# The Relationship between Clinical Dental Status and Oral Impacts in an Elderly Population

Georgios Tsakos<sup>a</sup>/Wagner Marcenes<sup>b</sup>/Aubrey Sheiham<sup>a</sup>

**Purpose:** To investigate the relationship between oral health-related quality of life and clinical dental measures in an elderly Greek population.

**Materials and Methods:** A cross-sectional survey was carried out of adults aged 65 years or older living independently in Athens. Data were collected through clinical examination and interviews. Oral health-related quality of life was assessed through the Oral Impacts on Daily Performance (OIDP) indicator. The sample consisted of 681 participants. Data analysis used non-parametric tests (Mann-Whitney, Kruskal-Wallis and multiple logistic regressions).

**Results:** The response rate was 87.8%. Dentate participants with 1–10 teeth were 2.05 (1.25, 3.35) times and those with 11–20 teeth were 1.81 (1.11, 2.95) times more likely to report oral impacts than subjects with 21 or more teeth. Participants with anterior tooth spaces were 2.86 (1.70, 4.80) times more likely to report oral impacts than those without anterior spaces. Participants with 0–8 natural occluding pairs (NOPs) were 1.72 (1.14, 2.58) times and those with 0–3 posterior occluding pairs (POPs) were 1.57 (1.04, 2.36) times more likely to experience oral impacts than subjects with 9–16 NOPs and 4–10 POPs respectively. Decayed teeth were not significantly related to the presence of oral impacts. Edentulous participants with inadequate denture adaptation were 2.59 (1.46, 4.59) times, those with inadequate denture retention 2.41 (1.39, 4.17) times and those with denture overextension 2.51 (1.10, 5.74) times more likely to report oral impacts than subjects without the respective denture deficiencies.

**Conclusion:** Clinical indicators of oral health status were significantly related to measures of oral health-related quality of life.

Key words: oral impacts, quality of life, elderly, dental status, teeth

Oral Health Prev Dent 2004; 2: 211–220. Submitted for publication: 13.05.03; accepted for publication: 19.05.04.

The measurement of general and oral health, and the assessment of treatment needs are based on the use of clinical measures. This clinical approach has been criticized because of its limited

focus (Sheiham et al, 1982; Locker, 1989; Mechanic, 1995; Reisine and Locker, 1995; Sheiham and Spencer, 1997). Clinical measures represent only one aspect of oral health status and often fail to consider functional and psychosocial aspects of health. Because of such shortcomings, clinical measures do not reflect the concerns and needs of the public. A wider approach was needed, based upon the bio-psychosocial model of health (Engel, 1977), which incorporates biological, social and psychological factors. Such an approach simultaneously considers the clinical, perceptual and the social aspects as well as the role of dentists and the health care system.

<sup>&</sup>lt;sup>a</sup> Department of Epidemiology and Public Health, University College London, London, UK.

<sup>&</sup>lt;sup>b</sup> Center for Oral Biometrics, Institute of Dentistry, Barts and The London, QMUL, University of London, London, UK.

**Reprint requests:** Georgios Tsakos, PhD, Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 6BT, UK. Fax: +44 20 78130280. E-mail: g.tsakos@ucl.ac.uk

The need for a more comprehensive approach stimulated the development of broader measures of health. In oral health, Cohen and Jago (1976) called for the development of sociodental indicators to supplement clinical indicators, by adding a social impact dimension. The subjective indicators, more recently named 'oral health-related quality of life measures', provide information on the impact of oral disorders and conditions and the perceived needs for oral health care. They should complement clinical measures of oral status and needs (Cushing et al, 1986; Locker, 1989; Sheiham and Spencer, 1997). A variety of measures of the subjective impact of oral conditions on quality of life have been developed and used in oral health surveys (Slade, 1997).

The use of oral health-related quality of life indicators and measures of perceived needs has highlighted the large differences between normative and perceived assessments of dental treatment needs (Smith and Sheiham, 1980; Tervonen and Knuuttila, 1988; Drake et al, 1990; Srisilapanan and Sheiham, 2001a), and demonstrated the inconsistent relationship between clinical measures and oral symptoms and impacts (Reisine and Bailit, 1980; Cushing et al, 1986; Wilson and Cleary, 1995). Overall, the associations between clinical indicators of normative needs and measures of oral health-related quality of life were weak (Gooch et al, 1989; Atchison and Dolan, 1990; Locker and Slade, 1994; Leao and Sheiham, 1995; Locker and Jokovic, 1996; Srisilapanan and Sheiham, 2001a). However, the associations were better for specific clinical conditions such as missing teeth, particularly anterior teeth, and NOPs (Locker and Slade, 1994; Slade and Spencer, 1994; Leao and Sheiham, 1995; Srisilapanan and Sheiham, 2001b). Because of the different findings for overall and specific clinical conditions it was considered worthwhile carrying out further research to explore the associations between specific clinical dental measures and oral health-related quality of life indicators. The aim of this study was to investigate the relationship between an oral health-related quality of life measure, which assesses oral impacts on daily performance, and specific clinical dental measures in an elderly Greek population.

# MATERIALS AND METHODS

A survey was carried out of adults aged 65 years or older living independently in the Athens region. The

sample was drawn from two municipalities, namely Athens and Holargos. These municipalities were chosen to ensure representation of a wide ranging socio-economic status in the study, rather than to select a representative sample of the whole elderly Greek population. The municipality of Holargos is a typical middle class area in the northern suburbs of Athens, while the participants from the central Athens municipality were from relatively lower socio-economic groups. In central Athens, participants were randomly selected from a group of elderly Athens' residents at a holiday camp, whose relatively low socio-economic status guaranteed them a place at the camp which prioritized those with low incomes (less than 4,400 euro per year). Houses in the camp were randomly selected and all subjects belonging to the eligible age group were asked to participate in the study. In Holargos, participants were randomly selected through a cluster sampling technique that used all the streets in the area as sampling units, thus allowing for a random selection of streets by numbered cards. All houses and flats were visited and all people aged 65 years or over were invited to participate. The study excluded people living in long-stay residential accommodation and nursing homes or those in hospital at the time of the survey. The selected participants were asked to answer a cognitive test. Those who failed the test were excluded from the study.

The study consisted of a clinical oral examination by 4 trained and calibrated dentists, and a questionnaire-based interview, administered by 7 trained interviewers. As there is no hierarchical structure of occupation classification in Greece, education level was used as a measure of socio-economic status in this study. The interview collected data on basic socio-demographic variables, such as age, sex and level of education, and on oral health-related quality of life using a modified version of the OIDP indicator that has been validated for the population under study (Tsakos et al, 2001a). The OIDP is a composite indicator focusing on 10 basic daily life activities and behaviors and provides a final score incorporating the measurement of both the frequency and the severity of the impact caused on these activities and behaviors by oral conditions in the last six months. It is a relatively brief instrument with strong theoretical support and acceptable psychometric properties that attempts to measure oral impacts that seriously affect the person's daily life (Adulyanon and Sheiham, 1997).

Dentate subjects underwent a detailed examination, involving the assessment of coronal and root caries and restorations, restored and unfilled spaces, natural tooth contacts, and tooth mobility. Edentulous participants were examined for the presence and condition of complete dentures. The format and criteria for the clinical examination are presented elsewhere (Steele et al, 1998). Duplicate examinations were undertaken on 54 dentate subjects by the gold-standard examiner to assess measurement reliability.

# Data Analysis

Data analysis was carried out separately for dentate and edentulous participants. Subjects were divided into two age groups (65–74 years-old, and 75 and older), while education level was categorized into low (no formal education or completed education at the age of 14 years) and high (formal education up to and beyond the age of 15 years). The frequency distribution of OIDP scores clearly indicated the presence of two distinct groups, thus separating the sample into participants without oral impacts (OIDP score = 0) and with at least one oral impact that affected their daily lives in the previous 6 months (OIDP score > 0).

Non-parametric tests were chosen to investigate the relationship between oral impacts and clinical variables because data were not normally distributed. These included the Mann-Whitney and Kruskal-Wallis tests. Further data analysis used multiple logistic regressions to adjust the results for the effect of age, sex and education. The Statistical Package for Social Sciences (SPSS) was used for data analysis. When the term 'statistically significant' is used, it indicates that the p value is lower than 0.05.

# RESULTS

Analysis was initially carried out separately for the two strata because different methodologies were used for the selection of the sample. However, the results were consistent for the two sampling strata, and thus they were pooled as one sample. The response rate was high; 784 subjects were asked to participate and 688 agreed (87.8%). The final sample consisted of 681 persons (448 dentate and 233 edentulous), as 6 persons failed the cognitive test and one failed to complete the clinical examination. The edentulous sample consisted of 230 people, as 3 people who did not wear any dentures were excluded from any further analysis involving clinical measures. High standards of measurement consistency were maintained throughout the fieldwork (Kappa scores: 0.90 for coronal caries, 0.75 for root caries, 0.88 for tooth mobility, 0.98 for spacing and 0.95 for contacts).

The mean age of the dentate sample was 71.4 (SD = 5.4) years and 74.5 (SD = 6.9) years for the edentulous; 67.6% of dentate and 63.9% of edentulous subjects were female; and 77.5% of dentate and 82.8% of edentulous belonged to the low education group. The dentate sample was almost equally divided according to the number of natural teeth: 33.7% had 1-10 teeth, 34.2% had 11-20 teeth, and 32.1% had more than 20 teeth in their mouth. The prevalence of tooth and root decay was 62.3% and 28.8% respectively; 50.7% of the sample had at least one mobile tooth; 16.5% had at least one unfilled space in the anterior region of the mouth due to missing teeth; in terms of tooth contacts 62.9% had 0-8 occluding pairs of natural teeth (NOPs); and 63.6% had 0-3 posterior occluding pairs (POPs). In relation to the clinical profile of the edentulous participants, 32.6% wore denture(s) with inadequate adaptation, 38.3% with inadequate retention and 12.6% had overextended dentures.

Overall, the prevalence of oral impacts, measured by the OIDP, was very high; 39.1% of dentate and 47.6% of edentulous experienced at least one OIDP impact that had affected their everyday lives in the previous six months (Tsakos et al, 2001b). The most prevalent impact was "difficulty eating", reported by 29.9% of dentate and 41.2% of edentulous subjects. A variety of other oral impacts (difficulty speaking, lack of emotional stability, avoiding showing teeth or dentures when smiling, lack of enjoyment of social contacts) were also relatively prevalent.

A variety of different clinical measures were used to investigate the relationship between oral impacts and clinical status among dentate (Table 1) and edentulous participants (Table 2). Among dentate subjects, the OIDP score was significantly related to: the number of teeth (p = 0.001); filled teeth (p = 0.021); the presence of unfilled anterior spaces (p < 0.001); the number of NOPs (p < 0.000) and POPs (p = 0.003); but not to the number of decayed teeth, decayed roots and mobile teeth. In relation to edentulous participants, the

	<i>·</i> ·	•		
Variables/categories	OIDP scores Quartiles	р	Eating OIDP scores Quartiles	р
Number of teeth		0.001		0.003
1–10 teeth	(0, 0, 9.6)		(0, 0, 15.0)	
11-20 teeth	(0, 0, 6.0)		(0, 0, 8.5)	
21–32 teeth	(0, 0, 1.6)		(0, 0, 0)	
Decayed teeth		0.495		0.192
No decay	(0, 0, 4.8)		(0, 0, 3.5)	
One tooth	(0, 0, 6.0)		(0, 0, 5.7)	
Two or more teeth	(0, 0, 6.0)		(0, 0, 8.0)	
Filled teeth		0.021		0.001
No fillings	(0, 0, 8,3)		(0, 0, 9,8)	
1–3 teeth	(0, 0, 8,0)		(0, 0, 12,0)	
4–8 teeth	(0, 0, 6,0)		(0, 0, 9,5)	
9–22 teeth	(0, 0, 1.6)		(0, 0, 0)	
Decayed roots		0.066		0.028
No decayed roots	(0, 0, 4.8)		(0, 0, 4.0)	
Decayed roots	(0, 0, 8.0)		(0, 0, 15.0)	
Tooth Mobility		0.079		0.007
No mobile teeth	(0, 0, 3.8)		(0, 0, 0.5)	
1-15 teeth	(0, 0, 6.4)		(0, 0, 12.0)	
Unfilled Anterior Spaces		< 0.001		< 0.001
No anterior spaces	(0, 0, 3.7)		(0, 0, 2.0)	
Anterior spaces	(0, 4.8, 13.7)		(0, 0.5, 16.0)	
Natural Occluding Pairs		< 0.001		< 0.001
0–8 pairs	(0, 0, 8.0)		(0, 0, 12.0)	
9–16 pairs	(0, 0, 1.7)		(0, 0, 0)	
Posterior Occluding Pairs		0.003		0.005
0–3 pairs	(0, 0, 8.0)		(0, 0, 11.0)	

# 

OIDP score related significantly with all three clinical measures of denture quality (p < 0.001 for denture adaptation and denture retention, and p =0.004 for denture extension). In general, clinical measures related to the eating-specific OIDP score

in a similar fashion to their relationship with the total OIDP score. The only notable differences refer to the statistically significant relationship of eating-specific OIDP score with root decay (p = 0.028) and tooth mobility (p = 0.007) in the dentate sam-

edentulous particip and p values	ants that wear	denture(s	6) (N = 230): quar	tiles
Variables/categories	OIDP scores Quartiles	р	Eating OIDP scores Quartiles	р
Denture Adaptation		< 0.001		< 0.001
Adequate	(0, 0, 4.8)		(0, 0, 8.3)	
Inadequate	(0, 4.0, 11.2)		(0, 8.0, 15.0)	
Denture Retention		< 0.001		< 0.001
Adequate	(0, 0, 4.0)		(0, 0, 4.0)	
Inadequate	(0, 3.8, 10.9)		(0, 7.0, 15.0)	
Denture Extension		0.004		0.005
Adequate	(0, 0, 6.0)		(0, 0, 10.0)	
Overextended	(0, 6.4, 12.0)		(0, 10.0, 20.0)	

Comparison of OIDP scores (and eating-specific OIDP

ple, while the respective relationships with the total OIDP score were not statistically significant.

Table 2

The relationship between oral impacts and clinical variables remained statistically significant after adjusting for age, sex and education level in both the dentate (Table 3) and edentulous participants (Table 4). In the dentate group, the prevalence of an oral impact was 45.7% among participants with 1-10 teeth and 42.5% among those with 11-20 teeth, while participants with 21 or more teeth had significantly lower prevalence of impacts (28.5%). After controlling for age, sex and education level, participants with 1-10 teeth were 2.05 (95%C.I. = 1.25, 3.35, p = 0.004) times more likely, and those with 11–20 teeth were 1.81 (95%C.I. = 1.11, 2.95, p = 0.016) times more likely to experience oral impacts, when compared to subjects with 21 or more teeth.

Filled teeth did affect levels of impacts; the prevalence of oral impacts was considerably lower (28.7%) in those with 9 or more filled teeth, compared to the other groups (43.8% in participants without any filled teeth, 43.3% for those with 1–3 filled teeth and 40.6% for those with 4–8 filled teeth). After adjustment, the odds ratios for participants with 0, 1–3 or 4–8 filled teeth were 1.87 (95%C.I. = 1.00, 3.47, p= 0.050), 1.87 (95%C.I. = 1.07, 3.24, p = 0.027) and 1.67 (95%C.I. = 0.96, 2.90, p = 0.065) respectively. The adjusted relationships between the presence of oral impacts

and tooth decay, root decay and tooth mobility were not statistically significant (p > 0.2).

The prevalence of oral impacts was significantly different between subjects with and without unfilled anterior tooth spaces (60.8% and 34.8% respectively). After adjusting for age, sex and education, participants with unfilled anterior spaces were 2.86 (1.70, 4.80) times more likely to have experienced oral impacts than subjects with no anterior spaces (p < 0.001). There was a variation in the prevalence of oral impacts according to the number of NOPs, as well as natural POPs; 30.7% of participants with 9–16 NOPs reported oral impacts, while the prevalence among subjects with up to 8 NOPs was 44.0%. Again, 31.9% of those with 4–8 POPs and 43.2% of those with less than 4 POPs reported oral impacts. After controlling for the effect of age, sex and education, subjects with 0-8 NOPs were 1.72 (1.14, 2.58) times more likely to experience oral impacts when compared to subjects with 9-16 NOPs (p = 0.009). Similarly, there was an increased risk of experiencing oral impacts in subjects with 0–3 POPs when compared to those with 4–10 POPs (odds ratio = 1.57, 95%C.I. = 1.04, 2.36, p = 0.031). When POPs were further adjusted for the presence of removable prosthesis in the posterior area of the mouth, then the relationship with the presence of oral impacts was highly significant (odds ratio = 2.45, 95%C.I. = 1.39, 4.29, p = 0.002).

Table 3	Percentage of dentate participants (N = 448) with any			
reported	oral impacts on daily performance in the past 6 months, by			
clinical status, and odds ratio (95% confidence interval) adjusted by				
age grou	o, sex and education level			

Variables/categories	n (%) with impact	Odds ratio (95% c.i.)	р
Number of teeth			
1–10 teeth	69 (45 7)	2 05 (1 25 3 35)	0.004
11_20 teeth	65 (42 5)	1 81 (1 11 2 95)	0.016
21-32 teeth	41 (28 5)	1	0.010
21 02 10011	+1 (20.0)		
Decayed teeth			
Up to one tooth	96 (37.8)	1	
Two or more teeth	79 (42.2)	1.23 (0.83, 1.81)	0.289
Filled teeth			
No fillings	35 (43.8)	1.87 (1.00, 3.47)	0.050
1–3 teeth	55 (43.3)	1.87 (1.07, 3.24)	0.027
4–8 teeth	54 (40.6)	1.67 (0.96, 2.90)	0.065
9–22 teeth	31 (28.7)	1	
Decayed roots			
No decayed roots	119 (37.3)	1	
Decayed roots	56 (43.4)	1.26 (0.83, 1.91)	0.274
Tooth Mobility			
No mobile teeth	80 (36 2)	1	
1–15 teeth	95 (41 9)	- 1 26 (0 86 1 85)	0.226
1 10 1000	30 (41.0)	1.20 (0.00, 1.00)	0.220
Unfilled Anterior Spaces			
No anterior spaces	130 (34.8)	1	
Anterior spaces	45 (60.8)	2.86 (1.70, 4.80)	< 0.001
Natural Occluding Pairs			
0–8 pairs	124 (44.0)	1.72 (1.14, 2.58)	
9–16 pairs	51 (30.7)	1	0.009
Posterior Occluding Pairs			
0–3 pairs	123 (43.2)	1.57 (1.04 2.36) +	0.031 +
4-8 pairs	52 (31.9)	1	0.001
	02 (01.0)	±	
† When the relationship between oral impacts and posterior occluding pairs of natural teeth (POPs) was further adjusted for the presence of denture(s) in the posterior area of the mouth, the odds ratio (and 95% c.i.) was estimated at 2.45 (1.39, 4.29) and the p value was 0.002.			

In the edentulous sample, there were significant variations in the prevalence of oral impacts in relation to all different clinical assessments of denture

deficiencies (Table 4). Participants with inadequate adaptation of their denture(s) had a higher prevalence of oral impacts that affected their daily lives

(N = 448) with any reported oral impacts on daily performance in the past 6 months, by clinical status, and odds ratio (95% confidence interval) adjusted by age, sex and education				
Variables/categories	n (%) with impact	Odds ratio (95% c.i.)	р	
Denture Adaptation Adequate Inadequate	61 (39.4) 47 (62.7)	1 2.59 (1.46, 4.59)	0.001	
Denture Retention Adequate Inadequate	55 (38.7) 53 (60.2)	1 2.41 (1.39, 4.17)	0.001	
Denture Extension Adequate Overextended	89 (44.3) 19 (65.5)	1 2.51 (1.10, 5.74)	0.028	

Percentage of edentulous participants that wore denture(s) Table 4

(62.7%) than those without adaptation problems (39.4%). Similarly, 60.2% of subjects with inadequate and 38.7% of those with adequate denture retention reported oral impacts, while the respective prevalence figures in relation to denture extension groups were 65.5% for participants with overextended denture(s) and 44.3% for those without such problems. Denture extension problems were quite uncommon compared to the other denture quality deficiencies; only 29 subjects had an over-extended denture and 19 of them reported oral impacts that affected their daily lives. After adjusting for socio-demographic factors, edentulous participants with inadequate denture adaptation were still 2.59 (1.46, 4.59) times, those with inadequate denture retention 2.41 (1.39, 4.17) times and those with overextended dentures 2.51 (1.10, 5.74) times more likely to report oral impacts that affect their daily lives, in comparison to their counterparts without such problems (p = 0.001 for adaptation, p = 0.001 for retention and p = 0.028 for extension).

The final stage of this analysis was to carry out stepwise multiple logistic regressions, with all socio-demographic and clinical measures as independent variables, in order to assess the independent effect of the different clinical measures on the presence of OIDP. Among dentate participants, the final model of the stepwise regression showed that participants with unfilled spaces in the anterior

region of their mouth were 2.71 (1.61, 4.55) times more likely to experience oral impacts affecting their daily lives, in comparison to their counterparts without unfilled anterior spaces (p < 0.001). In addition, dentate participants with 1-10 teeth were 1.91 (1.17, 3.12) times and those with 11-20 teeth were 1.59 (0.97, 2.60) times more likely than participants with 21 or more teeth to report OIDP (p = 0.010 and p = 0.069 respectively). In the edentulous sample, participants with inadequate denture adaptation were 2.47 (1.40, 4.34) times more likely to report OIDP than edentulous participants without such problems (p = 0.002). However, these results should be interpreted with caution, because there was considerable level of covariance among clinical variables. Consequently, the selection of variables in the stepwise model may represent the best available measurement of clinical oral status, but does not necessarily imply the lack of clinical significance of the variables excluded from the final model. Further research, with a much larger sample size, should be directed towards addressing this issue.

# DISCUSSION

The findings of this study demonstrated a clear association between clinical indicators of oral health status and subjective measures of oral health-related quality of life. More specifically, the number of teeth, as well as filled teeth, the number of NOPs, the number of POPs and the presence of unfilled anterior spaces among dentate subjects, and all three clinical measures (denture adaptation, retention, and extension) among edentulous subjects were significantly associated with OIDP.

The relationship between oral impacts and number of teeth in the dentate sample is in accordance with other studies (Cushing et al, 1986; Atchison and Dolan, 1990; Locker, 1992; Locker and Slade, 1994; Leao and Sheiham, 1995; Matthias et al, 1995; Rosenoer and Sheiham, 1995; Srisilapanan and Sheiham, 2001b). Furthermore, this study has shown that the prevalence of oral impacts among dentate subjects was significantly lower for those that retained 21 or more natural teeth.

There was an increased probability of experiencing oral impacts among dentate subjects with fewer than 9 filled teeth, in comparison to those with 9 or more. This finding may reflect the number of natural teeth present in the mouth. Indeed, participants with more filled teeth had more natural teeth. In addition, those with more than 9 filled teeth are a group with high levels of conservative treatment provision, which could be expected to experience fewer oral health problems and, consequently, report lower prevalence of oral impacts affecting their everyday lives.

Anterior tooth spaces due to missing teeth are significantly associated with oral impacts among dentate people (Slade and Spencer, 1994; Srisilapanan and Sheiham, 2001b). Participants with unfilled anterior spaces were 2.86 times more likely to have experienced an oral impact affecting their everyday lives than subjects without anterior spaces. Apart from the obvious difficulties of eating and speaking, the presence of gaps in the anterior region of the mouth relates to the appearance of a person and could be expected to affect many OIDP items (such as smiling, social contacts and emotional stability).

Another important finding, also reported by Locker and Slade (1994) and Leao and Sheiham (1995), is the significant relationship between oral impacts and NOPs. Participants with fewer than nine NOPs were 1.72 times more likely to report oral impacts than those with nine or more pairs. Furthermore, the presence of at least four POPs was associated with significantly lower levels of oral impacts. This is in agreement with the results from a study of adults aged 50 years and over in Canada (Leake et al, 1994), where the replacement of missing molars was considered beneficial only when the subject had fewer than three POPs, as well as from a study of employed adults (Rosenoer and Sheiham, 1995), where participants with five or more POPs had significantly lower levels of impacts. The use of measures of occluding pairs of teeth represents an interesting and favorable shift in the emphasis of clinical measures, as they are more comprehensive and reflect both the number of teeth present in the mouth and their position, thus providing also an indirect assessment of function.

On the other hand, the relationships between oral impacts and measures of tooth decay, root decay and tooth mobility in dentate participants were not statistically significant. Srisilapanan and Sheiham (2001b) found no significant relationship between oral impacts and either tooth or root decay, but the presence of mobile teeth was associated with higher OIDP scores. On the other hand, the Rand Health Insurance Study of adults aged 18-64 years demonstrated significant associations between impacts and the number of decayed teeth and tooth mobility (Gooch et al, 1989). The lack of associations between OIDP and the clinical indicators of tooth decay, root decay and tooth mobility may be partly attributed to the conceptual distinction between health and disease. While clinical indicators measure disease, which is a purely biological concept, subjective indicators concentrate on health, a broader psycho-social concept (Hunt et al, 1986; Locker, 1989; 1992). Disease does not always negatively affect subjective perceptions of well-being, and even when it does, its impact is influenced by the nature of the disease, as well as expectations, preferences, financial, social and psychological resources (Locker, 1992). In diseases that have long latent periods before causing symptoms or esthetic changes, such as caries and periodontal diseases, people are unlikely to have symptoms and perceive impacts, such as discomfort, pain or food packing until the late stages of the diseases.

In edentulous people, our results showed that the clinical assessment of the quality of dentures was significantly related to the experience of oral impacts affecting their daily lives. People whose dentures had inadequate adaptation, retention or extension were about 2.5 times more likely to report oral impacts compared to those with dentures of adequate quality. These significant differences in the experience of oral impacts were expected, because edentulous subjects with the aforementioned denture deficiencies experience increased functional difficulties, such as eating, speaking, avoiding smiling and showing their inadequately retained dentures, as well as other psychological and social impacts.

The relationships between eating-specific OIDP and clinical measures were mostly characterized by similarities with the respective relationships for the total OIDP score. This was expected, as difficulties with eating represent by far the most prevalent impact in both dentate and edentulous samples. Nevertheless, within the general pattern of similarities, interesting points of difference may be found and explored: for example, the statistical significance of the relationships of root decay and tooth mobility with the eating OIDP score, but not with the total OIDP score. This may be a type II error, as the p values for the relationship with the total OIDP score were 0.066 for root decay and 0.079 for tooth mobility. On the other hand, this difference may indicate the specific impacts caused by those clinical variables. Whereas root decay, and especially tooth mobility, may affect the ability of a person to eat, they do not appear to play an equally important role in causing oral impacts overall. Indeed, the total impacts' score reflects not only eating difficulties, but also other facets, such as esthetics, social and psychological life.

The sample in this study is not representative of the whole elderly population of Athens or Greece. However, apart from the higher proportion of females, the socio-demographic characteristics of the sample were generally comparable with national statistics (National Statistical Service of Greece, 1996), with the study sample being slightly younger and better educated than the total elderly Greek population due to its exclusively urban composition.

This study has shown that there is a strong and consistent relationship between most clinical measures of oral health status and perceived impacts in older people. It thereby goes some way to developing a measure of an acceptable oral health status by combining clinical status measures and oral impacts. For example, based on the findings in this elderly Greek population, the presence of at least 21 natural teeth among dentate people, with an acceptable tooth position with at least 9 pairs of occluding teeth overall and 4 pairs of occluding posterior teeth, together with the absence of unfilled anterior spaces, results in lower levels of oral health-related impacts. In relation to edentulous people, the presence of dentures of adequate quality, in terms of adaptation, retention and extension, plays an important role in reducing the level of oral impacts experienced, thus promoting the ability of a person to eat, speak and perform the majority of functional tasks related to the mouth.

Future research should be directed at establishing how oral health related quality of life measures can be incorporated into treatment needs estimation systems that could be used for planning services.

#### ACKNOWLEDGEMENTS

This research was financed by the European Commission, through the Human Capital and Mobility program. The authors would also like to thank the two anonymous reviewers for their constructive comments.

# REFERENCES

- Adulyanon S, Sheiham A. Oral Impacts on Daily Performances. In: Slade GD (ed). Measuring Oral Health and Quality of Life. Chapel Hill: University of North Carolina, Dental Ecology 1997;151-160.
- Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ 1990;54:680-687.
- Cohen LK, Jago JD. Toward the formulation of sociodental indicators. Int J Health Serv 1976;6:681-698.
- 4. Cushing AM, Sheiham A, Maizels J. Developing socio-dental indicators: the social impact of dental disease. Community Dent Health 1986;3:3-17.
- Drake CW, Beck JD, Strauss RP. The accuracy of oral self-perceptions in a dentate older population. Spec Care Dentist 1990;10:16-20.
- 6. Engel GL. The need for a new medical model: a challenge for biomedicine. Science 1977;196:129-136.
- Gooch B, Dolan TA, Bourque LB. Correlates of self-reported dental health status upon enrolment in the Rand Health Insurance Experiment. J Dent Educ 1989;53:629-637.
- 8. Hunt SM, McEwen J, McKenna SP. Measuring Health Status. London: Croom Helm 1986.
- 9. Leake JL, Hawkins R, Locker D. Social and functional impact of reduced posterior dental units in older adults. J Oral Rehabil 1994;21:1-10.
- 10. Leao A, Sheiham A. Relation between clinical dental status and subjective impacts on daily living. J Dent Res 1995;74: 1408-1413.
- 11. Locker D. An Introduction to Behavioural Science and Dentistry. London: Routledge 1989.
- 12. Locker D. The burden of oral disorders in a population of older adults. Community Dent Health 1992;9:109-124.
- 13. Locker D, Jokovic A. Using subjective oral health status indicators to screen for dental care needs in older adults. Community Dent Oral Epidemiol 1996;24:398-402.

- Locker D, Slade G. Association between clinical and subjective indicators of oral health status in an older adult population. Gerodontology 1994;11:108-114.
- 15. Matthias RE, Atchison KA, Lubben JE, de Jong F, Scweitzer SO. Factors affecting self-ratings of oral health. J Public Health Dent 1995;55:197-204.
- 16. Mechanic D. Emerging trends in the application of the social sciences to health and medicine. Soc Sci Med 1995;40: 1491-1496.
- 17. National Statistical Service of Greece (ESYE). Statistical Yearbook. 1991 Census data. Athens: ESYE 1996 (in Greek).
- Reisine ST, Bailit HL. Clinical oral health status and adult perceptions of oral health. Soc Sci Med 1980;14:597-605.
- Reisine ST, Locker D. Social, psychological and economic impacts of oral conditions and treatments. In: Cohen LK and Gift HC (eds). Disease Prevention and Oral Health Promotion. Socio-dental Sciences in Action. Copenhagen: Munksgaard 1995;33-71.
- Rosenoer LM, Sheiham A. Dental impacts on daily life and satisfaction with teeth in relation to dental status in adults. J Oral Rehabil 1995;22:469-480.
- 21. Sheiham A, Maizels JE, Cushing AM. The concept of need in dental care. Int Dent J 1982;32:265-270.
- Sheiham A, Spencer J. Health needs assessment. In: Pine CM (ed). Community Oral Health. Oxford: Wright 1997;39-54.
- 23. Slade GD. Measuring Oral Health and Quality of Life. Chapel Hill: University of North Carolina, Dental Ecology 1997.
- 24. Slade GD, Spencer AJ. Social impact of oral conditions among older adults. Aust Dent J 1994;39:358-364.

- 25. Smith JM, Sheiham A. Dental treatment needs and demands of an elderly population in England. Community Dent Oral Epidemiol 1980;8:360-364.
- Srisilapanan P, Sheiham A. Assessing the difference between sociodental and normative approaches to assessing prosthetic dental treatment needs in dentate older people. Gerodontology 2001a;18:25-34.
- Srisilapanan P, Sheiham A. The prevalence of dental impacts on daily performances in older people in Northern Thailand. Gerodontology 2001b;18:102-108.
- Steele JG, Sheiham A, Marcenes W, Walls AWG. National Diet and Nutrition Survey: People Aged 65 Years and Over. Volume 2: Report of the Oral Health Survey. London: TSO 1998.
- Tervonen T, Knuuttila M. Awareness of dental disorders and discrepancy between 'objective' and 'subjective' dental treatment needs. Community Dent Oral Epidemiol 1988;16: 345-348.
- 30. Tsakos G, Marcenes W, Sheiham A. Evaluation of a modified version of the index of Oral Impacts on Daily Performances (OIDP) in elderly populations in two European countries. Gerodontology 2001a;18:121-130.
- Tsakos G, Marcenes W, Sheiham A. Cross-cultural differences in oral impacts on daily performance between Greek and British older adults. Community Dent Health 2001b;18: 209-213.
- Wilson IB, Cleary PD. Linking clinical variables with health-related quality of life: conceptual model of patient outcomes. JAMA 1995;273:59-65.