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Social, Clinical and Psychometric Factors Affecting Self-Rated Oral Health, Self-Rated Health and Wellbeing in Adults: A Cross-Sectional Survey

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Abstract

Background: Many studies examined and reported oral and general health inequalities in clinical health, SROH and SRH. Objectives: The study aims to explore the social influences, gradients and predictors of self-rated oral health (SROH) and self-rated health (SRH) and wellbeing in Greek adults. Methods: Cross-sectional study, of men and women, aged 65 years and over (N = 743) in Greece. Descriptive and statistical analyses were performed for dentate and edentulous participants. For the association between socioeconomic exposures and binary outcomes, logistic regression was performed to estimate Odds Ratios and 95% Confidence Intervals (OR, 95% CI); levels of association and Cramer's V were applied to calculate associations and p-values. Results: The objective socioeconomic measures, such as household income, education level and last main occupation were significant predictors and determinants of both SROH and self-rated health (SRH). For Satisfaction with life (SWL), there was a diversity in the results analogous to the dental status of the participants. Household income and SSS were predictors of SWL in dentate participants. In the total sample Household income, occupation and SSS, were predictors of SWL, while in edentulous participants only occupation and SSS were statistically significant (*p* < 0.05). Subjective social status was statistically significant for SROH, SRH and SWL (*p* < 0.01). More men than women reported their SROH and SRH as good. Household income and SSS were predictors of SWL, in dentate participants, thus the better the income and the higher the relative social status, the higher feeling of SWL was recorded. Place of residence had significant associations only with SWL. Household income, education, occupation and SSS had significant levels of

association with SROH and SRH in dentate participants ($p < 0.05$). Conclusion: There are socioeconomic gradient inequalities in SROH and SRH in Greek adults living in Attica area. Subjective social status is a predictor of SROH, SRH and SWL. The need to prioritize interventions to eliminate disparities and inequalities in oral and general health and wellbeing of elders is evident.

Keywords

Self-Rated Oral Health, Self-Rated Health, Inequalities, Satisfaction with Life, Subjective Social Status

1. Introduction

Self-rating measures of oral and general health encompass not only the physical and mental domains of health but also social aspects and everyday functioning. Thus, in the literature, there is an increasing volume in epidemiological studies based on perceptions of health and wellbeing, oral health-related quality of life (OHRQoL) and global self-rated health. Self-rated health (SRH) is a global measure for recording subjective feelings of health recognized as subjective health that is extensively used in research. It is a simple and an adequate method in which a single question can capture participants' heath status and self-rating their health, from excellent to poor on a four or five-point scale [1]. Many studies have shown that this single item is a predictor of health and mortality [2]-[9]. A systematic review by DeSalvo *et al*. (2005) [10] of 22 cohort studies found a statistically significant relationship between poor self-rated health and the risk of mortality [10]. Furthermore, Wu *et al*. (2013) [1] examined the relationship of SRH and objective health in Chinese and reported that the prevalence of all diseases was associated with poorer SRH, thus SRH reflects objective health status and could be a global measure of health status [1]. Analysis of longitudinal data from the European Community Household Panel found income inequalities were negatively related to self-rated health status in the European Union [11].

Inequalities in health were present in studies that examined SRH and socioeconomic factors [12]-[19]. Some studies have used both global SRH and comparative SRH [20]. Self-rated oral health (SROH) and socioeconomic factors have been examined in many studies and countries (based on nationally representative samples or not) with interesting results. Inequalities in SROH have been reported according to income, education and occupation [21] [22] [23] [24] [25], while others examined SROH in terms of only income and education and also found inequalities [26]-[32]. Education alone has been reported to determine reported inequalities in SRH and SROH [15] [33].

Health, in a wide range of views, includes not only bodily and physical health and the presence or absence of disease, but also personal feelings, spiritual and

psychological well-being [34] [35]. Health includes the ideas of strength, vitality, and spirit; a person is healthy when he or she is free from illness, can properly participate in everyday life or has good physical status and well-being [36]. The need to develop subjective measures of oral health status was first proposed by Cohen and Jago (1976) [37], who reported the lack of data related to the psycho-social impact of oral health problems at that time [37]. Subjective measures and self-ratings of health have been associated with education level, socioeconomic status and ethnicity, and poor SRH was a strong predictor of subsequent mortality, as strong as, or even stronger than, physical measures. [7] [9] [38]. Moreover, psychosocial factors have been found to affect and predict SRH [12] [39] [40]. In social epidemiology, it is essential to use both clinical and subjective measures of health and oral health; individuals' feelings, personal beliefs, and life experience are fundamental to their own perceptions of well-being and self-rating health. The existence of social inequalities that affect health and mortality is well established. Longevity for those at the lower end of the social status ladder is considerably less attainable than for those higher on the ladder. These social class inequalities exist for almost all chronic diseases in industrial countries; similarly, these inequalities are also apparent in oral health. However, there is relatively little research available regarding these issues, using either clinical or subjective measures, in the ageing population of industrialized countries. Ageing populations, chronic diseases and social inequalities are all concerns for all industrial countries.

Social determinants of health produce inequalities and create a graded distribution of diseases across the whole spectrum of society within and among nations [12]. These social determinants are the underlying causes of health inequalities [41]. Studies reveal the existence of a gradient in general and oral health outcomes that is affected by a patient's socioeconomic position in society. Inequality indicates that individuals in poverty have poorer health, while the gradients show that at each lower level of the social hierarchy, individuals have worse health than those directly above them. Thus, the social gradient is not only for the poor and does not relate solely to absolute deprivation or poverty; instead, it is mainly explained by relative socioeconomic position [12] [42] [43] [44] [45] [46]. Individuals with higher SES are exposed to less stress than the individuals with lower SES, which reflects the impact of the socioeconomic hierarchy on health [47].

The principal aim of the present study is to determine whether social influences and gradients are present in relation to the global SROH and SRH of adults. Furthermore, the study aims to investigate how Greek elders self-rate their oral and general health and to determine the influence of socioeconomic status and wellbeing.

2. Methods

This cross-sectional study aims to examine the SROH, SRH, SWL and socioeco-

nomic inequalities and wellbeing of 743 Greek adults (males and females) aged 65 years or older, living in Athens and Piraeus (Attica) and visiting day centers. Details on the methodology, design and clustering sampling method of the study have been described previously [48]. In brief, permission from Day Centers was received, and an advertisement for the study was placed in each Day Center. Prospective participants were enrolled in the study only after indicating that they understood the aim of the study and were able to participate of their own free will. Visits to the day centers were arranged by appointment, either by telephone or personal communication. The clinical examination procedure was standardized in accordance with WHO guidelines [49] for oral health surveys.

2.1. Outcome Variables

For the study we used SROH, SRH and satisfaction with life as outcome (dependent) variables, in relation to explanatory variables, education, household income, occupation and subjective social status (SSS).

Self-rated oral health (SROH), was recorded using a 5-point scale. The participants were asked to answer the question "Would you say your oral health is?" Possible answers: excellent, very good, good, fair and poor. For the binary analysis, the answers were merged in two categories: excellent, very good and good were grouped together as good; poor and fair were grouped together as poor.

Self-rated health (SRH), was recorded using a 5-point scale. The participants were asked to answer the question "Would you say your health is…?" Possible answers: excellent, very good, good, fair and poor. For the binary analysis the answers were merged in two categories: excellent, very good and good were grouped together as good; poor and fair were grouped together as poor.

Satisfaction with life was measured through the Satisfaction with life scale [50], which includes five items: "In most ways my life is close to my ideal"; "The conditions of my life are excellent"; "I am satisfied with my life"; "So far I have gotten the important things I want in life"; and "If I could live my life over and over, I would change almost nothing". The participants answered using the following 7-point scale: strongly disagree, disagree, slightly disagree, neither agree nor disagree, slightly agree, agree, strongly agree. For binary logistic a dummy variable was created based on Diener's explanations for satisfaction with life scale [50]. The top category has 30 - 35 (very high score) meaning that they are highly satisfied. The next category is those with scores form 25 - 29 (high scores); the third category is the average score 20 - 24. The fourth category is the slightly below average-with scores 15 - 19 and those with this range of score that have feelings of dissatisfaction; usually these people have many problems in their everyday life that hardly feel satisfaction. The fifth category has scores 10 - 14 (dissatisfied) and these persons are dissatisfied with their lives. The last category has scores from 5 to 9, and is extremely dissatisfied with their lives. Thus, for the binary analysis, we merged the three lower score groups (<20) and the three higher score groups (≥20) as not satisfied vs satisfied.

Education level, was recorded as the total years of education, as the highest certificate of education received, and as an ISCED-97 classification. For the binary analysis, we used a dichotomous categorization of less than a lower secondary education vs a lower secondary education or higher. This categorization has been used before for other studies in Europe [51].

Income was recorded as personal and household income (euros per month) before taxes. For the analysis, we used the equivalence scale (square root scale) for household income according to OECD. The square root scale household income was merged into four categories: less than 600, between 600 and 799, between 800 and 999, and more than 999 euros per month.

Occupation classification was recorded according to the participant's former main occupation using the International Classification of Occupation [52]. For the analysis the ten groups were merged into four: professionals, service and shop keepers, agriculture and craft workers, and manual workers. For the binary analysis we used the dichotomous categorization of manual workers vs non manual workers.

Subjective social status (SSS) was assessed by the MacArthur social status scale, represented as a ladder with 10 steps. This social status measure was developed by the MacArthur Network on SES and Health to represent and record an individual's perception of their place on the social ladder, which takes into account multiple elements of socioeconomic status and social position [53].

2.2. Other Variables

1) Age: All the participants were 65 years old or older. For the binary analysis, two groups were formed: 65 - 74 years (n = 365; 49.1%) and 75 - 94 years (n = 378; 50.9%). Marital status was recorded using four categories: married, widowed, divorced or separated, and single. For the analysis the variable was recoded into three groups as: married (n = 318; 42.8%), widowed (n = 358; 48.2%) and divorced-separated-single (n = 67; 9%), and into the dichotomous variable married vs all others.

2) Oral Hygiene Index Simplified (OHI-S) [54]: The average individual or group debris and calculus scores were combined to produce the simplified Oral Hygiene Index. Oral Health Related Quality of Life (OHRQOL). We used the Oral Impacts on Daily Performance (OIDP) to assess OHRQOL [55] [56]. For the binary analysis we used the dichotomous has impact vs has no impact (answers "yes" or "no" for difficulty with activity that impact affecting their life).

Long-standing illness and long-standing illness limited daily activity were scored dichotomously (yes vs no).

3) Loneliness: was assessed by the UCLA 3-item Loneliness scale. This scale includes three items: "How often do you feel that you lack companionship?"; "How often do you feel left out?" and "How often do you feel isolated from others?". Possible answers are hardly ever, some of the time, and often. For binary analysis, the median was used (score 6).

Ethical approval for the study was granted by the Ethics Committee of the Dental School, National and Kapodistrian University of Athens (253/27-01-015). All the participants volunteered to participate, and informed consent was obtained from all individual participants included in the study. The ethical considerations of the study were in accordance with the principles of the 1964 Declaration of Helsinki and its later amendments.

2.3. Data Analysis

The descriptive analysis included sample demographics and socioeconomic characteristics. Statistical analyses were performed for dentate and/or edentulous participants, as shown in each table. The dependent variables were SROH, SRH and satisfaction with life. For the association between socioeconomic exposures and binary outcomes, we used logistic regression to estimate odds ratios and 95% confidence intervals (OR, 95% CIs). Furthermore, levels of association and Cramer's V were applied to calculate associations and p-values. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) program, version 24.

3. Results

The results are presented in five tables and additional three tables in the supplementary material: Table 1, summarizes the sample characteristics and dental status of the participants.

Participants were men and women from Attica, Greece residents of Athens or Peireuas. The prevalent population lived in Athens, were female and widowed. Most of the participants had less than lower secondary education, reported being in the second household income quintile, being plant and machinery operators, with good oral health index, and visited the dentist occasionally or when in trouble (Table 1).

The SROH, SRH, and satisfaction with life of the dentate and edentulous participants are presented in Table 2.

Two hundred and sixty participants (35%) self-reported their oral health as poor/fair, while two hundred and sixty-nine participants (36.2%) self-reported their general health as poor/fair. Associations between socioeconomic status predicting SROH and SRH as poor or fair are presented for the whole sample in Table 3. Household income, education, occupation and Subjective Social Status are statistically significant ($p < 0.05$) for both self-rated oral health and self-rated general health.

All regression models were adjusted for age, gender, place of residence, living alone, long-standing illness, long-standing illness limited daily activity and loneliness. Further analysis only for dentate participants revealed associations between socioeconomic status predicting SROH and SRH as poor or fair are presented in, Table 4. The results are similar as presented above for the total sample, thus, Household income, education, occupation and Subjective Social Status

Table 1. Demographic characteristics (N = 743).

Sample characteristics		Total sample		Edentulous		Dentate	
		N	%	N	%	N	%
Gender	male	354	47.6%	123	60.3%	231	42.9%
	female	389	52.4%	81	39.7%	308	57.1%
Place of residence	Athens	528	71.1%	143	70.1%	385	71.4%
	Piraeus	215	28.9%	61	29.9%	154	28.6%
Long standing illness	yes	148	19.9%	45	22.1%	103	19.1%
	no	595	80.1%	159	77.9%	436	80.9%
Limited daily activity	yes	99	13.3%	27	13.2%	72	13.4%
	no	644	86.7%	177	86.8%	467	86.6%
Age	65 - 74	365	49.1%	59	28.9%	306	56.8%
	75 - 94	378	50.9%	145	71.1%	233	43.2%
Living alone	yes	336	45.2%	120	58.8%	216	40.1%
	no	407	54.8%	84	41.2%	323	59.9%
Marital status	married	318	42.8%	62	30.4%	256	47.5%
	widowed	358	48.2%	135	66.2%	223	41.4%
	other	67	9.0%	7	3.4%	60	11.1%
Household Income (euro/per month)	>600	98	13.2%	34	16.7%	64	11.9%
	600 to 799	212	28.5%	83	40.7%	129	23.9%
	800 to 999	292	39.3%	65	31.9%	227	42.1%
	>999	141	19.0%	22	10.8%	119	22.1%
Subjective social status (SSS)	Low steps	259	34.9%	102	50.0%	157	29.1%
	Medium and High	484	65.1%	102	50.0%	382	70.9%
Education level (ISCED-97)	>Lower secondary	498	67.0%	161	78.9%	337	62.5%
	Lower secondary or above	245	33.0%	43	21.1%	202	37.5%
Occupation	manual	600	80.8%	43	21.1%	424	78.7%
	non manual	143	19.2%	28	13.7%	115	21.3%
Reason dental visits	occasionally orwhen in trouble	640	86.1%	199	97.5%	441	81.8%
	regularly	103	13.9%	5	2.5%	98	18.2%
Remaining teeth	has 1 - 10	135	25.0%	-	-	135	25.0%
	has 11 to 19	167	31.0%	-	-	167	31.0%
	has 20 to 31	237	44.0%	-	-	237	44.0%
OHRQOL	has impact	225	30.3%	68	33.3%	157	29.1%
	no impact	518	69.7%	136	66.7%	382	70.9%

Table 2. Self-Rated oral health, self-rated health, and satisfaction with life in dentate and edentulous participants (N = 743).

		SROH Poor N (%)		SRH Poor N (%)		SWL low N (%)	
		Edentulous	Dentate	Edentulous	Dentate	Edentulous	Dentate
Gender	male	45 (68.2%)	76 (39.2%)	42 (50.6%)	68 (36.6%)	51 (67.1%)	72 (49.0%)
Place of residence	Athens	49 (74.2%)	134 (69.1%)	63 (75.9%)	136 (73.1%)	43 (56.6%)	87 (59.2%)
Long standing illness	yes	21 (31.8%)	49 (25.3%)	34 (41.0%)	64 (34.4%)	19 (25.0%)	43 (29.3%)
Limited daily activity	yes	16 (24.2%)	36 (18.6%)	22 (26.5%)	52 (28.0%)	14 (18.4%)	25 (17.0%)
Age	65 - 74	19 (28.8%)	109 (56.2%)	31 (37.3%)	105 (56.5%)	16 (21.1%)	69 (46.9%)
Living alone	yes	37 (56.1%)	87 (44.8%)	47 (56.6%)	76 (40.9%)	51 (67.1%)	63 (42.9%)
Marital status	married	21 (31.8%)	85 (43.8%)	29 (34.9%)	80 (43.0%)	19 (25.0%)	69 (46.9%)
	widowed	42 (63.6%)	88 (45.4%)	48 (57.8%)	84 (45.2%)	56 (73.7%)	59 (40.1%)
	Single/divorced	3 (4.5%)	21 (10.8%)	6 (7.2%)	22 (11.8%)	1 (1.3%)	19 (12.9%)
Household Income (euro/per month)	>600	14 (21.2%)	31 (16.0%)	16 (19.3%)	29 (15.6%)	11 (14.5%)	24 (16.3%)
	600 to 799	26 (39.4%)	57 (29.4%)	26 (31.3%)	58 (31.2%)	40 (52.6%)	40 (27.2%)
	800 to 999	22 (33.3%)	74 (38.1%)	30 (36.1%)	66 (35.5%)	20 (26.3%)	50 (34.0%)
	>999	4 (6.1%)	32 (16.5%)	11 (13.3%)	33 (17.7%)	5 (6.6%)	33 (22.4%)
Subjective social status	Low steps (1 - 4)	43 (65.2%)	75 (38.7%)	48 (57.8%)	73 (39.2%)	59 (40.1%)	53 (69.7%)
Education level	>lower secondary	57 (86.4%)	143 (73.7%)	66 (79.5%)	133 (71.5%)	93 (63.3%)	67 (88.2%)
Occupation	manual	58 (87.9%)	166 (85.6%)	73 (88.0%)	156 (83.9%)	120 (81.6%)	74 (97.4%)
	non manual	8 (12.1%)	28 (14.4%)	10 (12.0%)	30 (16.1%)	27 (18.4%)	2 (2.6%)
Reason dental visits	occasionally/when in trouble	65 (98.5%)	164 (84.5%)	80 (96.4%)	155 (83.3%)	127 (86.4%)	74 (97.4%)
	regularly	1 (1.5%)	30 (15.5%)	3 (3.6%)	31 (16.7%)	20 (13.6%)	2 (2.6%)
Remaining teeth (dentate)	has 1 - 10	-	65 (33.5%)	-	65 (34.9%)	-	48 (32.7%)
	has 11 to 19	-	62 (32.0%)	-	46 (24.7%)	-	41 (27.9%)
	has 20 to 31	-	67 (34.5%)	-	75 (40.3%)	-	58 (39.5%)
OHRQOL	has impact	34 (51.5%)	95 (49.0%)	35 (42.2%)	66 (35.5%)	47 (32.0%)	27 (35.5%)
	no impact	32 (48.5%)	99 (51.0%)	48 (57.8%)	120 (64.5%)	100 (68.0%)	49 (64.5%)

are statistically significant ($p < 0.05$) for both self-rated oral health and self-rated general health (Table 4).

Summary models for socioeconomic factors and SSS, SROH, SRH and the results of logistic regression models for SROH, SRH for each socioeconomic variable are shown in Table 5. Household income, education level and occupation were predictors and determinants of both SROH and SRH. Education was not a predictor of SWL in dentate and in all participants. Moreover, occupation was not a predictor of satisfaction with life in dentate participants though it was a

Table 3. Associations between objective socioeconomic factors and subjective social status predicting SROH and SRH as poor or fair in the total sample, N = 743.

	All Participants N = 743							
	SROH				SRH			
Models	B	OR	95% CI	*P*	B	OR	95% CI	*P*
Household income <800 euro per month	−0.489	0.613	0.427 - 0.882	0.008**	−0.391	0.676	0.463 - 0.988	0.043*
Education level ISCED-97 (less than lower secondary)	−0.731	0.482	0.337 - 0.688	<0.001***	−0.433	0.649	0.452 - 0.931	0.019 **
Occupation (manual)	−0.557	0.573	0.377 - 0.870	0.009**	−0.468	0.626	0.408 - 0.961	0.032*
SSS (low steps 1 - 4)	−0.653	0.520	0.377 - 0.718	<0.001***	−0.657	0.519	0.370 - 0.728	<0.001***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Models adjusted for: age, gender, place of residence, living alone, long-standing illness, long-standing illness limited daily activity and loneliness.

Table 4. Associations between objective socioeconomic factors and subjective social status predicting SROH and SRH as poor or fair, in dentate participants, n = 539.

	All Participants N = 539							
	SROH				SRH			
Models	B	OR	95% CI	*p*	B	OR	95% CI	*p*
Household income <800 euro per month	−0.584	0.558	0.361 - 0.861	0.008**	−0.806	0.447	0.280 - 0.713	0.001**
Education level ISCED-97 (less than lower secondary)	−0.731	0.482	0.337 - 0.688	<0.001***	−0.433	0.649	0.452 - 0.931	0.019**
Occupation (manual)	−0.685	0.504	0.314 - 0.810	0.005**	−0.490	0.613	0.376 - 0.998	0.049*
SSS (low steps 1 - 4)	−0.646	0.524	0.356 - 0.773	0.001***	−0.635	0.530	0.352 - 0.797	0.002***

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Models adjusted for: age, gender, place of residence, living alone, long-standing illness, long-standing illness limited daily activity and loneliness. Education = less than lower secondary education vs lower secondary or above. Occupation = manual workers vs non manual. Subjective social status = low steps (1 - 4).

Table 5. Predictors for Satisfaction with life in dentate participants and in all participants N = 743.

	Dentate Participants n = 539		All Participants N = 743		Edentulous Participants n = 204	
Models	O R (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Household income <800 euro per month	0.565 (0.348 - 0.919)	0.021*	0.584 (0.396 - 0.860)	0.007**	0.672 (0.324 - 1.353)	ns
Education ISCED-97 less than lower secondary	0.842 (0.545 - 1.301)	ns	0.702 (0.484 - 1.017)	ns	0.461 (0.199 - 1.068)	ns
Occupation (manual workers)	0.731 (0.442 - 1.208)	ns	0.531 (0.335 - 0.841)	0.007***	0.110 (0.025 - 0.495)	0.004*
Subjective social status	0.454 (0.296 - 0.698)	<0.001***	0.401 (0.284 - 0.567)	<0.001***	0.328 (0.171 - 0.627)	0.001**

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Models adjusted for: age, gender, place of residence, living alone, long standing illness, limited daily activity and loneliness. ns: no significant differences.

significant predictor of satisfaction with life in all participants and in edentulous (with no teeth) (Table 5). All regression models were adjusted for age, gender, place of residence, living alone, long standing illness, limited daily activity and loneliness, and the Omnibus Tests of Model Coefficients sig was less than 0.05, and the Hosmer and Lemeshow test's significant values were greater than 0.05.

Household income and SSS were predictors and determinants of SWL in dentate participants while in the total sample Household income, occupation and SSS were predictors of SWL ($p < 0.05$). For those being edentulous only occupation and SSS were statistically significant ($p < 0.05$) and predictors of SWL (Table 5).

Logistic regression analysis results for edentulous participants revealed only education (p = 0.04) and SSS (p = 0.004) as predictors of SROH; and only SSS (p = 0.043) was a predictor of SRH in participants with no teeth (results not shown). Further analysis of other predictors and the effect of household income, education, occupation and SSS on SROH, SRH and SWL are presented in the supplementary material (Supplementary Tables S1-S3).

Long-standing illness, long-standing illness limiting daily activity, and the number of remaining teeth had significant levels of association for all three outcomes, in the total sample. Place of residence had significant associations only with SWL; those living in Athens had higher scores of SWL (Supplementary Table S1). Household income, education, occupation and Subjective Social Status had significant levels of association with SROH in the total sample and in dentate participants ($p < 0.05$) (Supplementary Table S2 and Table S3). The results of regression analysis for the total sample and the dentate participants showed that Household income, education, and SSS were predictors of SRH ($p < 0.05$) while occupation was not a predictor of SRH in the total sample and in dentate participants. These regression models were adjusted not only for age, gender, place of residence, living alone, long-standing illness, long-standing illness limited daily activity, and loneliness but also for satisfaction with life (Supplementary Table S2 and Table S3).

4. Discussion

In this study, we examined socioeconomic, clinical and psychometric factors affecting SROH, SRH and satisfaction with life (SWL) in adults aged 65 years and over. The study showed the association between household income, education level, occupation and clinical measures of health, and SROH and SRH in Greeks living independently in Attica. All three objective socioeconomic measures (household income, education, and occupation) used in the study were predictors of SROH in the total sample and in dentate participants ($p < 0.01$) while Household income and education were predictors of SRH in the total sample and the dentate participants ($p < 0.05$). The subjective socioeconomic measure SSS was also found to predict SROH, SRH and SWL; while SSS predicted SWL levels, education and occupation were not predictors of SWL, in dentate partici-

pants. Income and education were not predictors of satisfaction with life in edentulous participants. Thus, dental status of the participants and the number of remaining teeth influenced the overall results.

Gender, place of residence, long standing illness, SSS and loneliness were predictors of SWL. Men who lived in Athens with no long-standing illness, and placed themselves as standing on higher steps of the MacArthur social status scale and felt less lonely, were more likely to report being more satisfied with life (SWL). Thus, relative social status and psychosocial factors are associated and impact perceptions of wellness. Moreover, the results of the current study highlight the effect of remaining teeth in discernments of SROH and SRH. Place of residence was statistically significant and had an impact on perceptions of well-being and SWL, while levels of associations of OHRQOL were statistically significant only for SROH and SRH but not for SWL.

The analysis revealed the presence of health inequalities in SROH and SRH. Socioeconomic factors impacted consciousness and judgment of health and showed inequalities, educational, income and occupation gradients. Inequalities and the social gradient in clinical and subjective oral health were reported for Greek elders in a preliminary analysis of data [15]. To the best of or knowledge this is the first study to explore and found socioeconomic inequalities and the gradient in SROH in Greeks; the first study that examined oral health and SSS in Greece and the first study to examine SRH and socioeconomic inequalities using both objective and subjective socioeconomic measures and found gradient inequalities in Greek adults. Other studies in Greek adults examined SRH but used either a subjective or an objective socioeconomic measure and are discussed below. Self-rated general health and the presence of a gradient among Greek adults were reported by Theodosiou and Zingelides in 2009 [57]. A recent study in Greek adults examined SRH and SSS and found that age and the presence of a chronic disease affects SRH and that the higher the perceived SSS, the higher the odds of reporting very good SRH [58]. A study that examined SRH, socioeconomic status (objective measures) and indebtedness in Greek adults found that males and younger individuals with higher SES had a higher probability of reporting better SRH [14], which is in agreement with the results of the present study. The results of Daniilidou and co-workers [59] in a study of Greek adults (aged 18 and over), found that SRH was influenced by income, education, age and gender, however variables such as physical activity and psychometric factors were not used in that study [59]. In our study, there was no significant relationship between age and SRH; however, gender was significantly associated with SRH and SROH and women were more likely to report their SROH and SRH as poor. Long standing illness and long-standing illness that limited daily activity were significantly associated with SRH in the present study; those who reported having a long-standing illness that limited their daily activity were more likely to rate their SROH and SRH as poor and had lower levels of satisfaction with life. Those in the age group 65 - 74 years old were more possible to report good oral

health and more satisfied with life than those in the age group 75 - 94 years old. There was a gender effect for SROH and SRH; more men reported good SROH and SRH, than women, while there was no effect of place of residence. Those with the higher income, higher education level, with better jobs and higher SSS were more likely to rate their SROH and SRH as good and enjoy a higher level of satisfaction with life. These results are in accordance with previous studies worldwide that revealed socioeconomic inequalities in health, thus income, education and occupation were determinants of SROH [60]-[66], SRH [67] [68] [69] [70] and mortality [4] [71] [72]. Moreover, Song and co-workers [73], reported that various diseases and healthy lifestyles and socioeconomic status were determinants of SRH in Chinese adults. Thus, low to moderate alcohol consumption and physical activity were associated with good SRH. Likewise, higher socioeconomic status was associated with good SRH [73].

Olaf von dem Knesebeck and co-workers [51], used data from the European Social Survey 2003 where they examined education and SRH in 22 European countries, including Greece. Their results for SRH (less than good) were 22.8% for men and 34.4% for women in Greek adults are varying from the present study's results where 31.1% of men and 40.9% of women reported SRH less than good. The differences are possibly due to the sample procedures and methodology (inclusion criteria) as the present study included participants only from Attica and were 65 - 94 years old, while the European Society Survey had participants from all areas of Greece and were 25 years or older.

The results of the European Project "Enabling Autonomy, Participation, and Well-Being in Older Age: The Home Environment as a Determinant for Healthy Ageing" based on Latvian and Swedish data showed that poor perceived mobility was associated with poor SRH, while education was a determinant of SRH only for the Latvian. Age was not a significant determinant for either population [76]. Our results showed that for dentate participants' age was significantly associated with SROH and SWL ($p = 0.001$), however, the findings for SRH were not significant, in accordance with the Latvian and Swedish data, as reported by Harschel *et al*., 2015 [74]. In the present study, education, income and occupation were statistically significant with both SROH and SRH ($p = 0.01$) and better SROH and SRH were associated with higher socioeconomic status.

Income inequalities in self-rated health were also reported in Japan; at the prefecture level, the association between income and SRH was especially strong [75]. In a cross-sectional study in Russia, education, material deprivation and perceived control were related to SRH [76]. In the present study, SRH (poor vs good), was also predicted by education, occupation ($p < 0.05$), SSS ($p < 0.001$) and household income less than 800 euros per month ($p < 0.01$). Mejia and co-workers [77], examined SROH and social inequality among Australians (Australia's National Survey of Adult Oral Health, 2004-2006) and found that those who reported an annual income less than 20,000 Aus. $ and those who were less educated or unemployed were more likely to report poor oral health;

this finding is in accordance with our results; in the present study poor SROH was associated with lower income, lower level of education, manual workers and lower subjective social status ($p < 0.05$). However, an income of 20,000 Aus. \$ (~12.482 euro) is much higher than 800 euros per month (approximately about 9600 euros per year; 1 Australian Dollar equals 0.62 Euro), and Greece is a country in economic recession with reduced pensions and salaries because of the Memorandum.

A more recent study in Australia reported no associations between poor SROH and income inequality in Local Government Areas (LGAs) among Australians [78]. However, the present study's results are in agreement with a study from Sweden; socioeconomic measures were strongly associated with SROH (OR 1.76) and SRH (OR 3.95) in Swedish adults; these results remained significant after controlling for age (mean age 53.4 years), gender and lifestyle variables [79]. Another cross-sectional study had similar results with the present study's results and found socioeconomic gradients in dental health among adults 30-64 years old, in Spain (data from the 2006 Spanish National Health Survey); there were significant socioeconomic differences according to education, household income and occupation, in the spreading of self-reported dental problems among middle-age adults [21]. The present study's results are in agreement with the results of Jayasvasti and co-workers, in a cross-sectional study about SROH status in Myanmar. They found that tooth loss, less frequent dental care attendance and lower education were associated with poor SROH [80].

Additionally, in our study, participants with no teeth (edentulous) were more likely to report poor or fair SROH, poor or fair SRH and low scores of SWL. This is in line with the results of Barboza-Solis and co-workers [81], who reported that participants with severe tooth loss reported poor SRH. Furthermore, our results are in agreement with Farmer and co-workers results regarding education and income; the study took place in Canada; SROH was examined using a nationally representative Canadian survey, and poor SROH was found to be inversely related to education and income and both socioeconomic measures were evenly balanced with the gradients [82]. In the present study, the participants were 65 years old or older (65 to 94 years) and we found that those in the 75 to 94-year-old group had significant inequalities compared to the group of 65 to 74-years-old. A study in England, Wales and Northern Ireland found oral health inequalities in UK adult population with a tendency to diminish with age; for those aged 65 years and over, these inequalities were not statistically significant [83]. In contrast, our results showed that inequalities do not fade with age in the examined population. In the literature, there is conflicting evidence regarding whether socioeconomic inequalities in health diminish or persist in older age [84] [85] [86].

5. Limitations

The study has some limitations because of its design. This is a cross sectional

study with an observational study design in which the outcome and exposures are examined at the same time, which makes causal relationships difficult to conclude; thus, the results should be treated with caution. However, not only cross-sectional studies but longitudinal studies also have confirmed the existence of socioeconomic inequalities and the gradient in health and oral health in many countries; moreover, the results of longitudinal studies found causal associations of SRH and socioeconomic measures [87]. Furthermore, the strengths of the study are the use of multilevel sampling procedures, stratified and clustering methods according to postal codes, area of residence and day centers; the participants were elders aged 65 to 94 years (males and females); both clinical and subjective measures were used, and psychometric factors were also considered. This cross-sectional study can be used as a baseline for a future national cohort study.

6. Conclusions

The present study's results confirmed the presence of socioeconomic influences on SROH and SRH in the examined Greek adults. The study examined the effect of objective and subjective socioeconomic measures and found self-rated oral and general health gradient inequalities in Greek adults. Socioeconomic inequalities and the gradient affect SROH and SRH and wellbeing. Income, education level, last main occupation and SSS were predictors of SROH and SRH in dentate participants and the total sample, and the better the income and the higher the relative social status, the higher sensation of SWL was recorded.

Further research needed to explore inequalities and determinants of health and oral health and wellbeing in adults and factors that contribute to preserve more healthy teeth in the mouth in older ages and erase social inequalities. The use of a simple question as a proxy for self-rated oral health and self-rated health is costly effective and a useful screening instrument for epidemiologists and health care workers, especially when resources are limited. Policy makers, health planning and welfare should focus on methods and strategies aiming to eliminate social inequalities and health disparities in oral and general health, aiming to equity and fairness.

Declaration of Conflicting of Interests

The authors declare no conflict of interest.

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Supplementary File-Supplementary Tables

Table S1. Levels of association for SROH, SRH, SWL and socioeconomic measures in dentate participants n = 539 and all participants N = 743 (*Cramer's V*).

	Dentate participants (n = 539)			All participants (N = 743)		
	SROH	SRH	SWL	SROH	SRH	SWL
Models		*p*			*p*	
Long-standing illness	0.006**	<0.001***	<0.001***	<0.001***	<0.001***	0.001**
Lon-standing illness limited daily activity	0.008**	<0.001***	ns	<0.001***	<0.001***	0.029*
Place of residence	ns	ns	<0.001***	ns	ns	<0.001***
Remaining teeth	0.001***	<0.003**	ns	0.003**	0.003**	0.008**
OHRQOL	<0.001***	0.018*	ns	<0.001***	0.001**	ns
Household income	0.001***	<0.001***	0.022*	0.002**	0.009*	0.001**
Education	<0.001***	0.002**	ns	<0.001***	0.002**	ns
Occupation	0.003**	0.032*	ns	0.006**	0.023*	0.005**
Subjective social status	<0.001***	<0.001***	0.001**	<0.001***	<0.001***	<0.001***

$*p < 0.05$, $**p < 0.01$, $***p < 0.001$. ns not significant differences.

Table S2. Associations between objective socioeconomic factors and subjective social status predicting SROH and SRH as poor or fair. N = 743.

	All Participants N = 743							
	SROH				SRH			
Models	B	OR	95% CI	*p*	B	OR	95% CI	*p*
Household income <800 euro per month	−0.448	0.639	0.443 - 0.921	0.016*	−0.747	0.474	0.295 - 0.760	0.002**
Education level ISCED-97 (less than lower secondary)	−0.706	0.494	0.345 - 0.706	<0.001***	−0.400	0.670	0.466 - 0.964	0.031*
Occupation	−0.512	0.600	0.394 - 0.913	0.017*	−0.404	0.668	0.434 - 1.028	ns
SSS (low steps 1 - 4)	−0.595	0.552	0.397 - 0.766	<0.001***	−0.566	0.568	0.402 - 0.803	<0.001***

$*p < 0.05$, $**p < 0.01$, $***p < 0.001$. Models adjusted for: age, gender, place of residence, living alone, long-standing illness, long-standing illness limited daily activity, loneliness *and satisfaction with life.*

Table S3. Associations between objective socioeconomic factors and subjective social status predicting SROH and SRH as poor or fair. N = 539 (dentate).

	Dentate Participants N = 539							
	SROH				SRH			
Models	B	OR	95% CI	*p*	B	OR	95% CI	*p*
Household income <800 euro per month	−0.526	0.591	0.381 - 0.916	0.019*	−0.747	0.474	0.295 - 0.760	0.002**
Education level ISCED-97 (less than lower secondary)	−0.760	0.467	0.310 - 0.704	<0.001***	−0.502	0.605	0.396 - 0.924	0.020**
Occupation	−0.655	0.519	0.322 - 0.837	0.007**	−0.452	0.637	0.389 - 1.041	ns
SSS (low steps 1-4)	−0.567	0.567	0.382 - 0.841	0.005**	−0.539	0.583	0.384 - 0.885	0.011*

$*p < 0.05$, $**p < 0.01$, $***p < 0.001$. Models adjusted for: age, gender, place of residence, living alone, long-standing illness, long-standing illness limited daily activity, loneliness *and satisfaction with life.* Education = less than lower secondary education vs lower secondary or above. Occupation = manual workers vs non manual. Subjective social status = low steps (1 - 4).