	63	16.3	26.96	38	23.6	33.86	34	13.0	35.15	135	16.7
4 + 5	84.45	12	3.1	22.70	10	6.2	38.68	8	3.1	51.66	30	3.7
Total	34.17	386	100	22.92	161	100	29.84	261	100	30.53	808	100

* Two-way Anova: $F = 19.40$; $df = 5$; $p = 0.00$; $R^2 = 10.2$.
 † Three-way Anova: $F = 10.92$; $df = 23$; $p = 0.00$; $R^2 = 18.2$.

relationship was found between zones and number of filling DSUs: the higher the DMFS scores at the start of the study, the greater the number of filling DSUs provided during the study. No relationship was found between gingival status in terms of amount of gingival bleeding, expressed as percentage

and grouped (2), and DSUs provided during the study.

Discussion

During the entire 3-year period each participant received 30.53 DSUs, corresponding to 10.18 DSUs per year. More than half were of a diagnostic/preventive character, and well over one-fourth were fillings. The standard deviation was large, indicating very different service patterns from person to person.

The use of a standardized expression for dental services has been suggested by other researchers in dental health services research. Thus, The American Dental Association (7) listed 133 dental services and calculated relative values for each item to provide dentists with a relative value system of setting fees. Mackie & Lennon (8) intended to develop a fee scale for preventive items which could be combined with the General Dental Services Fee Scale to produce a resource-related index for use in epidemiologic studies. Setting clinical examination at 100, they were able to show considerable differences between their own assessment and two other resource-related indices developed by British researchers.

Table 4. Mean number of diagnostic/preventive and filling Dental Service Units (DSU) provided during entire study period in relation to caries severity zone at the start of the study and gingival status at the end of the study (GBI %). Only users among those who were examined were included ($n = 192$)

	Mean number of DSUs		
	Diagnostic/preventive	Fillings	<i>n</i>
Caries severity zone			
1	20.17	5.87	73
2	19.70	8.23	86
3	18.27	13.31	28
4	16.49	18.28	5
Spearman rho	-0.07; $p = 0.16$	0.35; $p = 0.00$	
GBI % grouped			
0	19.78	7.58	84
1-10	19.77	8.53	66
11-20	20.44	10.40	30
21+	15.09	7.40	12
Spearman rho	-0.05; $p = 0.24$	0.03; $p = 0.31$	
Total	19.59	8.33	192

The Swedish National Health Insurance scale of fees is mainly based on direct time studies of dental procedures (9). Although to a certain extent representing relative time use, the present weights of dental services are more 'arbitrary', since they are the result of negotiations and may therefore change from time to time. These attempts illustrate that existing indices are very closely linked with local dental service arrangements and cannot easily be used in international comparisons.

The present index of Dental Service Units was developed by the Danish Dental Association and used for forecasting the future demand for dentists (6). The basis was the list of dental service items agreed on by the Association and the NHI. It was modified slightly by a ministerial working party planning the future dental care system in Denmark, to assess the resource implications of different use and reimbursement levels in the NHI dental program (5). It is interesting to note that the working party estimated the mean number of DSUs for the age group 16–29 years to be 9.13–10.63 (in 1983), thus comprising the mean number of units in this population. Recalculating Hansen's data (10) on dental services given to 16- to 19-year-olds under the NHI dental program in 1978, 9.49 DSUs were provided. It thus seems that the level of dental services provided in this study is a reasonably valid estimate of the volume of dental services provided to young adults at this time. On the same basis, changes in public dental service provision may be studied in the future.

Irrespective of dental program, the main source of variation in provision of dental services was utilization and dental caries status at the start of the study (Table 3). This is not surprising, since, obviously, participants with frequent dental visits also stand a higher chance of receiving dental services than participants who stay away from dentists. This is further corroborated by the more detailed analysis of the users in Table 4, showing that the higher the number of fillings, the greater the number of new fillings or replacements provided (this deduction may be made, since the ratio FS/DMFS was 0.95 (2)). This phenomenon has been

observed by Elderton (11, 12), who has expressed concern that dentists tend to provide highly restoration-oriented dental care and that even young patients had already entered a cycle whereby their teeth are restored and re-restored (13). Gingival bleeding was entered into Table 4, since this was the other health indicator that might have influenced the character of the dental services. If gingival bleeding had been present during the years preceding the dental examination, this might have prompted the dentists to provide more preventive services during the study. It is not possible to establish whether the lack of association was due to the low level of gingival bleeding or to inattention by the dentists. Other data indicate that dentists were beginning to address gingival problems at this time (14).

One of the underlying assumptions of the study was that free care versus part payment care would affect both the utilization and the volume of dental services provided. The utilization aspect has been addressed earlier (3), and it was clear from the present data that when utilization was controlled, no differences in dental services could be demonstrated between those who received free care and those who were in a copayment program. This has been pointed out by Holst (15), but, conversely, Craft & Croucher (16) have argued strongly for the abolishment of charges for young adults. Such viewpoints might be considerably influenced by the structure of a country's dental health care system. This is further illustrated by the findings of the large experimental Rand Health Insurance Study, which examined the effect of cost sharing on use of dental services (17, 18). Considerable increase in dental use and expenses was found when people went from a minimal dental plan to more generous coverage, with most of the response occurring between 25% and 0% coinsurance rates. Incidentally, the latter rates correspond to the private and the public group in this study. Whereas utilization was higher in the public group (3), the same tendencies could not be demonstrated concerning amount and character of dental services.

The question is whether the dental care needed by most of these young adults is

really prohibitive in an economic sense. The mean number of DSUs of 10.18 per year corresponded to DKR 333–411 (1976–1980), of which about 25% had to be paid by the young adults themselves. This amount was close to the reported mean NHI expense per patient in this age bracket (19), but there were large deviations from the mean.

In conclusion, although differences in provision of dental services were found between the alternative programs, these were explained mainly by differences in utilization and initial dental caries status, and users in all three programs received equal amounts of dental services.

Acknowledgements.—Thanks are due to the dental and non-dental personnel of the municipalities of Frederikssund, Jægerspris, Hillerød, and Ishøj and Frederiksborg County for the permission to conduct the study and for the assistance with the data retrieval. This study was supported by the Danish Medical Research Council, grant 12-7222.

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