Prosthodontic Status Among Old Adults in Pomerania, Related to Income, Education Level, and General Health (Results of the Study of Health in Pomerania, SHIP)

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Purpose: The aim of the study was to evaluate associations among prosthetic status, socioeconomic factors, and general health of subjects aged 55 to 79 years. The data were taken from the Study of Health in Pomerania (SHIP). **Materials and Methods:** Socioeconomic information (age, sex, education level), medical information (number of diseases), and details on smoking and alcohol consumption were obtained. Prosthetic status in the maxilla and mandible was classified into complete denture (CD), removable partial denture (RPD), ≥ 10 natural teeth or teeth replaced with fixed prosthodontics (10T+), and ≤ nine natural teeth including fixed prosthodontics (9T–). **Results:** The data of 1,877 subjects were evaluated. CDs in the maxilla were more frequent than in the mandible. RPDs were more frequent in the mandible and in the group aged 65 to 74 years. Of the individuals with a low education level, 47% had a CD in the maxilla, and only 21% had 10T+. However, of subjects with a high education level, 22% had a CD in the maxilla, and 54% had 10T+. The odds ratio of having a CD in the maxilla increased to 11.9 at the age of 75 to 79 years, compared to 0.6 at the age of 55 to 59 years. Logistic regression analyses showed that the risk of wearing a CD was significantly associated with old age, low education level, low income, smoking, and alcohol abuse, whereas the number of diseases (used as an indicator of general health) was not. **Conclusion:** Alcohol abuse, smoking, low education level, low income, and old age were significant predictors of wearing CDs. *Int J Prosthodont 2003;16:313–318.*

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During the last century, dental health among adults and the elderly has improved in many countries.[1–6] During the same period, the number of elderly people increased, as did the proportion of elderly with natural teeth. To meet these demographic changes, it will be necessary to develop the scientific bases and the practical approach of oral health care for the elderly.[7–10] Thus, there will be a need for continuing research to describe and analyze the present oral health situation and identify indicators of reduced oral health care for future elderly, including the socioeconomic prerequisites and consequences.[6,11–13]

An accurate assessment of dental treatment needs is important to public health planners.[14–16] Many international studies in Europe and North America showed a prevalence of edentulism of between 7% and 91%.[17–21] The wide variations depended on age and living background. Most epidemiologic

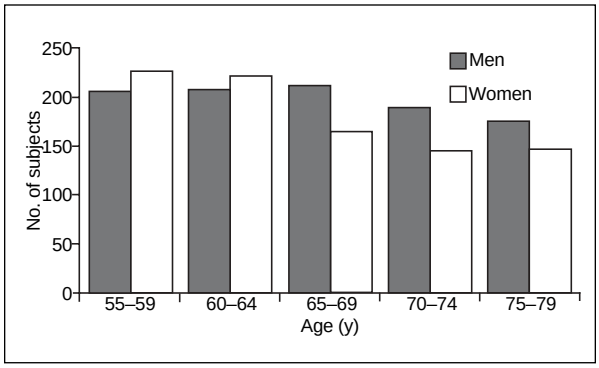

Fig 1 Distribution of 1,877 clinically examined subjects according to sex and age.

data were obtained by structured interviews and clinical examinations.[18] The use of questionnaires has been limited, although the data obtained have been reported to have reasonably good validity.[18,22,23]

Recent epidemiologic surveys have revealed that environmental factors influence oral health more than was previously anticipated.[2,7,24,25] In elderly people, socioeconomic factors such as low income, low education level, and limited social support have been shown to be closely associated with wearing complete dentures (CD) or removable partial dentures (RPD) and with having poor oral health.[7,25–28] Today, few data exist on the relationship between socioeconomic and medical factors and the prosthetic status among elderly adults in Germany. Two population-based studies in 1970 and 1973 were carried out in a northeastern region of Germany.[29–31] At that time, age groups ranging from 17 to 80 years had been examined. At 52 years of age, subjects had on average 14.3 remaining teeth, and at the age of 75, they had on average four teeth. Looking at the requirements for statistical procedures, these studies were not representative of the entire population because of study design. A 1998 population-based study in a southeastern region of Germany showed that partial tooth loss was replaced more often with RPDs than with fixed partial dentures.[32] This was independent of other variables.

The aim of this part of the Study of Health in Pomerania (SHIP)[29] was to evaluate the relationships among prosthetic status, socioeconomic factors, and general health in subjects aged 55 to 79 years.

Materials and Methods

A total of 6,267 subjects were derived from an adult population health examination study that comprised a randomized sample, stratified by age and gender, that had been drawn from community residents' registration data files. The study was undertaken from 1997 until 2001. The examinations and interviews took place in two special medical/dental offices that were equipped in the same manner (organized by the general management of SHIP) and located in the cities of Greifswald and Stralsund. On average, each subject had to spend 4 hours in the offfice to complete all parts of the study, including the questionnaires.[29] Of the total number of subjects, 4,310 (69%) agreed to be examined in SHIP. The stratified randomization resulted in a nearly equal distribution of males and females within each age group (Fig 1). The data on 1,877 subjects aged 55 to 79 years were evaluated in this study. Socioeconomic information (age, sex, education level), medical information (number of diseases), and questions on smoking and alcohol consumption were taken from an interview. Income was taken from a self-administered questionnaire.

Education level was classified into three groups: low (completing elementary school or having no formal professional education), middle (completing secondary [high] school or technical college), and high (holding a bachelor's degree or any university degree). The answers regarding monthly household income were classified into 22 groups, from less than DM 400 (≈ 200 €) to DM 15,000+ (≈ 7,500+ €). The general health of the subjects was evaluated using the number of diseases, taken from the medical part of the SHIP questionnaire. Subjects were classified into three groups according to the diseases reported: group 1 = none or one reported disease; group 2 = two to three diseases; and group 3 = four diseases or more.

To validate questions on diabetes and alcohol consumption, the markers for diabetes, hemoglobin A_{1C} (HbA_{1C}), and for alcohol abuse, carbohydrate deficient transferrin (CDT), were taken from blood analyses of the subjects.[33,34] Subjects having an HbA_{1C} of ≥ 7% were considered diabetics. Subjects with a CDT ≥ 6% and positive according to the Luebeck Alcohol Dependence and Abuse Screening Test (LAST)[35] were considered alcohol abusers. Subjects smoking cigarettes, cigars, or pipes on a regular basis were considered current smokers. Smokers who had quit smoking or did not smoke regularly were considered former smokers. Subjects smoking more than 15 cigarettes daily were considered heavy smokers.

The dental part of SHIP contained 1,217 parameters (including a structured interview). The dental examination was performed by five clinicians (alternating daily) from the dental school of the University of Greifswald, Germany. All clinicians were calibrated regularly twice a year. The prosthodontic status of the subjects was classified into four groups devided by jaw and designed on masticatory function:

Table 1 Distribution of Prosthetic Status in Various Age Groups and Education Levels*

	Age group (y)				Education level			
	55–64	65–74	75–79	Total	Low	Middle	High	Total
Maxilla								
9T–	43 (5)	31 (5)	8 (3)	82 (4)	68 (5)	12 (4)	1 (1)	81 (4)
CD	191 (23)	354 (51)	216 (69)	761 (41)	619 (47)	94 (28)	40 (22)	753 (41)
RPD	229 (27)	193 (28)	66 (21)	488 (26)	335 (27)	89 (27)	42 (24)	486 (27)
10T+	338 (45)	112 (16)	22 (7)	517 (28)	283 (21)	136 (41)	96 (54)	515 (28)
Mandible								
9T–	62 (7)	49 (7)	24 (8)	135 (7)	118 (9)	14 (4)	3 (2)	135 (9)
CD	88 (10)	227 (33)	149 (49)	464 (25)	381 (29)	59 (18)	22 (12)	462 (25)
RPD	250 (30)	230 (34)	99 (33)	579 (32)	433 (33)	90 (27)	49 (27)	572 (31)
10T+	446 (53)	175 (26)	33 (11)	654 (36)	378 (29)	169 (51)	105 (59)	652 (36)

*n (%).
9T– = no removable denture and fewer than 10 natural teeth, with or without fixed prosthodontics; CD = complete denture; RPD = removable partial denture; 10T+ = no removable denture and 10 or more natural teeth, with or without fixed prosthodontics

- Group CD comprised subjects who had a CD.
- Group RPD comprised subjects who had an RPD.
- Group 10T+ consisted of subjects having no removable denture and 10 or more natural teeth, with or without fixed prosthodontics.
- Group 9T– consisted of subjects having no removable denture and fewer than 10 natural teeth, with or without fixed prosthodontics.

The maximum number of teeth in this study was 28 (third molars not included).

Statistical Analyses

For the purpose of analyses, estimated household income was computed as the midpoint between the interval limit of the income class to which the subject belonged. The estimated income followed a normal distribution according to a P-P plot. To compute the odds ratios (OR) of each prosthodontic status group, dichotomous variables were created. The OR was estimated by every 5-year age group to the total of all subjects among the variables of each prosthetic status group in a two-by-two table. Binary logistic regression analyses were used to identify risk markers for wearing a CD or RPD using a stepwise backward method with a cutoff point of 0.10 for removal and 0.05 for reentering the variable. The OR and 95% confidence interval (CI) were computed from the β coefficient.

Results

Among the 1,877 subjects (aged 55 to 79 years) who participated in the study, 73% had a low education level and 10% had a high education level. A total of 1,777 (95%) subjects answered the question related to income, of whom 29% reported an income lower than 1,000 €, while 12% had an income of more than 2,000 € per month.

The number of diseases reported by the subjects varied from zero to fifteen, with a median of two. Diabetes was shown in 15% (n = 272) of the subjects, and 19 subjects were abusing alcohol. A total of 43% (n = 795) were current smokers, a further 47% were former smokers or irregular smokers, and 10% had never smoked.

Table 1 shows the prosthodontic status in three age groups. The percentage having a CD in the maxilla tripled from 23% at age 55 to 64 years to 69% at age 75 to 79 years and quadrupled in the mandible, from 10% at age 55 to 64 years to 49% at age 75 to 79 years. On the contrary, the percentage of subjects in group 10T+ decreased in both jaws with age. Subjects with a high education level belonged more frequently to group 10T+ in both jaws, whereas subjects with a low education level had CDs more frequently (Table 1). On the other hand, the subjects belonging to group 9T– had a low education level more frequently compared to the other prosthetic status groups. Table 2 shows the association between the prosthetic status in the maxilla and mandible. Of the subjects having a CD in the mandible (n = 462), 94% had a CD in the maxilla as well. Of the 516 subjects having 10T+ in the maxilla, 84% also had 10T+ in the mandible.

The OR of having a CD increased significantly with age (Table 3) to reach 11.9 (95% CI 8.9–15.9) in the 75- to 79-year age group for the maxilla and 8.9 (95% CI 6.8–11.7) for the mandible. The OR of having an RPD in the maxilla was maximal at the ages of 60 to 64 and 70 to 74 years (2.0), whereas in the mandible, the OR was highest at the age of 65 to 69 years (2.4). Table 4 shows the results of the logistic regression analyses of having a CD for each jaw (dependent variable). For statistical analyses, stepwise backward elimination of variables was used. The same analyses were performed for having an RPD to demonstrate that the only risk marker for having an RPD in the maxilla and/or mandible was age.

Table 2 Relationship Between Prosthetic Status in the Maxilla and Mandible*

	Maxilla			
	9T–	CD	RPD	10T+
Mandible				
9T–	27 (2)	35 (2)	42 (2)	22 (1)
CD	2 (< 1)	432 (24)	27 (2)	1 (< 1)
RPD	7 (< 1)	243 (13)	275 (15)	54 (3)
10T+	45 (3)	25 (1)	142 (8)	439 (24)

*n (%).
9T– = no removable denture and fewer than 10 natural teeth, with or without fixed prosthodontics; CD = complete denture; RPD = removable partial denture; 10T+ = no removable denture and 10 or more natural teeth, with or without fixed prosthodontics

Table 3 Bivariate Odds Ratio (95% Confidence Interval) of Having a Complete Denture (CD) and Removable Partial Denture (RPD) in Each Jaw by Age Group

	Maxilla		Mandible	
Age (y)	CD	RPD	CD	RPD
55–59	0.6 (0.5–0.8)	1.8 (1.4–2.4)	0.4 (0.3–0.7)	1.9 (1.5–2.4)
60–64	2.0 (1.6–2.6)	2.0 (1.6–2.6)	1.8 (1.3–2.3)	2.1 (1.7–2.7)
65–69	4.2 (3.3–5.3)	1.8 (1.4–2.4)	3.3 (2.6–4.4)	2.4 (1.9–3.1)
70–74	6.3 (4.9–8.2)	2.0 (1.6–2.7)	6.1 (4.7–7.9)	2.3 (1.8–3.0)
75–79	11.9 (8.9–15.9)	1.2 (0.9–1.7)	8.9 (6.8–11.7)	2.1 (1.6–2.8)

Table 4 Two Logistic Regression Analyses of "Having a Complete Denture" as Dependent Variable and Selected Variables in the Maxilla and Mandible as Independent Variables

	Complete denture maxilla*			Complete denture mandible†		
Independent variable	*P* value	Odds ratio	95% confidence interval	*P* value	Odds ratio	95% confidence interval
Age (continuous variable)	< .001	1.1	1.1–1.2	< .001	1.1	1.1–1.2
Gender	.025	1.4	1.0–1.9	.059		
Income (continuous variable)	.006	1.0	1.0–1.0	.013	1.0	1.0–1.0
Education level high‡	.001			.027		
Education level medium	.985			.615		
Education level low	.013	1.7	1.1–2.7	.044	1.7	1.0–2.9
No. of diseases 4+‡	.913			.676		
No. of diseases 2–3	.719			.438		
No. of diseases 0–1	.937			.494		
Diabetes	.724			.790		
Current smoker	.001	1.7	1.3–2.3	.013	1.6	1.1–2.2
Former smoker	.804			.394		
Heavy smoker	.109			.390		
Alcohol abuser	.005	5.0	1.6–15.6	.068		

*Classification table 71%.
†Classification table 76%.
‡Categoric variable used as reference.

Discussion

To maintain high reliability of the data collected, all examiners were calibrated twice a year, and the calibrations were evaluated and discussed. Criteria for the clinical examination were well-defined at the beginning of the study.

Many studies reported on tooth loss and the prosthodontic status of the elderly,[16–18,27,28,32,36–40] but all used different classifications of prosthetic status. Some authors differentiated between maxilla and mandible and different combinations of prostheses.[17,27,36,40] Our classification has proven statistical reasons to be the most powerful. All studies showed that tooth loss is most frequent in the maxilla, which was confirmed in the present study. The last remaining teeth for elderly individuals are the anterior teeth in the mandible. In the present study, the subjects were classified in one of four groups for each jaw, ie, there were 16 possible combinations. Subjects having 10T+ in each jaw were

likely to have at least premolar occlusion and unimpaired function and esthetics, whereas subjects having 9T– and no RPD were likely to have impaired function and esthetics.[41]

For classification of education level, the number of years of schooling was used, in correspondence to other studies.[42,43] Suominen-Taipale et al[43] examined Finnish adults aged 25 to 65 years. In their multivariate logistic regression analyses of subjects with a low education level, the OR of being edentulous in both jaws was 5.1. However, the Finnish study was not related to an elderly population, and the OR was computed to 5-year age cohorts. In our regression analyses, the OR of age was computed to ages 55 to 79 years. Our results showed that subjects with a higher education level were more likely to have natural teeth, possibly combined with fixed prosthodontics, whereas the lower education group more frequently had a CD or 9T– remaining in each jaw without RPDs. Similar results have been published previously.[2,42,43] Studies using different statistical methods also clearly showed that edentulism is negatively related to education level and annual income.[27,43] It seems that people with high education levels might realize the importance of retaining natural teeth or that having fixed prosthodontics until old age would have a positive impact on quality of life. High education level was a significant factor for having remaining teeth (supplemented or not by fixed prosthodontics rather than removable prosthodontics).

To our knowledge, this is the first study in which the bivariate OR for a particular prosthetic status in different age cohorts has been presented. The risk of having a CD increased steadily with age, and the OR was higher in the maxilla. This pattern was not found for RPDs. The likelihood of wearing an RPD was highest among 65- to 74-year-old people. It seems that the oldest group had less chance to wear RPDs because of social history. As the OR of being edentulous increased with age in one jaw, the OR for having an RPD decreased. Amazingly, subjects between the ages of 55 and 59 had an OR of 1.8 for having a partial denture, a relatively high rate for subjects in this age group.

Logistic regression analyses were presented to report on risk markers for having a CD in the maxilla and mandible. The highest risk marker was alcohol abuse, with an OR of 5.0 (in the maxilla). Alcohol dependence results in long periods during which the patient does not maintain oral care and thus is much more prone to needing dentures compared to the general population.

It was unexpected that the number of diseases did not appear to be a risk marker. It appears that subjects suffering from many diseases were not particularly at risk of being denture wearers. This will be investigated by further research correlating the type of disease with the odds of having, for example, at least one CD. Number of diseases may not be an appropriate marker of general health for our studied population, which lives independently in a community. Other factors, such as the dental education of the subject's clinician, social habits, nutrition, social acceptance of being edentulous, intraoral factors, and oral diseases, could be more important predictors of edentulism. Most of the ORs in the logistic regression analyses were low to medium, but they were still significant risk markers.

As previous results have shown, high age, low education level, low household income, smoking, and alcohol abuse seem to continue to be risks in this study population for wearing a CD, related to the other classification of prosthetic status.

Acknowledgments

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