

Possible enabling and disabling factors when implementing an oral hygiene protocol in nursing homes

by

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Abstract

Aim: *This study explored possible disabling and enabling factors in order to develop and implement a structured oral hygiene protocol in nursing homes.*

Methods: *Data were collected from a representative sample of residents (n=359) and health care workers (n=225) in 16 Belgian nursing homes selected by a technique of stratified random sampling based on number of residents and management. Oral hygiene and specific characteristics on individual patient level were assessed during a clinical*

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examination and, on institutional level, in addition to the stratification variables, oral hygiene facilities, behaviour of the director, personnel behaviour and knowledge were assessed by a self-administered validated questionnaire.

Main findings: The mean dental plaque index and the mean denture plaque index were 2.17 (maximum=3) and 2.13 (maximum=4) respectively. Significant positive correlations were found between the availability of oral hygiene facilities in an institution and personnel knowledge, supportive and directive behaviour of the directors, number of residents, mean age and degree of dependency of residents. Multiple regression analysis revealed personnel knowledge as the most predictive variable for the availability of oral hygiene facilities on institutional level. On an individual level, degree of dependency was the only significant determinant for the presence of dental plaque (adjusted OR: 3.09). The only significant explanatory variable for denture plaque was the management of the institution with better denture cleanliness for residents in commercial institutions (adjusted OR: 0.43).

Principal conclusions: *After controlling for potential confounders, primary enabling factors affecting the implementation of an oral hygiene protocol were good personnel knowledge, the type of management of the institution and the supportive and directive behaviour of the board of directors. Potentially disabling factors were high degree of dependency of the residents, high mean age of the residents and a high proportion of dentate residents.*

Introduction

As in the majority of West-European countries, in the nearest future caring for the oldest part of the population will be an important objective of the Belgian oral health system. In 2000 7.2% of the Belgian population was older than 75 years and 3.5% older than 80 years. Similar percentages, 6.95% and 3.4% respectively, were found for Flanders, the Dutch speaking part of Belgium. In 2030 the amount of people of 75 and older will increase to 9.4% and the number of people of 80 and older to 5.7% (1).

The population is growing older with more people in chronic diseases and dependency. Many elderly people suffer from physical, psychological and cognitive complaints (co-morbidity), particularly during the last years of their lives (compression of morbidity). In Flanders, about 65,000 persons older than 75 (15%) reside in nursing homes or long-term care institutions and 80,000 (20%) reside at home needing supportive

domiciliary care. Based on data reported in 1999, 40% of these people have a low or moderate degree of functional dependency, 60% are nearly totally or totally dependent (2). In the Netherlands, the prevalence of dependent people older than 85 years is more than 75% (3).

Frail institutionalised elderly people are at risk for infections due to prevalent neurological diseases and co-morbidity. Elderly patients with uncontrolled diabetes or rheumatoid arthritis are at higher risk for periodontitis (5-9). It is beyond all doubts that oral health is essential for general health and contributes positively to quality of life (10-15) and that the importance of oral health increases with age (16-19).

In the medical, dental and nursing literature, there is consensus that effective oral hygiene is a determining factor in preventing oral problems (20). Since ageing people become frailer, oral hygiene should be an integral part of total care (21). Several studies focusing on oral health of dependent elderly people residing at home or in nursing homes, revealed poor oral hygiene and poor oral health (22-30). Not only the oral hygiene of the remaining teeth was inadequate (28,31), but also most denture-wearing residents living in nursing homes often do not clean their dentures satisfactorily (31,32). Dental and denture plaque may function as a reservoir of potential respiratory pathogens facilitating colonisation of the oropharynx (33). Aspiration of oropharyngeal (including periodontal) pathogens is the dominant cause of nursing home-acquired pneumonia (7,34-40). Colonisation of dental and denture plaque also gives rise to oral problems, such as caries (especially root caries), periodontitis, oral candidiasis (41,42), denture stomatitis (42,43) and halitosis (44). Plaque accumulation is a significant predictor for number of teeth lost in institutionalised older people (34). Moreover, neglected oral hygiene may increase morbidity and mortality in frail older people.

Nitschke and Hopfenmüller (45) concluded that regular dental care visits and assistance with oral hygiene are often thought to be unnecessary by the management of nursing homes and Kambhu and Levy (46) reported that all oral hygiene assessment processes appeared deficient. A lack of assessment and documentation was highlighted by Adams (47) and Sumi et al. (21) mentioning that caregivers have little experience with systematic oral care. Many authors highlighted the need of adequate oral health care programmes (48-51), management of professional dental care (29), risk assessment, oral health strategies and standards (47-52), guidelines and protocols specially developed for long-term care institutions (46,53-57).

Yet, actualisation and implementation of well-structured oral health care programmes for long-term care institutions still have to be started in several European countries. Today, evidence-based guidelines and/or protocols for improving the oral health of frail elderly people are lacking in Belgium, as in many other countries, although now guidelines and protocols are developed in a collaborating project between Belgium and the Netherlands. Developing new strategies improving quality of care, it is important to involve all actors supplying and demanding care. Initial contacts with stakeholders of organizations caring for elderly people show a high demand of support and willingness to participate in the battle to increase the quality of oral health of all nursing homes residents.

Besides this demand it is important to know that, even if guidelines and/or protocols exist, it is still an uphill battle to introduce these new care concepts. Prior to the development and implementation of innovative health care programmes, tracing possible influencing factors seems to be very important (58,59).

The aim of this study is to explore possible disabling and enabling factors when implementing a structured oral hygiene protocol in nursing homes. All actors, including residents, will be involved in the exploration.

Material and Methods

Institutionalised older people of 75 years or older ($n=2585$) living in long-term care facilities ($n=36$) in the region of Ghent in Flanders-Belgium formed the study population.

Data were collected from a representative sample of residents and 225 health care workers in 16 nursing homes in the region of Ghent in Flanders-Belgium. These nursing homes were selected from a total of 36 by a technique of stratified random sampling with proportional allocation using nine different strata. Strata were obtained by combining three categories defining the size of the institution (< 50; between 50 and 100; > 100 residents) and three categories depending on the funding of the institution (private non-profitmaking institution, with a Catholic background; social service institution; commercial institution).

Within the selected nursing homes a sample of 359 residents (14%) were selected by a technique of stratified random sampling with proportional allocation using 4 different strata based on their degree of dependency O, A, B and C (60) (Table 1).

TABLE 1.
Categories of Degree of Dependency based on Katz-Index

Category O	Physically independent and not demented
Category A	Physically dependent for bathing and/or dressing Mentally independent but disoriented in time and space
Category B	Physically dependent for bathing, dressing, transferring and/or toileting Mentally dependent, disoriented in time and space and dependent for bathing and/or dressing
Category C	Physically dependent for bathing, dressing, transferring and/or toileting and/or feeding and incontinent. Mentally dependent, disoriented in time and space and dependent for bathing, dressing, transferring, and/or toileting and/or feeding and incontinent

Deeply demented subjects were excluded. In the analysis O and A were defined as low degrees of dependency and B and C were considered high degrees. At least 10% of all residents in each nursing home were selected. When a subject refused to participate, a replacement strategy was considered. To this end each subject was selected within a cluster belonging to the same stratum. In this sampling procedure the probability to be selected for an individual depended on the probability to be sampled in a dependency group *j* belonging to one of the 9 strata *k*. In this way probabilities were checked to evaluate possible oversampling/undersampling. An oversampling was only found for the stratum private non-profit/ > 50 < 100. Given the minimal oversampling, the use of weighting factors was not considered.

The outcome variables oral hygiene (denture and dental plaque) and oral hygiene facilities were assessed using a clinical examination and a questionnaire respectively. A team of fourteen examiners carried out the clinical examinations. They were specifically trained and calibrated in the use of defined diagnostic criteria. Prior to the study, a random sample of 16 subjects (113 scores) was examined to determine inter-examiners' reliability in scoring denture plaque. The intraclass correlation coefficient was 0.96 (95%CI: 0.92-0.99 / *p* < 0.001) for total mean score per denture.

Denture plaque was scored simultaneously and independently by two investigators using Methylene Blue disclosing solution according to Augsburger and Elahi (61) (score range= 0 to 4). Dental plaque was scored by one investigator using the plaque index described by Silness and Løe (62) (score range= 0 to 3). Due to the destructive method of scoring (plaque could be removed during examination) calibration is not feasible.

During the clinical examination additional parameters at an individual level were recorded on the examination sheet: gender, age (continuous), presence (yes or no) and condition of oral hygiene tools (almost none or minimal versus moderate or strong wear) in residents' room.

Oral hygiene facilities, at institutional level, including the existence of a written protocol, communication by caregivers concerning oral hygiene needs or provided assistance by the caregivers, were assessed by a self-administered validated questionnaire filled out by all employed persons in the institutions (n=225). The results of the answers, given on a Likert scale (1= never occurs to 4= very frequently occurs), were converted and standardised to a maximum of 100.

Data on institutional level measuring directive and supportive behaviour of the director, committed behaviour, personnel independent behaviour and knowledge were collected by the same questionnaire as mentioned above. These variables are described in detail in a previous study (63).

Face and content validity of the questionnaire were assessed during a pre-test, performed in seven similar institutions (matched to the study group by the stratification variables). Further evaluation by an expert panel of managers of comparable institutions and two experts in the field, was performed. This process resulted in deletion of some questions and modification of others.

The reliability of the questionnaire was assessed during a test-retest procedure in a random sample of 30 caregivers at a two-week interval. Intraclass correlation coefficients (normal distribution) and the Wilcoxon signed rank test (skewed distribution) were calculated for the different component scores. One component of personnel behaviour (commitment) indicated a poor degree of reliability. After excluding one item from this component its reliability was acceptable.

Table 2, Table 4 and Table 5 show the annotation of all explanatory variables used and their different levels both on institutional and individual level.

The study was approved by the Ethical Committee of Ghent University and informed consent was obtained from all nursing homes prior to the start of the study.

Univariate statistical analysis of the data was carried out by Pearson or Spearman's rho correlation analyses for two continuous variables (depending on the normality of the distribution of the variables). To

compare continuous variables for different groups, means and standard deviations were calculated and differences were tested by analysis of variance and *t*-test, depending on the nature of the variable. Due to the large number of significance tests involved, the reported *P*-values in the univariate analysis have only an explanatory nature.

In order to determine the independent effect of explanatory variables on the variability of oral hygiene facilities, multiple linear regression analyses were performed using forward selection procedures. Variables that turned out to be significantly correlated in the univariate analyses were included in this model.

The variability of oral hygiene (dental and denture plaque, dichotomised at the median) for different explanatory variables was tested using multiple logistic regression analyses.

After testing for all possible interactions the best fitted model included gender, stratification variables and proportion of degree of dependency.

Analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 11.0 for Windows®. Probability of 5% was defined to indicate statistical significance of the associations examined in this study.

Results

Descriptive approach

The mean age of the residents was 84.87 years (SD 2.40) and nearly half of them (49.2%) were highly dependent. Three quarters (77.7%) were women. Most of the institutions in the sample were private non-profitmaking institutions (62.4%) followed by nearly one quarter (24.2%) social service institutions and 13.4% commercial institutions. The proportion of these different management categories in the population is 55.6%, 27.8% and 16.7% respectively. Of all institutions in the sample, 37.6% had less than 50 residents, 15.3% more than 50 but less than 100 and 47.1% more than 100 residents. The proportion of different sizes of nursing homes in the population is 38.9%, 30.6% and 30.6% respectively.

About two thirds of the residents (230/64%) were edentulous. Nearly half of the residents (171/47%) wore complete dentures, including one overdenture on implants. Some edentulous residents wore only a maxillary denture (n=41) or a mandibular denture (n=2). Sixteen edentulous residents had no dentures at all. Only 128 (36%) residents had

remaining teeth in one or both dental arches. One of them wore a complete overdenture on 2 natural teeth. For only 19.3% of the residents, wearing complete or partial dentures, a denture brush was available in their room. No toothpicks, floss or interdental brushes were found for residents with remaining teeth. For only about 10% of all residents, mouth rinse products were available.

The mean dental plaque index and denture plaque index per subject was 2.17 (SD 0.75) (maximum = 3) and 2.13 (SD 0.88) (maximum = 4) respectively indicating that good oral hygiene is more difficult for elderly people with a natural dentition. Only 4% of the subjects with natural teeth had plaque index scores less than 1 and about 30% had extremely poor oral hygiene (maximum score 3). Of all denture wearers, 46.5% had a denture plaque index higher than 2 indicating poor denture hygiene (>50% surface plaque coverage).

Figure 1. Examples of dentures with mean scores for dental plaque



Mean score (4 quadrants mucosal): 4



Mean score (2 quadrants buccal left): 3



Mean score (2 quadrants buccal right): 1.5



Mean score (4 quadrants mucosal): 2

Figure 1 shows examples of dentures with plaque scores. Only 15 residents (5%) scored 1 or lower than 1. Plaque levels were significantly higher on the mucosal site of the dentures than on the oral site, and denture cleanliness was better for maxillary dentures than for mandibular dentures.

All institutions examined reported that a structured oral hygiene protocol is rarely used and there is little or no support by a dentist. Nevertheless, caregivers reported the existence of internal communication about oral hygiene procedures and an active practice of daily oral hygiene by their residents, with or without the assistance of the caregivers. If given, basic oral hygiene is often carried out without reference to individual patients' needs.

TABLE 2.
Correlation coefficients and probabilities of relationships between the outcome (oral hygiene facilities) and explanatory variables on institutional level as continuous variables

n=225											
		Supportive behaviour director	Directive behaviour director	Committed behaviour personnel	Independent behaviour personnel	Personnel knowledge	Mean age residents	Managerial group	Mean degree of dependency residents	Size of the institution	
Oral hygiene facilities	-	.36	.35	.13	-.01	.41	-.31	.25	-.29	-.26	
	P value	<0.001	<0.001	0.06	0.86	<0.001	<0.001	<0.001	<0.001	<0.001	

TABLE 3.
Estimates from stepwise multiple linear regression model for oral hygiene facilities in the institutions

		B (SE)	95% CI	P	Collinearity statistics VIF	Durbin-Watson
Constant		72.635 (17.630)	37.842-107.427	0.000		
Personnel Knowledge	0.299	0.510 (0.114)	0.286-0.735	0.000	1.129	
Mean age of the residents	-.201	-0.605 (0.198)	-0.996-0.213	0.003	1.102	
Directive behaviour management	0.186	0.443 (0.163)	0.122-0.764	0.007	1.191	
Supportive behaviour management	0.144	0.325 (0.161)	0.008-0.642	0.045	1.297	1.631

R² = 0.304 P = 0.045

Analytical approach

The results of the bivariate correlation analysis between the availability of oral hygiene facilities in the institutions and the different explanatory variables are shown in Table 2. A significant positive correlation was found for 'knowledge of personnel' ($P < 0.001$), supportive and directive behaviour of the management ($P < 0.001$). A negative correlation was found for the mean age of the residents ($P < 0.001$), the number of residents in the institution ($P < 0.001$) and the degree of dependency of the residents ($P < 0.001$). Institutions with more residents, older residents and residents with a higher degree of dependency tend to have a lower score on the availability of oral hygiene facilities. There was also a significant difference in the availability of oral hygiene facilities between institutions depending on their management and funding system ($P < 0.001$).

In the multiple linear regression model with the oral hygiene facilities as outcome variable (Table 3) different variables met the entry requirement and were included in the equation to avoid possible confounding. These variables were the knowledge of caregivers, two components of managerial behaviour (directive and supportive) and the mean age of residents. The R-square value indicates that 30% of the variance in the availability of oral hygiene facilities is explained by the variables included in the analysis. The standardised β values show that the strongest unique contribution, explaining the dependent variable, is found in the variable 'knowledge of the care-givers' ($\beta = 0.30$), followed by 'mean age of residents' ($\beta = -0.20$) and then 'directive behaviour of the management' ($\beta = 0.19$). This model resulted in a Durbin-Watson value of 1.63 and a Variance Inflation Factor ranging from 1.1 to 1.3. The Durbin-Watson test statistic detects first-order autocorrelation. The distribution of the Durbin-Watson test is symmetric about 2.00 and ranges from 0 to 4. Positive serial correlation results in a Durbin-Watson near 0, negative serial correlation results in a Durbin-Watson near 4. Thus, as the Durbin-Watson statistic approaches 2 (as the case in the present analysis), it is more likely that the residuals are independent of each other.

In the univariate analysis using oral hygiene as an outcome variable, on an individual level (Table 4) there was a statistically significant relationship between degree of dependency of the resident and dental plaque ($P=0.01$). The mean dental plaque was higher in residents with a high degree of dependency. The same tendency, although without statistical significance, was found for denture plaque ($P=0.09$). On institutional level (Table 5), statistical significance was found between denture

plaque and management of the institution ($P=0.05$) and supportive behaviour of the direction ($P=0.05$). Commercial management and supportive directors had a favourable effect on denture cleanliness. Only a tendency ($P=0.07$) towards cleaner prostheses was found to correspond with a high level of knowledge of the personnel. Dental plaque was only significantly related to the management of the institution ($P=0.04$). Social service management had an unfavourable effect on dental cleanliness.

These findings were confirmed by the multiple logistic regression analyses (Table 6) showing the degree of dependency to be the only significant determinant for the presence of dental plaque (OR: 3.09 - 95% C.I.: 1.28-7.47) and showing better denture cleanliness for residents in commercial institutions (Table 7) (OR: 0.43 - 95% C.I.: 0.20-0.93).

Discussion

This study wants to determine enabling and disabling factors affecting the implementation of a structured oral hygiene protocol. Potentially factors included both aspects directly related to the residents and their oral hygiene, and aspects related to the preconditions for successful implementation of oral hygiene facilities in the institution.

TABLE 4.
Relationship of denture or dental plaque and different possible explanatory variables at an individual level

ANOVA		Denture plaque N=288			Dental plaque N=104		
		Mean	SD	p-value	Mean	SD	p-value
Sex	men	2.16	0.98	0.80	2.10	0.71	0.62
	women	2.12	0.85		2.19	0.77	
Degree of dependency	low	2.05	0.86	0.09	1.99	0.75	0.01
	high	2.22	0.89		2.36	0.72	
Toothbrush	absent	2.14	0.86	0.91	2.4	0.55	0.13
	present	2.12	0.88		2.07	0.76	
Toothpaste	absent	2.14	0.80	0.89	2.27	0.65	0.34
	present	2.12	0.91		2.08	0.76	
Denture brush	absent	2.12	0.87	0.89			
	present	2.14	0.90				
Denture cleaning tablets	absent	2.15	0.86	0.68			
	present	2.10	0.90				
Mouthwash	absent	2.14	0.88	0.59	2.14	0.74	0.72
	present	2.01	0.88		2.04	0.86	
Condition toothbrush							
	no or minimal wear	1.92	0.79	0.09	2.10	0.75	0.79
	moderate or strong wear	2.14	0.80		2.06	0.80	

TABLE 5.
Relationship between denture or dental plaque and different possible explanatory variables at institutional level

ANOVA	Denture plaque			Dental plaque		
	Mean	SD	p-value	Mean	SD	p-value
Size	< 50	2.11	0.91	2.07	0.80	
	≥ 50 ≤ 100	2.16	0.88	2.29	0.64	0.95
	>100	2.14	0.88	2.23	0.75	
Management	private non-profit	2.2	0.91	2.07	0.79	
	social service	2.12	0.81	2.48	0.54	0.05^a
	commercial	1.85	0.78	1.95	0.81	0.04^b
Proportion of residents with low degree of dependency						
	Only residents with low degree of dependency	2.06	0.88	1.58	0.97	
	At least 40% residents with low degree of dependency	2.14	0.90	2.24	0.74	0.95
	<40% residents with low degree of dependency	2.13	0.86	2.11	0.74	
Supportive behaviour director						
	(median dichotomized)					
	low	2.19	0.86	2.18	0.80	0.66
	high	1.97	0.83	2.10	0.65	
Directive behaviour director						
	(median dichotomized)					
	low	2.08	0.86	2.19	0.72	0.15
	high	2.04	0.83	1.85	0.75	
Committed behaviour personnel						
	(median dichotomized)					
	low	2.05	0.84	2.22	0.63	0.40
	high	2.09	0.87	2.08	0.80	
Independent behaviour personnel						
	(median dichotomized)					
	low	2.02	0.81	2.17	0.71	0.80
	high	2.11	0.88	2.13	0.75	
Personnel knowledge						
	(median dichotomized)					
	low	2.15	0.90	2.17	0.76	0.65
	high	1.94	0.76	2.08	0.66	

^a first group differs from third group, ^b first group differs from second group ($p \leq 0.05$)

TABLE 6.
Stepwise multiple logistic regression analysis
with dental plaque as dependent variable

<i>Independent variables</i>	B	SE	OR (95% CI)	p-value
Sex	0.675	0.515	1.96 (0.72-5.4)	0.19
Degree of dependency on an individual level	1.131	0.449	3.09 (1.28-7.47)	0.01
Size (Ref.: < 50 residents)				0.24
≥ 50 ≤ 100 residents	-0.940	0.950	0.39 (0.61-2.51)	0.32
> 100 residents	0.343	0.595	1.41 (0.44-4.52)	0.56
Proportion residents with high degree of dependency (Ref.: 0% high dependent)				0.71
1- 60% high dependent	-0.373	1.014	0.69 (0.94-5.02)	0.71
> 60% high dependent	-0.743	1.115	0.48 (0.5-4.2)	0.51
Management of the institution (Ref.: private non-profit)				0.56
Management social service	0.571	0.660	1.77 (0.49-6.5)	0.39
Management commercial	-0.441	0.808	0.64 (0.13-3.14)	0.59
Constant	-2.040	1.208	0.13	0.09

TABLE 7.
Stepwise multiple logistic regression analysis
with denture plaque as dependent variable

<i>Independent variables</i>	B	SE	OR (95% CI)	p-value
Sex	-0.212	0.309	0.81 (0.44-1.48)	0.49
Degree of dependency on an individual level	0.279	0.263	1.32 (0.79-2.21)	0.29
Size (Ref.: < 50 residents)				0.84
≥ 50 ≤ 100 residents	-0.19	0.472	0.98 (0.39-2.48)	0.97
> 100 residents	-0.174	0.320	0.84 (0.45-1.57)	0.59
Proportion residents with high degree of dependency (Ref.: 0% high dependent)				0.30
1- 60% high dependent	-0.782	0.558	0.46 (0.15-1.37)	0.16
> 60% high dependent	-0.977	0.629	0.38 (0.11-1.29)	0.12
Management of the institution (Ref.: private non-profit)				0.10
Management social service	-0.81	0.377	0.92 (0.44-1.93)	0.83
Management commercial	-0.841	0.391	0.43 (0.20-0.93)	0.03
Constant	0.860	0.671	2.36	0.20

After controlling for numerous potential confounders, primary enabling factors were high personnel knowledge, the type of management of the institution and the supportive and directive behaviour of the managers.

Potentially disabling factors were high mean age and degree of dependency of the residents, and a high proportion of dentate residents.

Despite the validation and reliability tests, using a questionnaire in the assessment of the organisation of oral hygiene practices in the institution could have resulted in some recall bias leading to an overestimation of real practices. A similar conclusion was made by Hardy et al. (48). Because it is to be expected that this overestimation is independent of the level of other variables, the misclassification will be non-differential and tends to introduce a bias towards the null hypothesis.

Institutions with a higher proportion of highly dependent residents and with older residents show a lower score for "oral hygiene facilities". This could probably be the result of financial arrangements. Institutions with highly dependent residents need more personnel and financial restrictions may prevent this. It is possible that lack of time may prohibit the use of a structured oral hygiene protocol. Weeks & Fiske (1994) revealed, in a qualitative study with in-depth interviews carried out in one institution, that time constraints associated with workload were an inhibiting factor for oral care in people with disabilities (64).

Further investigation with in-depth interviews (qualitative approach) is needed to explore the correlation between the mean age of the residents and the implementation of oral hygiene practices. This could be attributed, for example, to the caregivers spending more time on general health care with consequently less time for oral health care. Another hypothetical explanation could be the fact that a high proportion of the older age groups were edentulous (64%). In this case carers think that edentate people have a lesser need for oral hygiene.

Knowing these factors implicates that one should take into consideration these disabling factors (mean age and degree of dependency) and give more support when implementing a structured oral hygiene protocol in this kind of institutions.

According to the results on institutional level a lot of variability was found in the implementation of oral hygiene practices depending on the management and funding system of the institution. Private non-profit-making institutions scored the lowest and commercial institutions the highest. It could be that the socio-economic status of residents acts as

a confounding factor since this variable can be associated with both the exposure and the outcome. Directors who are more directive and more supportive seem to have a positive effect on the oral hygiene procedures in an institution, suggesting that it is important to involve the management from the beginning in any oral hygiene strategy. This is in agreement with Nitschke and Hopfenmüller who interviewed managements of 85 institutions in West Berlin and concluded that information and motivation of the management and nursing staff is the first step towards improving the dental care of home residents (45).

The regression analysis revealed personnel knowledge as the most important predictor for oral hygiene practices in the institution. Many publications already mention a lack of knowledge as one of the most important inhibiting factors in achieving an acceptable level of oral hygiene for institutionalised elders resulting in inadequate oral care (47). In particular, caregivers are poor at recognising oral disorders and assisting with oral hygiene (56). It is difficult to compare the obtained level of knowledge with those from other studies because standard questionnaires to measure personnel knowledge in the institutions are lacking. In this study no correlation was found between personnel knowledge and dental cleanliness, only a tendency ($P=0.07$) towards cleaner prostheses was found to correlate with a higher level of knowledge. These findings give rise to confirm a possible hypothesis, that nurses and caregivers provide some assistance for denture cleaning and nearly no assistance for brushing remaining teeth of dentate dependent older people. This suggests that the implementation of an oral hygiene protocol could require more efforts in institutions with a higher proportion of dentate residents. This is a real challenge because more elderly people shall have more natural teeth in the future and more complicated oral and dental status with more natural teeth all or not restored or replaced by implants and fixed prostheses (19,65).

Conclusions

Oral cleanliness was generally poor and dental plaque scores were worse than denture plaque scores indicating that good oral hygiene is more difficult for elderly people with natural dentition.

After controlling for potential confounders primary enabling factors affecting the implementation of an oral hygiene protocol were good personnel knowledge, the type of management of the institution and supportive and directive behaviour of the board of directors. Potentially disabling factors were high degree of dependency of the residents, high

mean age of the residents and a high proportion of dentate residents. The frailer and older residents are, the greater the need for a structured and supported oral hygiene protocol.

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