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Partial- or Full-Mouth Examination Assessing the Dental and Prosthetic Status among Elderly Individuals

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Abstract - *The aim of this study was to determine whether half-mouth examinations accurately reflect the dental and prosthetic status of the entire mouth. Samples of 1,830 adults aged 55-79 years were examined. The rate of agreement between half- and full-mouth examinations was estimated using weighted and unweighted Kappa values comparing findings of each tooth bilaterally. A power analysis was performed to estimate the number of subjects representing complete dental recordings within a certain power. Subjects showed unweighted Kappa values from 0.34-0.96. Weighted Kappa values ranged from 0.74-0.99. A power analysis for unweighted Kappa scores computed that findings from 122-335 individuals were necessary to equal the results obtained using complete dental recordings.*

KEY WORDS: Dental Status, Elderly, Kappa, Full Mouth Examination, Cross-sectional Study, Power analysis

INTRODUCTION

Large scale epidemiological examinations of the oral cavity are frequently used to describe the oral status of a population [1-6]. Examinations usually record multiple observations per subject, for example the condition of the dental hard tissues, the type of material used and loss of periodontal attachment at four points around each of 32 teeth. In one such study, the Study of Health in Pomerania (SHIP-0) [7], researchers could record up to 9,856 data points. Collecting and recording such comprehensive information is time-consuming and costly. The use of a partial-mouth examination technique can potentially increase efficiency and is of interest to researchers and their funding bodies [8].

Half-mouth examinations have been more frequently used in epidemiological studies examining prevalence of caries and periodontal disease [1-6] but have been used less frequently in relation to prosthodontics [9]. The use of half-mouth examinations is performed mostly in large scale studies, such as NHANES, NIDR, and SHIP and is based on the assumption that oral conditions are distributed in a equal way bilaterally, but vary among the teeth on each side in a reasonably symmetrical pattern [1,2]. For example, measuring periodontal pocket depths in eight teeth in diagonally opposing quadrants demonstrates a correlation of 0.96 with full-mouth scores [2]. When results of partial recordings are doubled to represent data for a complete mouth score, little information is lost [1]. However, an evaluation of the efficiency of half-mouth examinations of determining prosthetic status using partial-recording techniques has never been performed.

The aims of this study are firstly to test the hypothesis that partial recording of prosthetic status using an alternating diagonal half-mouth examination gives results which can accurately represent complete recordings, and secondly to estimate the number of subjects required to provide equal power of detecting significant change as seen with full-mouth examination techniques.

MATERIAL AND METHOD

Data collection

From October 1997 to May 2001, a randomized, cross-sectional, population-based, observational study was carried out in the region of West Pomerania in northeast Germany (Study of Health in Pomerania - SHIP). The main aim of SHIP was to determine the prevalence of a number of general and dental diseases by means of interviews, questionnaires, and clinical examinations and to explore interrelationships with the socio-economic status and behavior of the participants. The study's management team selected randomized subjects using the County Registry Office files and selected subjects were invited to attend the study examination centre [10]. The total sample comprised 6,267 people within an age range of 20 to 81 years. The response rate was 68.8% and 4,310 subjects were examined.

The examinations were performed by five calibrated dentists from the Centre of Oral Health at the University of Greifswald, Germany. Training and calibration was undertaken prior to the study starting and twice a year during the study. This involved the use of training manuals, practical examinations and consensus discussions. The inter-examiner Kappa values recording the dental status were >0.95.

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The dental status of each tooth was recorded during the examination with 5 possible alternatives:

- Group 1: sound tooth or tooth with any directly placed restoration;
- Group 2: tooth with crown, partial crown, or implant retained restoration;
- Group 3: missing tooth replaced by fixed partial dentures (pontics);
- Group 4: missing tooth replaced by removable partial denture, and
- Group 5: missing tooth with no replacement[8].

Root remnants and teeth which had lost most of their crown structure were classified as missing teeth. The maximum number of teeth included in this study was 28, ie the third molars were excluded.

The present investigation was limited to 1,830 subjects aged between 55 to 79 years. Subjects were stratified into 3 groups according to their age; 55-64yr, 65-74yr, and 75-79 yr.

Statistical analyses

The rate of agreement in relation to the presence or absence of teeth and the prosthetic rehabilitation, between right and left side of the maxilla and mandible was estimated using unweighted and weighted Kappa values according to Fleiss [11]. Kappa values of greater than 0.60 being suggestive of a "strong" agreement, whilst values in excess of 0.80 suggest agreement is "excellent" [12]. Fleiss classified Kappa values of between 0.4 and 0.75 as being "fair to good" and of more than 0.75 as "good" [11]. Weighted Kappa values were used to ensure that misclassification of a sound tooth and a crown is less than the difference between a sound tooth and a missing tooth. The factors of weighting Kappa are presented in Table 1.

A power analysis was performed using nQuery Advisor® to estimate the number of subjects having a half-mouth examination that would be required to provide representative findings for complete (full-mouth) recordings. To compute unweighted ratings the level of significance was set at p = 0.05, a 2-sided test with an alternative agreement of 0.4 was set, proportion success varied from 0.7 to 0.9, and the hypothesis agreement varied from 0.6 to 0.7.

RESULTS

Of the 1,830 subjects examined, 846 were aged between 55 to 64 years (430 females, 416 males), 683 were aged between 65 to 74 years (301 females, 382 males), and 301 were aged between 75 to 79 years (137 females, 164 males).

Subjects in the two most elderly groups showed unweighted Kappa values between 0.61 (second premolar) and 0.90 (central incisor) in the maxilla, whereas the younger subjects aged 55 to 64 years showed lower Kappa values of between 0.51 (second premolar) and 0.87 (central incisor).

A similar pattern was seen in the mandibular arch with the two older age groups having Kappa scores ranging between 0.41 (second premolar) to 0.95 (central incisor), whereas 55 to 64 year old group had scores of between 0.34 (second premolar) to 0.96 (central incisor) (Figure 1).

Higher results were obtained with statistical weighting (Figure 2). In the maxillary arch the age groups 65 to 74 years and 75 to 79 years had Kappa scores ranging from 0.88 to 0.99; however in the age group 55 to 64 years there was less agreement with scores of between 0.79 to 0.93. In the mandibular arch the lowest agreement was found for the second premolar (0.88) and the highest for the central incisor (0.99) in subjects aged 65 to 74 years and 75 to 79 years. The Kappa of subjects aged 55 to 64 years ranged from 0.74 (second premolar) to 0.99 (central incisor). There were no significant differences between males and females.

A power analysis for unweighted Kappa scores that depended on settings of hypothesis, alternative agreement, and proportion success computed that findings from 122-335 individuals were necessary to equal the results obtained using complete dental recordings. The results of the power analysis are presented in Figure 3. They demonstrate how the required sample size is dependent on the number of "agreements" and the Kappa of the hypothesis with constant Kappa of 0.4 for the alternative hypothesis.

DISCUSSION

The survey sample used in this study was representative of the population within the study region of Pomerania [8,10]. The population of Pomerania is mainly Caucasians, who are living in a rural area in the former East Germany. The use of well-defined clinical criteria and the repeated calibration of the examiners proved efficient with minimal variability as illustrated by inter-examiner correlation [8,10].

To our knowledge this is the first study to examine the reliability of a half-mouth examination technique as a means of assessing the dental/prosthetic status of a population, and which, in so doing has calculated an approximate minimum number of subjects required to duplicate the results of a full-mouth technique using power analysis.

Table 1. *Weighting of Kappa values*

	Natural teeth with or without fillings	*Crown, partial crown, implant*	*Pontic (replaced by FPD)*	*Teeth replaced by RPD*	*Missing teeth without replacement*
Natural teeth with or without fillings	1	0.75	0.5	0	0
Crown, partial crown, implant		1	0.75	0	0
Pontic (replaced by FPD)			1	0.25	0
Teeth replaced by RPD					0
Missing teeth without replacement					1

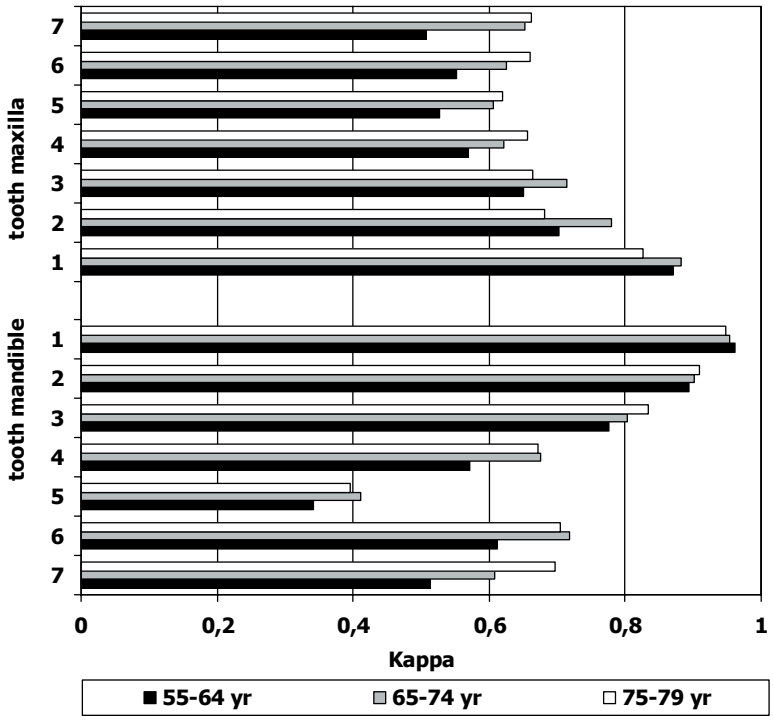


Figure 1. *Unweighted Kappa coefficient by comparing each tooth bilaterally in maxilla and mandible*

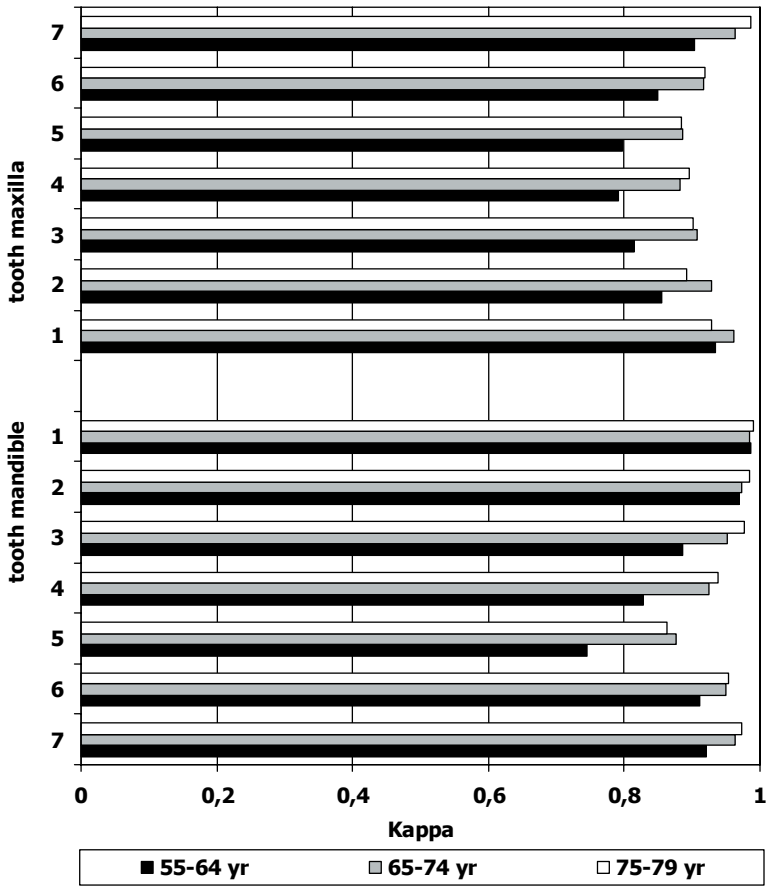
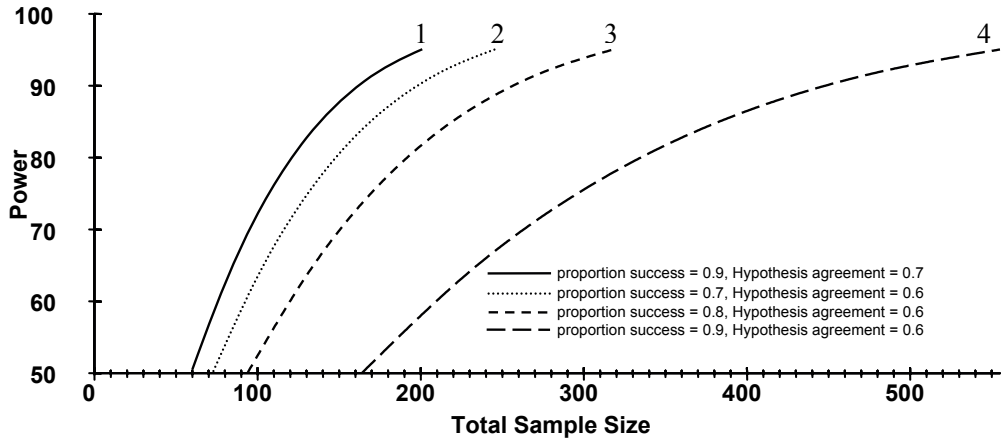


Figure 2. *Weighted Kappa coefficient by comparing each tooth bilaterally in maxilla and mandible*



The dependence on the number of "agreements" was symmetrical about the 50% value, in other words 90%~10%, 80%~20%, 70%~30% etc. From the lines 2, 3, and 4 in Figure 3 the increment of the sample size with increasing number of "agreements" beyond 50% can be seen at constant hypothesis (in this case Kappa = 0.6) and at constant alternative hypothesis with Kappa = 0.4.The increment is at its maximum when the amount of "agreement" is very high (i.e. replaced at maxilla 6) or very low (i.e. pontic at maxilla 1). Lines 1 and 4 indicate that at constant value of "agreements" – here 90% - the sample size increases steeply with the reduction of the difference of hypothesis; in this case from Kappa = 0.7 to Kappa = 0.6 of the alternative hypothesis with Kappa = 0.4.

Figure 3. *Power analysis using unweighted Kappa values*

Such computations pre-suppose a high sample size which was the case with SHIP.

Kappa values of more than 0.60 can be considered to suggest a "strong" agreement as stated by our hypothesis [12]. Strong Kappa values were seen in the two groups of subjects aged 65+ years, with thirteen out of 14 pairs of teeth examined demonstrating high agreement. One possible explanation for this reason is the high tooth loss in these age groups [13]. When comparing tooth loss in subjects aged 55-64 years to that of the elderly, the agreement is significantly lower, and, this can lead to a misclassification in subjects with a greater number of teeth regarding the presence or absence of teeth and/or the type of prosthesis present (fixed or removable).

The lowest agreement was found in relation to the presence or absence of the second premolar in the mandible. This is an area which will involve different choices in treatment planning. For missing molars, both patient and dentist have to decide between the concepts of the shortened dental arch (SDA) or removable partial denture (RPD). In this context, social and financial aspects as well as preferences of the dentist play an important role [14]. Furthermore, the historical background of the subjects must be considered: In former East-Germany a simple therapy was preferred over complicated prosthetic care [13]. Simple therapy resulted in the extraction of teeth [15]. In the upper jaws deviation of the Kappa values is less but the values are higher because normal tooth loss is nearly symmetrical and finally tooth loss in the upper jaw starts earlier than in the lower jaw [13].

In general, half-mouth examinations may provide an underestimation of prosthetic rehabilitation requirements [1-3]. To avoid this problem, the number of subjects examined should be high enough to minimise loss of information. Spencer discussed the half-mouth examination critically and concluded that the numbers of subjects are often not high enough to get reliable and comprehensive results [1]. It is our opinion that this statement depends on the clinical parameter being examined in the study and generalised statements may not necessarily be applicable to all oral examinations.

The number of subjects that are required to provide an 80% power of agreement when comparing the results of a half-mouth technique is between 126 and 335 subjects, based on our unweighted Kappa values. The actual number depends on the settings of the parameter hypothesis, the alternative agreement and the proportion success. This, however, is only valid for subjects aged 55 years or older. Computations on younger subjects suggest an increased subject number is required due to lower agreement. By evaluating the results using weighted Kappa, the amount of subjects could be reduced to 30-50%. Further, the results can be made more reliable if the examiner asks the subjects to specify if they have a complete denture or RPD or fixed partial denture (FPD) or any tooth replacement.

The fact that tooth loss, particularly amongst the elderly is a reflection of their society, and the dental regime to which they have been exposed [13,14] might limit the reproducibility of this study in other countries as their dental treatment philosophies might be different. Therefore our results need to be confirmed by different data from other countries. Nevertheless, half-mouth examinations cannot be recommended when the number of subjects is very low, as in this situation the loss of information is too high and doesn't relate to statistic power or time saving.

To conclude, half-mouth examination in elderly populations may be a feasible alternative to if time and resource constraints do not allow complete dental and prosthetic examinations. This may be dependent on the aim of the study and on the minimum number of individuals available within the study.

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