Chewing Ability and Dental Functional Status

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Purpose: The aim of this research was to explore the relationship between chewing ability and dental functional status, perceived oral health–related quality of life, and a number of background variables in a Vietnamese population. ***Materials and Methods:*** The cluster stratified sample consisted of 2,805 dentate subjects aged ≥ 20 years from urban and rural areas in Southern Vietnam. Chewing ability was assessed using a questionnaire that included questions on perceived difficulty with respect to eight foods and three questions of the Oral Health Impact Profile that were considered relevant. ***Results:*** Only a minority reported serious problems with chewing ability (reporting difficult or very difficult to chew). The logistic regression analysis on chewing ability outcomes showed significant relationships between chewing ability and having ≥ 10 teeth in each arch, having sufficient molar regions (≥ 1 molar posterior occlusal pair [POP] bilaterally) for hard and soft foods, and having sufficient premolar regions (≥ 3 POPs), especially for hard foods. In the hierarchical functional classification system, likelihood to report complaints on chewing ability appeared to discriminate in the branch "≥ 10 teeth in each arch." Likelihood at subsequent levels ranged from approximatel 1.5 to 3. In the branch "< 10 teeth in each arch," likelihood did not discriminate because the groups lacked sufficient homogeneity. ***Conclusions:*** Chewing ability and oral health–related quality of life were positively correlated. Among all dental and other variables, decreased chewing ability was strongest when correlated with older age categories and not correlated or weakly correlated with sex, socioeconomic status, and residence. *Int J Prosthodont 2011;24:428–436.*

The World Health Organization has considered the number of teeth to be a key indicator for oral health status.[1–4] However, since different tooth types have different functions, the question arises of whether simply the number of teeth present is adequate to describe the status of dentitions in terms of functionality. Moreover, it has been demonstrated that the impact of missing teeth on oral functions and oral health–related quality of life (OHRQoL) is only partially dependent on the number of missing teeth.[5–8] Also, location and tooth type are mentioned to be relevant in this respect.[9–13]

Loss of anterior teeth markedly impairs esthetics and satisfaction with dentition, while satisfaction is most likely to be achieved in individuals who also retain premolars.[9,14–16] Absent molars have a relatively small impact on esthetics and satisfaction[15] but are associated with impaired chewing function.[16–18] Several studies described the relationship between chewing ability and the number of posterior occluding pairs (POPs), but although this has been recognized to be a key variable, only ambiguous results were found regarding the exact number and location of POPs needed for satisfactory chewing ability.[12,19–23]

In a previous paper, the authors described the development of a hierarchical classification system, based on easily computable conditional probabilities, that reflects the functionality of dentitions. The classification is based on the number of teeth present, completeness of anterior regions, and number

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of posterior POPs. It was concluded that this classification system is a useful framework for mapping a large variety of configurations of dentitions with a fairly high homogeneity.[24]

The present study aimed to investigate the relationship between chewing ability and functional levels according the system described previously, after controlling for a number of background variables.[24] It was hypothesized that chewing ability was correlated with the configurations identified by the classification system.

Materials and Methods

Sample Construction

A cluster stratified sampling design was used to draw subjects aged ≥ 20 years from urban and rural areas of three provinces in Southern Vietnam: Can Tho, An Giang, and Ho Chi Minh. The sample construction has been described in detail in a previous report.[1] A total of 3,073 subjects participated in the epidemiologic study (Table 1). Urban subjects were randomly selected from lists of factory employees and administrative lists of citizens obtained from local authorities; rural subjects were randomly selected from representative villages using administrative lists of citizens from local authorities.

Table 1 No. of Subjects per Province

	Province			
	Can Tho	An Giang	Ho Chi Minh	Total
Residence				
Urban	703	446	412	1,561
Rural	538	556	418	1,512
Sex				
Male	603	495	384	1,482
Female	638	507	446	1,591
Total	1,241	1,002	830	3,073

Questionnaire

After obtaining verbal consent, subjects were asked to complete a self-administered questionnaire including items regarding demographic information (age and sex) and socioeconomic status (SES)[1] and questions that asked if the subject was able to chew eight different common Vietnamese foods. The eight foods were listed randomly in the questionnaire and included four foods that Vietnamese people consider as soft (cooked rice, bread, crusts, meat) and four that are considered as hard (raw vegetables, raw carrots, apples, and nuts). Perceived difficulty of chewing was scored as follows: 1 = very easy to chew; 2 = minor problems with chewing, got used to it; 3 = minor problems, cannot get used to it; 4 = difficult to chew, not avoiding this food; 5 = very difficult to chew, not avoiding; 6 = very difficult to chew, avoiding this food; 7 = not avoiding this food, never eating it. Satisfaction with chewing function in general was recorded in a dichotomized manner (yes/no). The Vietnamese version of the short-form Oral Health Impact Profile (OHIP-14VN[25]) was included in the questionnaire to assess OHRQoL. Responses to each OHIP question were given on a 5-point Likert scale (0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, 4 = very often) for a reference period of 6 months.

Subjects not able to complete the questionnaire themselves (eg, because of illiteracy or visual impairment) were helped by a dental assistant who read the questions aloud and recorded the answers.

Clinical Examination

Following the completion of the questionnaires, subjects underwent an oral examination. One calibrated examiner performed the examinations in natural light with the subject seated in an ordinary chair. The examiner was calibrated against three experienced researchers for assessment of decayed, missing, or filled teeth. A headlight was used when natural light was felt to be insufficient. Of all variables recorded, only the presence of teeth (including third molars), tooth type, and number and location of POPs were considered in the present study. Other variables (tooth wear, bleeding on probing, and tooth replacements) were not considered. A tooth root was considered as an absent tooth. A POP was defined as a posterior opposing pair of natural teeth. The research was carried out in compliance with the Helsinki Declaration. The Educational Scientific Committee of Can Tho University of Medicine and Pharmacy granted ethics approval (decision no. 390/QĐ ĐHYDCT).

Dental Functional Status Classification System

Dentitions were classified based on a dichotomized five-level functional classification system in which the criteria, as applied on the levels, were based on conditions that reflected functionality (Table 2). These conditions were the number of natural teeth, the tooth types present, and the number of POPs.[24]

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Table 2 Levels and Criteria for Dichotomization in the Step-by-Step Branching Hierarchy[24] and Percentage of Dentate Subjects (n = 2,805) Meeting Each Criterion

Level	Criterion (% of subjects)		Dichotomy
I: Dentition	≥ 1 tooth present in each arch (100%)		≥ 1 tooth vs no teeth
II: Arch	≥ 10 teeth in both mandible and maxilla (74%)	< 10 teeth in mandible or maxilla (26%)	≥10 teeth vs < 10 teeth
III: Anterior region	All 12 anterior teeth present (62%)	< 12 anterior teeth present (38%)	Complete vs incomplete
IV: Premolar region	3 or 4 occluding pairs of premolars (68%)	≤ 2 occluding pairs of premolars (32%)	Sufficient vs impaired
V: Molar region	≥ 1 occluding pair of molars at both left and right side of the dentition (64%)	No occluding pairs of molars at left or right side of the dentition (36%)	Sufficient vs impaired

Data Analysis

Subjects edentulous in the mandible or maxilla were excluded from analysis.

Chewing ability was analyzed using logistic regression models. In these models, the following dental and background variables were included: levels II to V of the functional dental status (Table 2); satisfied with chewing ("Are you satisfied with your dentition about your chewing function?"; dichotomized, "not satisfied" as reference); dichotomized scores of three OHIP items considered relevant for chewing ("never" as reference): OHIP 3 ("Have you had painful aching in your mouth?"), OHIP 4 ("Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth, or dentures?"), and OHIP 8 ("Have you had to interrupt meals because of problems with your teeth, mouth, or dentures?"); OHIP total score; four age categories (20 to 35 [reference], 36 to 55, 56 to 65, and 66 years and older); sex (male as reference); residence (rural as reference); and SES (three levels[1]; SES middle as reference). Since it was shown that the questionnaire administration format (self-administered vs [partly] assistance-administered) when completing the OHIP questionnaires resulted in significantly influenced OHIP scores,[25] this variable was also added to the model (self-administered as reference).

With respect to chewing ability of the eight separate foods, the answers "very easy to chew," "minor problems with chewing, got used to it," and "minor problems, cannot get used to it" were considered as having no or minor problems with chewing; the answers "difficult to chew, not avoiding this food," "very difficult to chew, not avoiding," and "very difficult to chew, avoid this food" were considered as having substantial problems with chewing. Therefore, in the analysis of chewing ability of the respective foods, outcomes were dichotomized as follows: no or minor problems with chewing (scores 1, 2, and 3) vs substantial problems with chewing (scores 4, 5, and 6). Score 7 (not avoiding this food, never eating it) was considered missing.

Combined soft and hard foods were analyzed at a different level in which a more stringent criterion was applied. Cut-off for dichotomization here was defined as "no problem with chewing at all" (score 1 ["very easy to chew"] for each of the four combined foods) vs "problems with chewing" (score > 1 for at least one of the combined foods).

To analyze the relationship between chewing ability and functional dental status, likelihood ratios for having problems with chewing soft and hard foods were calculated after dichotomization at levels II to V of the functional status classification system. These ratios express the extent to which a given classification, for instance having at least 10 teeth in each arch, contributes to making a distinction between people with and without chewing problems. This ratio is calculated as the odds between people with and without chewing problems in the group failing to meet a classification criterion and the odds in the comparison group. A likelihood ratio of 1 indicates a classification criterion that is not discriminatory. The more the likelihood ratio differs from 1, the more the criterion is associated with differentiating people with and without chewing problems.

Results

Of the total sample of 3,073 subjects initially included in the study, 253 subjects (8%) were edentulous in the maxilla or mandible and excluded from analysis. In addition, 15 dentate subjects were excluded because of incomplete data sets. This left 2,805 dentate subjects (92%) for further analysis.

A large majority of subjects (varying from 73% for carrots to 92% for cooked rice) showed nonproblematic chewing ability for all foods (Fig 1). More problems in terms of frequency as well as severity were reported for hard foods than for soft foods. Score "very difficult" was scarce (less than 2%) for soft foods; however, it amounted to approximately 10% for the hard foods carrots, apples, and nuts.

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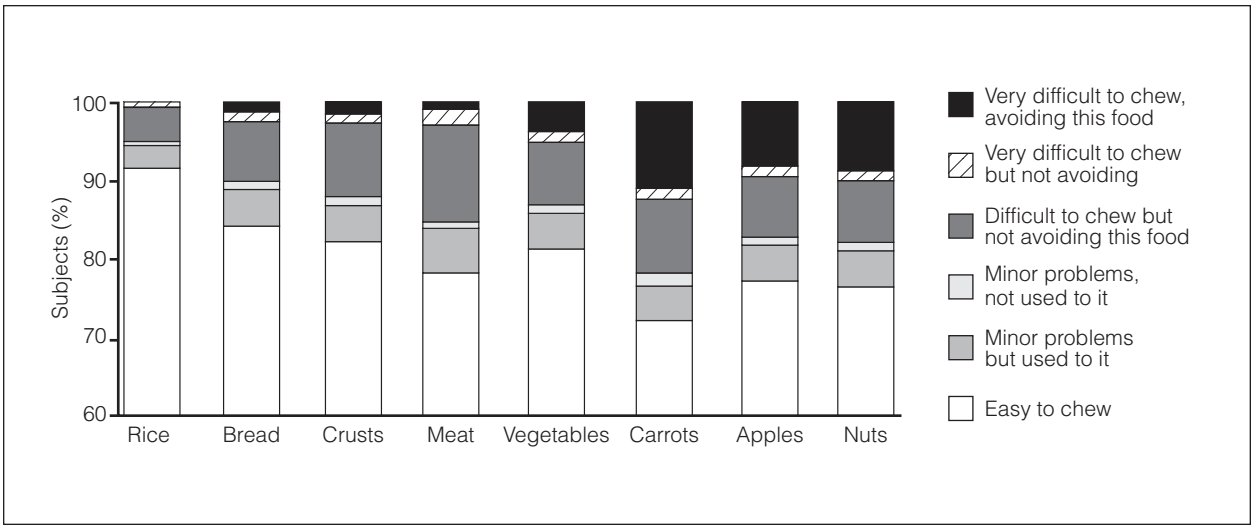

Fig 1 Distribution of dentate subjects reporting ease or various levels of difficulty with chewing the eight foods investigated in this study (n = 2,805).

In the model investigating the eight common foods separately (Table 3), the odds ratios on chewing ability revealed that having sufficient molar regions compared to not meeting this criterion reduces the risk for having problems with chewing by a factor of 0.50 to 0.62 (meaning a significant reduction of problems by approximately 40% to 50%) for all hard foods and for three soft foods. Having sufficient premolar regions reduces the risk for having problems with chewing by approximately 30% to 45%; however, this was significant only for the four hard foods and one soft food.

The influence of having complete anterior regions on chewing ability was shown to be weak (significant for three foods), whereas having more than 10 teeth in each arch generally showed no relationship with chewing ability, with the exception of nuts.

Being satisfied with chewing reduced the chance of indicating problems with chewing ability by up to approximately 60% (odds ratios ranging from 0.32 to 0.63, significant for all foods).

Chewing ability did not significantly correlate with OHIP item 3 (painful aching) or OHIP item 8 (interrupt meals), except for crusts. Chewing ability correlated significantly with OHIP item 4 (uncomfortable eating) for all types of foods (odds ratios ranged from 1.57 to 1.96; up to 95% increase in the chance of having problems with chewing ability), except for cooked rice.

Chewing ability was significantly positively correlated with OHRQoL, as indicated by the OHIP total scores for all foods.

Subjects that were assisted with the completion of the OHIP questionnaire reported more complaints regarding chewing ability (odds ratios ranged from 1.58 to 2.79) for all foods except rice compared to those who completed the questionnaires without assistance.

Age appeared to be a factor with a significant impact on chewing ability. The older the age category, the more complaints on chewing ability reported (with three exceptions in the age category 36 to 55 years), amounting up to a factor of 10 for subjects over 65 years for chewing meat and nuts. Females tended to report more complaints on chewing ability, but this was significant only for the hard foods carrots, apples, and nuts. Urban-dwelling individuals had fewer complaints; this difference in chewing ability was significant for six of the eight foods. Although there seemed to be a trend that chewing ability correlated with SES (SES high having fewer complaints, SES low having more complaints), only two significant relationships were demonstrated (vegetables and nuts).

The logistic regression for combined soft and combined hard foods showed that meeting each of the four dental functional level criteria decreased the chance of having problems with chewing both soft and hard foods (Table 4). This was significant for the criteria "at least 10 teeth in each arch" and "molar region sufficient." A sufficient premolar region was significant for chewing hard foods but not soft foods.

In this model, the OHIP items "uncomfortable eating" and "interrupt meals" showed significant negative relationships with chewing ability. The OHIP item "painful aching" did not correlate with chewing ability.

As in the regression analysis of the separate foods, OHIP total scores were positively correlated with chewing problems. Again, in this analysis, the two

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Table 3 Odds Ratios for Having "Substantial Problems" with Chewing for the Eight Foods According to the 14 Variables Included in the Logistic Regression Model

	Odds ratio (95% confidence interval)*							
	Rice	Bread	Crusts	Meat	Vegetables	Carrots	Apples	Nuts
≥ 10 teeth in each arch (II)	0.62 (0.33–1.17)	1.07 (0.66–1.73)	0.98 (0.62–1.56)	0.83 (0.54–1.27)	0.70 (0.45–1.08)	0.91 (0.63–1.33)	0.77 (0.51–1.15)	**0.60** (0.40–0.90)
Complete anterior region (III)	0.87 (0.50–1.50)	0.69 (0.46–1.02)	**0.57** (0.40–0.83)	0.76 (0.55–1.07)	0.79 (0.55–1.12)	**0.73** (0.55–0.97)	**0.66** (0.48–0.92)	0.73 (0.53–1.00)
Premolar region sufficient (IV)	0.89 (0.51–1.55)	0.70 (0.46–1.07)	0.74 (0.50–1.11)	**0.66** (0.46–0.95)	**0.67** (0.46–0.98)	**0.54** (0.39–0.74)	**0.62** (0.44–0.89)	**0.59** (0.42–0.84)
Molar region sufficient (V)	**0.50** (0.29–0.85)	**0.56** (0.37–0.82)	0.70 (0.48–1.01)	**0.62** (0.44–0.86)	**0.62** (0.44–0.89)	**0.60** (0.45–0.81)	**0.54** (0.39–0.75)	**0.60** (0.43–0.82)
Satisfied with chewing	**0.63** (0.41–0.96)	**0.37** (0.27–0.51)	**0.40** (0.29–0.54)	**0.42** (0.31–0.56)	**0.51** (0.38–0.68)	**0.35** (0.27–0.46)	**0.34** (0.26–0.45)	**0.32** (0.25–0.43)
OHIP 3: painful aching	1.16 (0.72–1.87)	1.35 (0.94–1.95)	1.09 (0.77–1.54)	1.96 (0.70–1.32)	0.96 (0.69–1.33)	1.18 (0.90–1.56)	1.18 (0.86–1.60)	1.05 (0.77–1.42)
OHIP 4: uncomfortable eating	1.40 (0.80–2.46)	**1.78** (1.17–2.70)	**1.96** (1.32–2.90)	**1.57** (1.10–2.24)	**1.61** (1.11–2.33)	**1.80** (1.31–2.46)	**1.77** (1.25–2.51)	**1.58** (1.12–2.24)
OHIP 8: interrupt meals	1.06 (0.66–1.72)	1.25 (0.86–1.80)	**1.60** (1.12–2.27)	1.06 (0.76–1.48)	0.97 (0.69–1.37)	1.21 (0.89–1.62)	1.06 (0.77–1.47)	1.14 (0.82–1.58)
OHIP total	**1.08** (1.05–1.12)	**1.07** (1.04–1.09)	**1.07** (1.05–1.10)	**1.09** (1.07–1.11)	**1.08** (1.06–1.10)	**1.04** (1.02–1.06)	**1.07** (1.04–1.09)	**1.07** (1.04–1.09)
Assistance administered	1.57 (0.98–2.53)	**1.97** (1.36–2.85)	**2.79** (1.94–4.02)	**2.36** (1.71–3.27)	**1.58** (1.15–2.19)	**1.85** (1.41–2.42)	**2.09** (1.53–2.84)	**1.76** (1.30–2.38)
Age 36 to 55 y	**2.78** (1.20–6.44)	1.09 (0.69–1.73)	1.30 (0.83–2.03)	**1.64** (1.08–2.48)	**1.97** (1.25–3.10)	1.11 (0.81–1.52)	**1.92** (1.29–2.86)	**2.11** (1.41–3.15)
Age 56 to 65 y	**5.70** (2.31–14.08)	**2.45** (1.43–4.21)	**3.97** (2.36–6.66)	**4.96** (3.06–8.02)	**4.43** (2.64–7.46)	**1.95** (1.31–2.91)	**3.70** (2.30–5.96)	**4.22** (2.63–6.79)
Age > 65 y	**9.62** (3.84–24.11)	**4.23** (2.42–7.40)	**7.39** (4.29–12.73)	**10.10** (6.08–16.77)	**8.48** (4.94–14.55)	**4.82** (3.15–7.38)	**9.33** (5.66–15.38)	**10.65** (6.46–17.56)
Female	1.14 (0.78–1.68)	0.91 (0.68–1.23)	1.06 (0.80–1.40)	1.06 (0.81–1.37)	1.24 (0.95–1.63)	**1.44** (1.15–1.81)	**1.34** (1.04–1.74)	**1.50** (1.16–1.94)
Urban	0.71 (0.47–1.06)	**0.65** (0.47–0.89)	**0.65** (0.48–0.87)	0.76 (0.58–1.00)	**0.60** (0.45–0.79)	**0.64** (0.51–0.82)	**0.56** (0.43–0.73)	**0.48** (0.37–0.63)
SES high	0.77 (0.45–1.31)	0.98 (0.66–1.44)	0.90 (0.62–1.30)	1.16 (0.83–1.62)	0.97 (0.68–1.39)	0.88 (0.65–1.19)	0.81 (0.58–1.13)	0.82 (0.58–1.15)
SES low	1.30 (0.82–2.04)	1.41 (0.98–2.02)	1.14 (0.80–1.61)	1.32 (0.95–1.82)	**1.41** (1.01–1.95)	1.19 (0.89–1.57)	1.36 (0.99–1.86)	**1.38** (1.01–1.88)

*Bold numbers indicate significant relationships.

highest age categories had a significant negative impact on chewing ability. The relationship between chewing ability and dental functional categories is displayed in Fig 2. The branching hierarchy described 84% of all dentate subjects (n = 2,805) up to level IV (premolar region) and 75% up to level V (molar region). Forty-eight percent of the dentate sample met all criteria for a sufficient functional dentition (meeting all cut-offs up to level V); 18% met none of the criteria.

Likelihood for having problems with chewing if the criterion was not met was given for each of the branches analyzed for combined hard foods (Lh) and for combined soft foods (Ls). At level II of the classification system, the likelihood to report problems with chewing for combined hard foods was 3.070, meaning that the chance for reporting any chewing complaints was approximately 3 times higher for subjects not meeting the criterion "≥ 10 teeth in each arch" compared to subjects meeting the criterion. The likelihood for soft foods (Ls) at this level was 2.561; subjects that did not meet the "≥ 10 teeth in each arch" criterion had approximately 2.5 times higher risk to report any complaint for chewing soft foods.

In the "≥ 10 teeth" branch (two left columns in Fig 2), completeness of the anterior region (level III) appeared to be a relevant criterion in reporting complaints about

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Table 4 Odds Ratios for Having Any Problem with Chewing for the Combined Soft (Cooked Rice, Bread, Crusts, Meat) and Hard (Raw Vegetables, Raw Carrots, Apples, Nuts) Foods

	Soft foods		Hard foods	
	OR*	95% CI	OR*	95% CI
≥ 10 teeth in each arch (II)	**0.68**	0.47–0.99	**0.62**	0.44–0.87
Complete anterior region (III)	0.86	0.65–1.14	0.85	0.66–1.09
Premolar region sufficient (IV)	0.79	0.58–1.09	**0.63**	0.47–0.84
Molar region sufficient (V)	**0.74**	0.56–0.99	**0.74**	0.57–0.95
Satisfied with chewing	**0.44**	0.35–0.57	**0.41**	0.32–0.52
OHIP 3: painful aching	0.91	0.70–1.19	0.83	0.65–1.06
OHIP 4: uncomfortable eating	**2.43**	1.83–3.23	**1.85**	1.42–2.42
OHIP 8: interrupt meals	**1.93**	1.48–2.53	**1.73**	1.34–2.23
OHIP total	**1.06**	1.04–1.08	**1.05**	1.03–1.07
Assistance administered	1.17	0.92–1.49	1.20	0.97–1.50
Age 36 to 55 y	1.14	0.86–1.51	1.12	0.88–1.44
Age 56 to 65 y	**2.59**	1.79–3.74	**1.96**	1.40–2.74
Age > 65 y	**4.95**	3.31–7.40	**3.90**	2.69–5.66
Female	0.93	0.75–1.14	1.18	0.97–1.43
Urban	1.20	0.96–1.49	0.97	0.80–1.19
SES high	**1.53**	1.18–1.98	1.17	0.91–1.49
SES low	1.02	0.77–1.34	1.02	0.79–1.31

OR = odds ratio; CI = confidence interval.
*Bold numbers indicated significant relationships.

chewing the four hard foods (Lh = 1.581) as well as the four soft foods (Ls = 1.638). The highest likelihood values in this branch were found at level IV (criterion: sufficient premolar region): Lh = 2.030, Ls =2.138. Thus, not meeting the criterion "sufficient premolar region" doubled the chance for having any complaint for chewing ability. At this level, the number of POPs differed markedly between meeting the criterion (7.7 ± 1.7) and not meeting the criterion (3.7 ± 1.6). The effect of meeting the criterion "sufficient molar region" (level IV) appeared to be weaker than the premolar criterion (both Lh and Ls approximately 1.5).

In the "< 10 teeth" branch (two right columns in Fig 2), likelihood for reporting complaints at all levels was approximately 1. This indicates that despite the differences between numbers of teeth and numbers of POPs, the classification criteria were not discriminatory with respect to chewing ability.

Discussion

This study aimed to explore the relationship between chewing ability and dental functional status, perceived OHRQoL, and a number of background variables in a Southern Vietnamese adult population. Since this study is part of a larger epidemiologic study, sample construction aimed at equal distribution of subjects according to residence, province, sex, and age.[1] In comparison to the age group distribution in the population, older subjects were overrepresented in the sample. The sample's SES structure is comparable with governmental data.[26]

Reduced dentitions are common in Vietnam: 86% of the adult Southern Vietnamese population has at least one missing tooth, with the mean number of missing teeth increasing almost linearly from 2 at the age of 30 years to approximately 16 in elderly individuals.[1]

Despite the high mean number of missing teeth in this population, difficulties with respect to chewing were reported only in low frequencies and with confined differences for the hard and soft foods. This might be related to the typical Vietnamese diet and food preparation, while the distinction between hard and soft Vietnamese foods is arbitrary. For example, in Western countries, crusts and meat can be considered hard foods.

Looking at factors influencing chewing ability, a moderate cut-off (no or minor problems vs substantial problems) was used for analysis of the separate foods, and a more stringent cut-off (no problem at all vs problems) was used when foods were combined.

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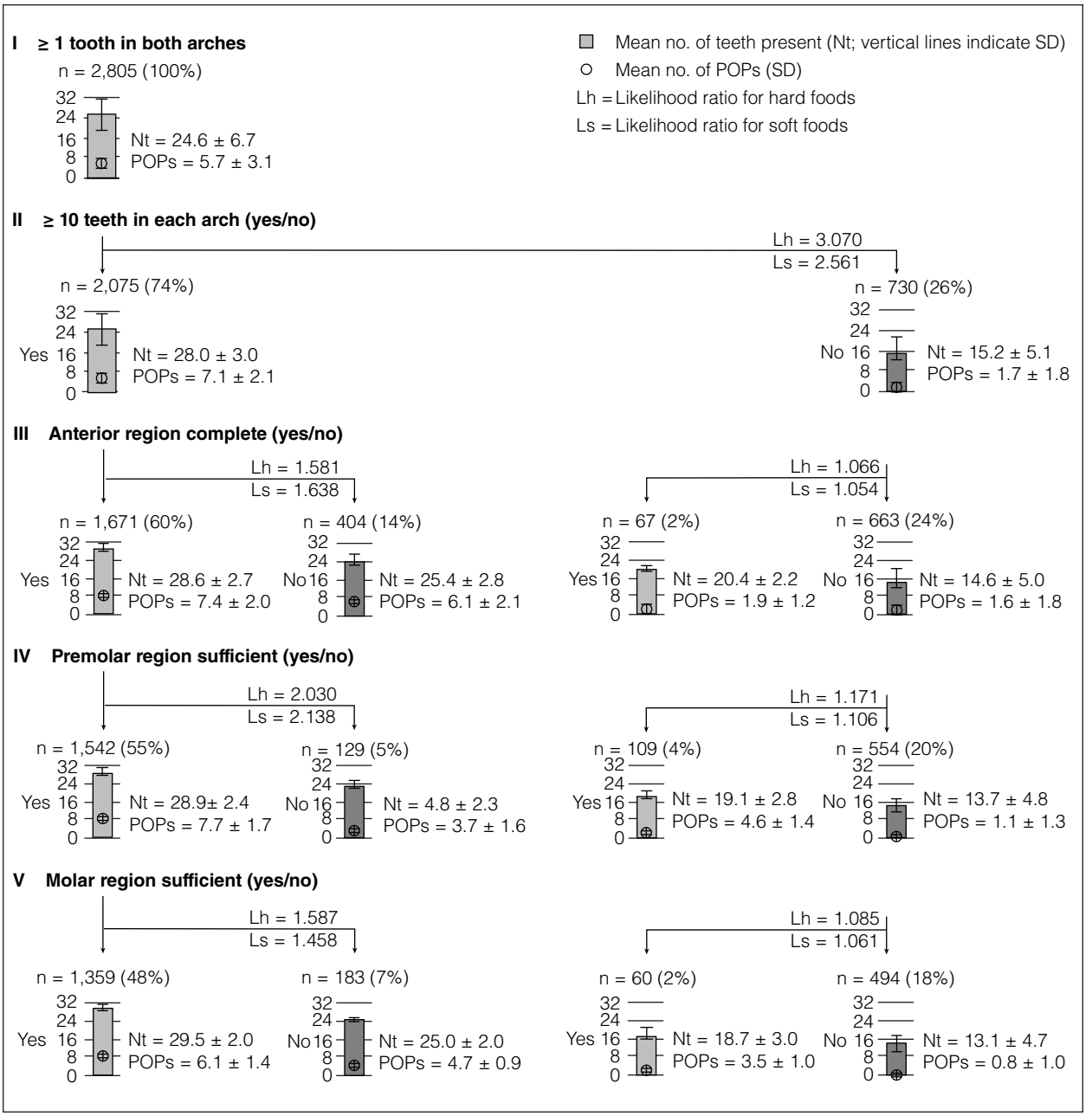

Fig 2 Distribution of dentate subjects according to the functional classification system[24] and likelihood for having problems with chewing: (I) dentate in each arch, (II) ≥ 10 natural teeth in each arch, (III) anterior region complete, (IV) premolar region sufficient, and (V) molar region sufficient. Dark columns indicate status of not meeting criterion. SD = standard deviation.

Despite this difference in cut-offs, subjects with impaired molar regions reported more chewing complaints for soft as well as hard foods, whereas subjects with impaired premolar regions reported this only for hard foods. The criterion "complete anterior region" seemed to have a relative minor influence on chewing; however, the significant odds ratios for crusts, carrots, and apples indicate its importance for biting of these foods.

Having less than 10 teeth in each arch revealed substantial chewing problems for nuts only. However, with the cut-off of having any problems, this criterion was important for combined hard and soft foods.

Although the logistic regression models control for the effects of (background) variables, it should be noted that they lack hierarchy. This means, for example, that the odds ratios for sufficient molar regions are based on a range of 18.7 ± 3.0 to 29.5 ± 2.0 teeth

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present and a range of 3.5 ± 1.0 to 8.1 ± 1.4 POPs (Fig 2). As a result, sufficient molar regions do not reflect the functional occlusal status in detail. This shortcoming is confronted by using a hierarchical functional classification system as proposed. It has been shown previously that this system creates homogenous dental configurations, especially in the "≥ 10 teeth in each arch" branch.[24] With respect to chewing ability, the "≥ 10 teeth in each arch" branch showed likelihoods for hard and soft foods that discriminate between the cut-offs at all functional levels. Apparently the relative heterogeneity in number of teeth and POPs in the "< 10 teeth in each arch" branch is because of nondiscriminatory likelihood ratios for chewing ability.

A positive association of number of (functional) teeth and presence of posterior occlusal support to chewing ability has been described for several populations.[27–33] Data supporting this outcome are mostly derived from elderly populations.

Of all variables in the regression models, age showed the highest impact on chewing ability. Although it is known that dental status is correlated with age, the impact of age in this study appeared to be much more relevant and significant than any of the dental variables. For subjects above the age of 55 years, odds ratios for having chewing problems were higher than for any other variable in the logistic regression models (including dental variables indicating number of teeth present and number of POPs) and statistically significant for all hard and soft foods. Nondental functional reductions, such as decreased occlusal force and swallowing ability as well as factors such as general health and psychosocial and social well-being, have been associated with chewing ability of elderly individuals.[34–37] In contrast, the dental literature provides almost no information regarding the relationship between chewing ability and aging for adults younger than 65 years of age. The present study indicates that after controlling for the effects of dental variables, impaired chewing ability might also be associated with nondental factors (common among elderly individuals) in subjects in the age category of 56 to 65 years, but not in adults younger than 55 years.

The present study showed a significant association between chewing ability, assessed by the criterion of having any problems with chewing hard and soft foods, and OHRQoL, as assessed by OHIP total score. Although chewing ability was significantly associated with OHIP total score for all (combined) foods, higher OHIP total scores only resulted in less than 10% increased reporting of difficulties with chewing. In this population, OHRQoL seems to have less impact on chewing than in other studies.[33,38] OHIP items 3 (painful aching) and 8 (interrupt meals) were not associated with reporting problems with chewing.

The weak effect of sex (females having more complaints with chewing hard foods) might be explained by differences in occlusal force and chewing efficiency.[39,40]

Conclusion

Although a considerable portion of Vietnamese adults had reduced dentitions in varying degrees, a minority reported serious problems with chewing. Chewing ability was correlated with sufficient molar regions for soft and hard foods and sufficient premolar regions for hard foods only. Chewing ability and OHRQoL were positively correlated.

For specific dental configurations, the hierarchical functional classification system enabled quantifying chewing ability in terms of likelihood ratios. In the branch "≥ 10 teeth in each arch," likelihood for adequate chewing ability differed substantially between those meeting the criteria at each subsequent level and those not. In the branch "< 10 teeth in each arch," likelihood to report complaints on chewing ability did not discriminate.

The outcomes of this study are considered valid for the Southern Vietnamese population investigated. The validity for other populations remains to be verified.

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