

# Changes in problem-based and routine-based healthcare attendance: a comparison of three national dental health surveys

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**Abstract – Background:** Healthcare utilization either may be guided by a preventive orientation leading to regular visits to the doctor, or it may be triggered by impaired health. Using data from three German national surveys, we wanted to examine whether the effects of income on the utilization of dental health services increased over time owing to the considerable decrease in insurance coverage over the years and the increase in higher out-of-pocket costs from patients. **Methods:** Data from three national dental health surveys (1989, 1997 and 2005) were used. The data of all respondents aged between 35 and 44 years were available, and the number of caries-free and unrestored healthy teeth was used as outcome. **Results:** Over the years, the proportion of routine attenders increased considerably, and the dental health measure used indicates the improvement. The least educated respondents and those with the lowest income profited less than other groups. In spite of higher copayments, the effects of income on the utilization of dental care did not increase over time. Regarding the results of education, a significant effect was only found in the study from 2005. No clear differences between routine- and problem-oriented attenders emerged with respect to the dental health measure chosen. **Conclusions:** Material conditions and education had effects on utilization behaviour. Contrary to expectation, increasing copayments did not yield higher effects of income on healthcare utilization.

Key words: dental health; epidemiology; public health

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The utilization of dental health services may be driven by a preventive orientation leading to regular visits to the doctor in order to detect dental injuries as soon as possible. In contrast, problem-oriented attenders will consult the dentist only in cases of pain or other symptoms indicating impairment. In the latter case, the dental health status of such patients is likely to be worse because many damages will remain undetected until symptoms are perceptible. It was documented in several studies that problem-oriented attenders had poorer oral

health (1–3), although the evidence is not consistent (4).

Problem-driven utilization behaviour may be explained by the lack of knowledge regarding the relationships between regular dental hygiene and dental health, but it may also be considered rational if subjects do not possess efficient financial resources for covering the necessary costs of routine visits. In particular, this could apply in countries where health insurance coverage is low and health is competing with others as a valuable

good. Indeed, low income was shown to be associated with higher problem-oriented utilization of dental services (2, 5, 6), and social gradients to the detriment of more disadvantaged groups have been reported for dental health (6–9).

Relationships between dental health, utilization patterns and social position may also be affected by the way in which health insurance systems are set up, who is paying for services and whether and how much money patients have to pay in addition to regular insurance fees. Germany is a case where in times of economic growth the statutory health insurances covered more and more medical services, but in the last 30 years the catalogue of medical treatment had been reduced, and this holds particularly true for dental care. Taking this into account, this led to a shift from insurance-based coverage to increasing direct payments from individuals with statutory health insurance, that is, 90% of the German population.

In 1989, the so-called bonus booklet was introduced where patients with statutory health insurance were required to document regular visits to the doctor, and in the case of missed visits, they have to pay a higher percentage by themselves. Owing to the time necessary to implement this instrument, it first became effective in January 1991. More changes implied the exclusion of payments for orthodontic treatment in adults over 18 years of age, and the exclusion of coverage of defined dental bridges in 1992. In 1996/1997, some dental implants and dental prostheses were no longer covered. Later, only a fixed amount of money was paid for dental prostheses, that is, the health insurance had to pay the same amount of money irrespective of the quality of the prostheses, thus resulting in increasing copayments.

After 1997, prophylactic measures for adults above 18 years of age were no longer covered. In 2003, a practice charge of 10€ was introduced, which has to be paid for each quarterly period with medical treatment, but it is waived for patients below a specified income level. In 2003, the system of allowances was extended.

Thus, over the years, clients of statutory health insurances had to cover increasing shares of their dental care out of their pockets in addition to health insurance premiums. If the individual income exceeds a certain threshold, it is possible to switch to private insurance. This group corresponds to the upper 10% of the wage earners, and the coverage depends on the individual contract with an insurer. Private health insurances in

Germany do not have systematic and comprehensive preventive programmes. As a result, it can be expected that the utilization of dental health services will shift to problem-based behaviour in order to save money in the short run. The bonus booklet might have effects in the opposite direction, thus making utilization behaviour difficult to predict.

Based on the background of these considerations, we wanted to examine the following questions:

- Is the level of income associated with preventive behaviour or, in the present case, with a higher likelihood for regular attendance at dental check-ups?
- The effects of income on utilization behaviour were assumed to increase over time, and copayments accompanying lower healthcare coverage should be higher in 2005 than in 1989.
- Do the relative effects of income and education change over time?
- The effects of income were expected to increase, while the effects of education might decrease.
- Is the improvement of dental health owing to similar changes in all income and educational groups?
- It was assumed that groups with low income and low education may profit less from improvements.

The following analyses are based on the German Oral health studies (10–12). Four of these national surveys have been conducted with the first one dating back to 1989. Data from the first, third and fourth study will be used. The second study was omitted because it only covered East Germany where at that time the aftermaths of the healthcare system of the German Democratic Republic were still effective, thus leading to incomparable data.

## Material and methods

### *Study population*

The studies were designed to provide prevalence data on the oral health status of the population with German nationality. They were collected by means of questionnaires and medical examinations. Detailed descriptions of the procedures and the basic findings have been published elsewhere (10–12). According to the recommendations of the World Health Organization (WHO) (13), the study populations were divided into three age cohorts: 12 and 15 years, 35–44 years

(in the first survey: 35–54, but 35–44 were considered) and 65–74 years. In the following analyses, only information of middle-aged respondents will be considered, because it is the standard monitoring group for studying the health of adults. Most diseases including oral health can be observed in this age group.

Random samples were drawn from the records of the registration offices at the municipal level. In order to draw valid conclusions for all German regions, individuals living in rural areas had a higher probability of being included in the study than individuals living in densely populated regions. In the first survey (11) conducted in 1989, a response rate of 56% was obtained in the middle-aged group (10); in the second survey, the corresponding figure was 56%, and 52% in the fourth (12). The main reason given for nonparticipation was lack of time, because at least 1 h was necessary for the completion of the questionnaires and the medical check-ups. The financial compensation was also considered too small for being perceived as appropriate payment.

The response rates made it necessary to examine whether biased samples might lead to false conclusions. In the first survey, comparisons between the sample and the general population were made. Only minor differences in the distributions of gender, type of community, occupational level, and occupational positions were found (10). In the surveys conducted in 1997 and 2005, nonresponders were contacted again and received a short list of key questions that had already been a part of the main survey. In both cases, it turned out that in nonresponders, the proportion of men was higher than in the main samples, and also the proportion of respondents with routine-based attendance was lower (11, 12).

### *Utilization behaviour*

As practised in earlier studies, problem-based versus routine-based attendance was used as an outcome indicator of preventive behaviour (1, 3). It was considered as more appropriate than outcomes that are based on amounts of visits without assessing the reason for attendance. Concerning the latter method, it is not possible to separate preventive behaviour from visits that are motivated by manifest complaints. In all surveys, utilization behaviour was assessed by asking the question 'Are you going to the dentist only in case of pain or complaints, or are you also going routinely for supervision' with response options being coded

'I am regularly going for supervision/I am going sometimes for supervision/I am going only in case of pain or complaints'. In the following analyses, the first and the second response alternatives were subsumed under 'routine attendance', and the last one was counted under 'problem-oriented' utilization behaviour.

### *Income*

Income is a measure of financial resources, which was assessed by the monthly net household income. The currencies were not the same in all surveys, that is, Deutsche Mark in 1989 and in 1997 and Euros in 2005; 1 € = 1.96 DM.

For the following analyses, income was divided into five categories (Table 1). We decided not to split them up into smaller intervals in order to obtain categories with sufficiently high cell frequencies.

Household size was not registered; thus, it was not possible to calculate the amount of money available for each household member. Cases with missing information were not excluded. In earlier studies, it turned out that subjects without valid data are not distributed at random, and thus it was not necessary to omit them (14, 15). Besides substantial reasons for including cases with missing data, the loss of subjects might become too high if all respondents with at least one missing value on key variables would be excluded.

### *Education*

Education is an indicator of knowledge, of the ability to use it more or less effectively in terms of mental flexibility and to cope successfully with demanding or potentially stressful situations (16). It was depicted by school education denoting the highest educational level attained: Lowest: up to 9 years/intermediate: 10 years/highest: 12 or 13 years of school education. Again, cases with missing data on education were kept in the analyses.

### *Oral health*

The measure of oral health used in the analyses was the number of caries-free and unrestored healthy teeth. The use of a measure indicating dental health instead of impairment is more appropriate than the frequently used decayed, missed, filled teeth (DMFT) or decayed, missing, filled surfaces (DMFS) measures, because regular control refers to preventive habits directed towards maintaining health. The values of this variable were varying between 0 and 32.

Table 1. Basic distributions of the study variables over the three studies

Oral Health Survey I-1989 (N = 500)														
Utilization pattern	Gender		Monthly net household income in DM				Education in years			Age (M/SD)		Caries-free teeth (M/SD)		
	Male	Female	<1500	1500–2500	>2500–3500	>3500	Missing	Up to 9	10	12/13	Missing			
Routine-based	380/76%	174	205	13	49	85	108	125	200	99	75	6	39.0/2.9	14.9/5.2
Problem-based	109/21.8%	64	45	13	13	29	20	34	67	25	15	2	39.1/2.8	16.2/6.1
Missing data	11/2.2%	5	7	0	0	0	2	9	4	2	0	5	41/2.2	26.6/4.8
All	500/100%	243/48.6%	257/51.4%	26/5.2%	62/12.4%	114/22.8%	130/26.0%	168/33.6%	271/54.2%	126/25.2%	90/18.0%	13/2.6%	39.1/2.9	15.3/5.5

  

Oral Health Survey III-1997 (N = 655)														
Utilization pattern	Gender		Monthly net household income in DM				Education in years			Age (M/SD)		Caries-free teeth (M/SD)		
	Male	Female	<2000	2000–3499	3500–4999	>5000	Missing	Up to 9	10	12/13	Missing			
Routine-based	573/87.5%	266	307	67	175	180	130	21	171	250	148	4	39.4/2.8	14.7/6.5
Problem-based	75/11.5%	40	35	20	30	13	9	3	14	29	32	0	40.0/2.8	14.7/5.7
Missing data	7/1.1%	5	3	2	3	0	9	2	1	0	4	2	40.1/3.1	19.2/9.9
All	655/100%	310/47.3%	345/52.7%	89/13.6%	208/31.8%	193/29.5%	148/21.2%	26/4.0%	186/28.4%	279/42.6%	184/28.1%	6/0.9%	39.5/2.8	14.8/5.9

  

Oral Health Survey IV-2005 (N = 921)														
Utilization pattern	Gender		Monthly net household income in €				Education in years			Age (M/SD)		Caries-free teeth (M/SD)		
	Male	Female	<1250	1250–1999	2000–2749	>2750	Missing	Up to 9	10	12/13	Missing			
Routine-based	843/91.5%	356	487	148	216	198	216	65	281	371	169	22	39.7/2.8	17.3/5.4
Problem-based	66/7.2%	42	24	26	20	8	9	3	10	30	24	2	39.7/3.1	17.1/6.3
Missing data	12/1.3%	8	4	3	1	2	2	4	2	2	4	4	39.3/2.8	15.2/10.7
All	921/100%	406/44.1%	515/55.9%	177/19.2%	237/25.7%	208/22.6%	227/24.7%	72/7.8%	293/31.8%	403/43.8%	197/21.4%	28/3.0%	39.7/2.9	17.2/5.6

### *Statistical procedures*

Dental health comparisons were made using the Kruskal–Wallis rank-test, and the relationships between education and income as indicators of social differentiation were calculated by means of rank order correlations. The main analyses were carried out by means of binary logistic regression with routine attendance as a standard of comparison (dependent variable). In the analyses, the answering categories ‘going regularly for supervision’ and ‘sometimes going for supervision’ were subsumed under ‘routine-based’ utilization.

Two-sided *t*-tests were used for comparing problem-oriented and routine attenders with respect to impairments of dental health; a two-sided approach was appropriate here because differences at both ends of the distribution were expected. The last regression analyses with the number of caries-free and unrestored healthy teeth as outcome were performed by means of ordinary least-squares regression. In all surveys, this measure was normally distributed.

All analyses were performed using STATA Version 11SE (17).

## **Results**

The main research questions were directed towards the effects of income and education on the utilization behaviour as outcome.

### *Basic frequencies*

The distributions of the variables used in the following analyses are displayed in Table 1. In the first survey (1989), a sample size of  $N = 500$  respondents was obtained; in the second one (1997), the sample comprised  $N = 655$  and  $N = 921$  in 2005.

The compositions of the three samples did not change with respect to age as the three means were close together. The female/male ratios were similar in the first two surveys, but the proportion of men decreased in 2005. The distribution of respondents by income groups differed over the three studies, and the same holds true for education, where the shift of educational degrees towards higher qualifications was depicted in the data. Differences between income distributions were, however, marked.

The proportion of respondents going to the dentist only in case of complaints decreased from 1989 to 2005. The Kruskal–Wallis test for rank differences between the three surveys was statistically significant ( $\chi^2 = 77.2$ ; d.f. = 2;  $P < 0.001$ ).

### *Regression analyses*

The rank order correlations between income and education were moderate, and thus they can be included in the regression analyses without risking estimation problems because of multicollinearity. The association in the 1989 data was  $r = 0.27$ ; it was  $r = 0.31$  for 1997 and  $r = 0.37$  for 2005.

The main research question referred to variations in effects with respect to education and income. In 1989, a statistically significant odds ratio was found only for the lowest income category, while the effects of education were insignificant (Table 2).

In 1997, significant odds ratios emerged for income, but not for education (Table 2); in 2005, the figures were significant for the lowest category of income and of education.

Statistically significant income effects for the lowest group were found in all surveys, but contrary to expectation there was no evidence of increasing effects as the strongest ones emerged not in 2005, but in 1997.

In all regression analyses, utilization behaviour was depicted by condensing the response categories indicating that subjects went ‘sometimes’ and ‘routinely’ for dental supervision, while the ‘complaint-oriented’ category was left as it was.

### *Dental visiting patterns and impairments*

Initially, we expected dental health status to be better in routine-oriented (ro) than in problem-oriented (po) patients, and this should hold true for all surveys. For 1989, the test was statistically significant ( $M_{ro} = 14.5$ ;  $SD = 4.8/M_{po} = 15.9$ ;  $SD = 5.9$ ;  $T = -2.08$ ; d.f. = 444;  $P = 0.02$ ), but neither for 1997 ( $M_{ro} = 14.7$ ;  $SD = 5.7/M_{po} = 14.8$ ;  $6.1$ ;  $T = 0.11$ ; d.f. = 646;  $P = 0.55$ ) nor for 2005 ( $M_{ro} = 17.2$ ;  $SD = 5.4/M_{po} = 17.7$ ;  $SD = 6.5$ ;  $T = 0.25$ ; d.f. = 907;  $P = 0.60$ ).

### *Differences in dental health indicators between social groups over the years*

Dental health improved over the years (Table 1), and Table 3 depicts how these changes have occurred in general and after stratification by indicators of social differentiation. The statistically significant differences between mean scores indicate that all social groups profited from this development. However, comparing 1989 and 2005 reveals that no social differences were present in 1989 and 1997, but they became statistically significant only in 2005. The better educated and those with the highest income levels profited the most. In

Table 2. Effects of education and income on utilization patterns (i.e. being driven by complaints instead of prevention/early detection) for the three surveys

	1989 <sup>a</sup>		1997 <sup>a</sup>		2005	
	OR	95% CI	OR	95% CI	OR	95% CI
<b>Education</b>						
12/13 years	1	Reference cat.	1	Reference cat.	1	Reference cat.
10 years	1.35	0.65–2.80	1.17	0.58–2.38	1.91	0.89–4.12
Up to 9 years	1.57	0.81–3.05	1.96	0.97–4.00	2.57	1.14–5.82
Missing data	1.66	0.30–9.12	–	–	1.84	0.36–9.31
<b>Monthly household income</b>						
Highest	1	Reference cat.	1	Reference cat.	1	Reference cat.
Second highest	1.61	0.83–3.13	0.95	0.38–2.34	0.78	0.29–2.11
Second lowest	1.46	0.66–3.23	2.29	1.00–5.21	1.70	0.73–3.94
Lowest	4.58	1.81–11.60	4.10	1.67–10.06	2.89	1.24–6.70
Missing data	1.59	0.85–2.95	2.03	0.49–8.35	1.03	0.26–4.02
<b>Gender</b>						
Male	1	Reference cat.	1	Reference cat.	1	Reference cat.
Female	0.62	0.39–0.97	0.74	0.45–1.22	0.44	0.26–0.75
Age (years)	0.996	0.922–1.076	1.114	1.018–1.218	1.0	0.915–1.095

Income categories 1989: <1500 DM (lowest)/1500–2500 DM (second lowest)/>2500–3500 DM (second highest)/>3500 DM (highest).

Income categories 1997: <2000 DM (lowest)/2000–3499 DM (second lowest)/3500–5000 DM (second highest)/>5000 DM (highest).

Income categories 2005: <1250 € (lowest)/1250–1999 € (second lowest)/2000–2749 € (second highest)/>2750 € (highest).

<sup>a</sup>In 1989 and 1997, amounts are given in Deutsche Mark (DM); 1 € = 1.96 DM.

addition, the mean differences between social groups increased over the years, thus indicating widening social inequalities in dental health.

These findings were elaborated further by performing regression analyses with the three surveys. The effects of income, education and gender were entered into the analyses as dummy variables with the first category as a standard of comparison. In 1989 (Table 4), a sole gender effect emerged, indicating that women had better dental health than men. Education and income were unimportant in terms of both effect size and statistical significance. This was repeated for 1997 with a smaller gender effect. For all variables considered, significant effects emerged in 2005. Dental health improved with increasing educational level, and smaller, but significant effects were obtained for income. Ultimately, it can be concluded that there was little difference in oral health based on either income or education in the first two surveys; however, there was an apparent difference in the 2005 survey.

## Discussion

The main question guiding our analyses was related to social differences in utilization patterns of dental care in Germany. In particular, this referred to the role of income, and against the

backdrop of increasing extra payments; it was assumed that income effects would become more pronounced by shifting utilization behaviour towards problem-oriented attendance. The literature is inconsistent in that respect (4), but it was assumed that dental health of individuals going to the dentist in the case of complaints would be worse than of those using dental health services routinely. This appeared to be reasonable because the Oral Health Studies conducted in 1989, 1997 and 2005 have shown that also in Germany variations in dental health follow the well-known social gradients to the detriment of individuals with lower education and lower income (9, 18).

A general development towards routine-oriented utilization occurred over the observed years. However, for the lowest income groups, the likelihood of problem-oriented utilization increased, but higher out-of-pocket payments for patients did not lead to a general shift towards higher problem-oriented utilization behaviour.

It is remarkable that in 1989 as well as in 1997, the effects of education were not statistically significant. A significant result was obtained in the survey in 2005, but analogous to income, this occurred only in the lowest category.

In 2005, the proportion of subjects using dental care routinely was higher than the respective figures of Sweden in the 1980s and in the 1990s (19)

Table 3. Means and standard deviations for the number of caries-free and unrestored healthy teeth over the three surveys for education and income

		Number of caries-free and unrestored healthy teeth (means and standard deviations)											
		School education in years					Income						
	All	≤9 years	10 years	12/13 years	M1-M3	Kruskal-Wallis test <sup>a</sup>	Lowest	Second lowest	Second highest	Highest	Missing data	M1-M4	Kruskal-Wallis test <sup>a</sup>
1989	15.3/5.5	15.0/5.7	15.5/5.6	15.7/4.5	-0.7	$\chi^2 = 1.9$ ; d.f. = 2; $P = 0.38$	15.7/4.5	15.5/5.6	15.0/5.7	15.9/6.3	15.0/5.5	0.7	$\chi^2 = 5.3$ ; d.f. = 3; $P = 0.15$
1997	14.8/5.9	14.2/5.9	15.2/6.0	14.7/5.5	-0.5	$\chi^2 = 5.2$ ; d.f. = 2; $P < 0.07$	14.4/6.8	14.9/6.2	14.6/5.7	14.9/4.9	15.0/6.3	-0.5	$\chi^2 = 1.4$ ; d.f. = 3; $P = 0.70$
2005	17.2/5.6	16.2/6.2	16.8/5.1	18.7/5.1	-2.5	$\chi^2 = 27.5$ ; d.f. = 2; $P < 0.001$	16.4/5.8	16.7/5.7	17.8/5.6	18.3/5.3	16.2/4.8	2.1	$\chi^2 = 13.6$ ; d.f. = 3; $P = 0.04$
$M_{05-M_{98}}$ Kruskal-Wallis test	$\chi^2 = 87.9$ ; d.f. = 2; $P < 0.001$	$\chi^2 = 67.2$ ; d.f. = 2; $P < 0.001$	$\chi^2 = 15.5$ ; d.f. = 2; $P < 0.001$	$\chi^2 = 14.7$ ; d.f. = 2; $P < 0.001$			$\chi^2 = 46.5$ ; d.f. = 2; $P < 0.001$	$\chi^2 = 30.4$ ; d.f. = 2; $P < 0.001$	$\chi^2 = 17.0$ ; d.f. = 2; $P < 0.001$	$\chi^2 = 7.8$ ; d.f. = 2; $P = 0.02$	$\chi^2 = 3.1$ ; d.f. = 2; $P < 0.22$		

<sup>a</sup>Cases with missing values on income were excluded.

as well as for Australia during the same period (20). In the UK, regular attendance has also increased over the years, but for 2009 (21), the figures are still lower than for Germany in 2005. A general shift towards routine-based attendance has taken place in many countries without the disappearance of social inequalities in dental health. It can be assumed that social gradients owing to education may be explained by individuals with lower educational degrees falling short if new behaviours are to be adopted (22). In the present case, this applies to routine-oriented utilization of dental services, and this assumption is supported by increasing effects of education on utilization behaviour. Two practical consequences can be derived from our results. If individuals shall be motivated to change their behaviour towards more routine-oriented utilization, financial barriers for the lowest income group have to be redressed. The development of capabilities for using healthcare facilities more effectively (23, 24) by improving health literacy is of equal importance. This should include the dissemination of information in schools, in the media and also in healthcare facilities.

Explanations for the general shift from complaint- to routine-oriented utilization have not been systematically explored because this requires long-term observations. There are, however, some plausible clues: over the years, individuals became increasingly convinced that they can contribute to the preservation of their health, and this was associated with improving dental hygiene (10–12) and other prophylactic measures (25).

A materialistic explanation for the reported general behavioural changes appears less likely. Although between 1989 and 2005 household incomes in Germany have increased, purchasing power has not grown accordingly, and this development was accompanied by growing income inequalities, in particular between 2000 and 2005 (26).

The conclusions from our results for the further development of dental health care and prevention are dependent on relationships between utilization behaviour and dental health. This was demonstrated for the UK (27) and for the United States (28), and thus it was to be expected that it might also have occurred in Germany. Unexpectedly, utilization behaviour and dental health (as measured by the number of caries-free and unrestored healthy teeth) turned out to be related only in the 1989 survey. The relationship between health and utilization may also vary with the outcome

Table 4. Effects of education, income, gender and age on the number of caries-free and unrestored healthy teeth for the three surveys

	1989 <sup>a</sup>			1997 <sup>a</sup>			2005		
	$\beta$	<i>b</i> /SE	<i>P</i>	$\beta$	<i>b</i> /SE	<i>P</i>	$\beta$	<i>b</i> /SE	<i>P</i>
Education									
12/13 years	Reference	–	–	Reference	–	–	Reference	–	–
10 years	0.01	0.17/0.79	0.83	0.06	0.67/0.57	0.24	–0.14	–1.54/0.43	<0.001
Up to 9 years	–0.06	–0.70/0.73	0.34	–0.032	–0.43/0.64	0.50	–0.15	–1.99/0.53	<0.001
Missing data	0.06	2.28/1.86	0.22	0.04	2.19/2.47	0.37	–0.11	–3.51/1.07	0.001
Monthly household income									
Highest	Reference	–	–	Reference	–	–	Reference	–	–
Second highest	0.07	0.95/0.74	0.20	–0.03	–0.41/0.67	0.54	–0.02	–0.20/0.52	0.69
Second lowest	–0.01	–0.13/0.87	0.88	–0.01	–0.04/0.68	0.95	–0.09	–1.14/0.52	0.03
Lowest	0.02	0.56/1.26	0.66	–0.04	–0.62/0.83	0.46	–0.09	–1.22/0.57	0.03
Missing data	0.01	0.11/0.66	0.87	–0.00	–0.01/1.28	0.99	–0.06	–1.28/0.74	0.08
Gender									
Male	Reference	–	–	Reference	–	–	Reference	–	–
Female	0.26	2.80/0.52	<0.001	0.11	1.30/0.46	0.01	0.14	1.54/0.36	<0.001
Age (years)									
	–0.01	–0.01/0.09	0.90	–0.06	–0.12	0.14	–0.15	–0.29/0.06	<0.001

Income categories 1989: <1500 DM (lowest)/1500–2500 DM (second lowest)/>2500–3500 DM (second highest)/>3500 DM (highest).

Income categories 1997: <2000 DM (lowest)/2000–3499 DM (second lowest)/3500–5000 DM (second highest)/>5000 DM (highest).

Income categories 2005: <1250 € (lowest)/1250–1999 € (second lowest)/2000–2749 € (second highest)/>2750 € (highest).

<sup>a</sup>In 1989 and 1997, amounts are given in Deutsche Mark (DM); 1 € = 1.96 DM.

considered (29). The absence of consistent relationships permits the conclusion that individuals may also be capable of maintaining their dental health independent of regular dental check-ups, and this is supported by the literature (30). Based on these findings, it might be concluded that routine visits to the dentist may not necessarily contribute to maintaining overall dental health, but extending the considerations from the middle-aged respondents to the younger (12 and 15 years) and to the older ones (65–74 years) suggests that routine visits are indeed related to better dental health (12).

The income indicator used in our studies was the unweighted household income, that is, the number of household members was not taken into account. In a recent analysis with subjective health as an outcome, it was shown that the effects of unweighted and weighted incomes did not differ (15); thus, there is a reason to assume that the probability of erroneous conclusions is low.

Taken as a whole, the surveys have produced the same age distributions and similar female/male ratios. The samples differed with respect to education. In part, this depicts the increase in educational qualifications in the population over the years (31), and sampling inaccuracies may have contributed to deviations from the population distribution. This may, however, not affect the

substantive interpretations, as the research questions were not directed towards population distributions but rather towards the associations between indicators of social stratification and utilization behaviour.

This study supports existing knowledge that dental health and preventive behaviours have improved over the years. In spite of rising copayments, the deleterious effects of low income on utilization behaviour have not increased, but low income may still prevent individuals from attending the dentist regularly.

The comparability of categories is, however, more difficult to establish for income. Between 1989 and 2005, significant shifts have taken place. This refers to increases in incomes, costs of living, several tax increases and changes in the social structure. The interpretations should thus be treated with caution.

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