

ORIGINAL ARTICLE

Social inequality in oral health-related quality-of-life, OHRQoL, at early older age: Evidence from a prospective cohort study

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Objectives. This study aimed to assess the long-term effect of socio-behavioral characteristics on oral impacts on daily performances (OIDP) at age 65 and the influence on OIDP at age 65 of changes in socio-behavioral characteristics between age 50 and 65. **Methods.** In 1992, all 50-year-olds in two counties of Sweden were invited to participate in a longitudinal survey. A total of 6346 responded and, of those, 4143 completed follow-ups at ages 55, 60 and 65 years. **Results.** At age 65, 26.9% had oral impacts. Subjects being immigrants, being unmarried, reporting economic barriers, bad general health, bad quality dental care, less than annual dental attendance, limited social network and smoking at age 50 experienced oral impacts at age 65 more frequently than their counterparts in the opposite groups. Compared to the stable advantaged groups, stable disadvantaged groups regarding marital status, health status, smoking and reported quality of care had increased ORs for oral impacts. Compared to the stable advantaged groups, those who experienced deterioration with respect to health status, dental attendance and quality of oral health care and those who quit smoking had increased ORs for oral impacts. **Conclusions.** Disadvantaged socio-behavioral condition at age 50 had a long lasting detrimental effect on OHRQoL at age 65. Deterioration in socio-behavioral circumstances was associated with increased oral impacts. Early protection against the effect of socio-behavioral adversity by imposing economic barriers, ensure provision of high quality care and by promotion of healthy lifestyles seems to have the potential to reduce oral impacts at older ages.

Key Words: cohort, OIDP, socio behavioral, risk factors**Introduction**

Population aging occurs globally and, by 2050, people older than 80 years will comprise 20% of the world's elderly population [1]. The third age period, recognized to be subjects in their 60s and 70s, stretches from labor market exit to the onset of physical dependency [2]. Significant events occurring during this period, such as loss of income because of exit from the labor force, increasing probability of chronic diseases, loss of social networks and inadequate provision of pension have been reported to influence health and quality-of-life [3]. Accumulated experience of oral diseases might make older adults more likely to report poor OHRQoL [4]. There

are concerns about the ability of populations to cope with the demands of aging and the national health authorities have been urged to monitor oral health and give oral health goals for older people [5].

A recent population-based study of Norwegian and Swedish 65-year-olds showed that three quarters of the subjects investigated confirmed satisfaction with teeth [6]. Consistent with theoretical and empirical evidence, satisfaction with teeth was strongly influenced by contextual, as well as individual oral health-related variables such as socio-demographics, number of teeth, oral symptoms and functional problems. Like most previous studies considering contextual and individual variation in self-reported oral health

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outcomes, the study of Norwegian and Swedish 65-year olds was of cross-sectional design [7]. Cross-sectional studies might fail to fully elucidate the contribution of socio-behavioral status to oral health. It is increasingly recognized that oral health status of later life is affected by adult-, as well as earlier life stage characteristics, including those operating prior to conception and during the pre-natal period [8,9]. According to a life-course approach, exposure to factors at various life stages is likely to accumulate over the lifespan of an individual [8,9].

Whereas there is a growing literature demonstrating that health outcomes are affected by socio-economic positions during the lifecourse, few studies have explored this issues with oral health outcomes [10,11]. Results based on the Newcastle Thousand Families cohort revealed that the impact of childhood socio-economic position on tooth retention in adulthood seemed to diminish with increasing age, whereas adult socio-economic position and lifestyles had increasing influence [12]. Moreover, women who remained in the non-manual social class from childhood to adulthood had the greatest tooth retention by the age of 50 [13]. Similarly, socio-economic conditions at various life stages have been shown to associate with OHRQoL in middle-age and with tooth satisfaction as it develops from middle- to early older ages [6,14]. Some studies have focused on the extent to which poor oral health in adulthood is a consequence of social transition from childhood and adulthood. Poulton et al. [10] and Thomson et al. [15] followed children born in New Zealand in 1972 and revealed that by the age 26, subjects from low childhood and low adulthood socio-economic status groups presented with more dental caries than did their counterparts from high childhood and high adult socio-economic status groups. Adolescents of stable low socio-economic status had also higher caries experience than those moving upward socio-economically across time. Accordingly, a Brazilian birth cohort study revealed that adolescents who were always poor showed a worse, whereas adolescents who were never poor showed an improved pattern of dental caries [16]. Yet, no study has investigated the impacts of changes in socio-behavioral characteristics through middle and early older ages on OHRQoL of the elderly. This is noteworthy, as OHRQoL indicators are of increasing importance with respect to the identification of target groups, advocacy for oral health promotion and treatment programs and in evaluation of the dental healthcare services [4]. This study aimed to examine the long-term impact of socio-behavioral characteristics on OHRQoL at age 65 and to assess how social mobility in terms of stability, improvement and deterioration of socio-behavioral characteristics through middle- and early old ages influence OHRQoL at age 65.

Materials and methods

Study population

The present work is based on four separate data collections from a cohort study of subjects born in 1942. Data collections were conducted at age 50 and again after 5, 10 and 15 years. Information was collected on a wide range of health and oral health-related aspects by means of questionnaires containing core questions repeated in every study. In 1992, all 50-year-olds in two counties of Sweden were invited to participate in the study [17]. Of the total population of 8888 subjects, 6346 responded. The response rates (71.4%) were the same in both counties. In 1997, 2002 and 2007 the corresponding response rates were 74.3% (6513/8764), 75.0% (6372/8500) and 73.1% (6078/8313). Of the 6346 subjects who completed the 1992 questionnaire, 4143 (65%) also completed the questionnaires at age 55, 60 and 65 years (47.8% male and 52.2% female). The original studies in 1992 and 1997 were approved by the Ethics Committee in Sweden. Due to new regulations, an approval by an ethics committee on the follow-up questionnaires was not required.

Measures

To ensure comparability of data, identical questionnaires were used in each data collection. A measure of OHRQoL was included for the first time in 2007. The complete questionnaire design, originally used in 1992, has been described previously [6,17]. The dependent variable of OHRQoL was assessed using the eight-item OIDP inventory [18]. 'During the previous 6 months, how often have problems with teeth or mouth caused you any difficulty with: (1) eating and enjoying food, (2) speaking and pronouncing clearly, (3) tooth cleaning, (4) sleep and relaxation, (5) smiling and showing teeth without being embarrassed, (6) being emotionally stable, (7) being sociable, (8) performing daily chores' Each item was scored from 1–5 using a 5-point scale; (1) 'never affected', (2) 'less than once a month', (3) 'once or twice a month', (4) 'once or twice a week', (5) 'every or nearly every day'. Because the prevalence of impacts was anticipated to be low, a 5-point response scale rather than the original 6-point scale was used. Each item was dichotomized yielding the categories; (1) 'affected' (including the original categories 2, 3, 4 and 5) and (0) 'never affected' (the original category 1). One sum index, the extent of oral impacts, OIDPSC, was constructed from the eight dummy variables. For the purpose of cross-tabulation analyses, the OIDPSC score (0–8) was dichotomized as 0/1, producing the categories; (0) no daily performance affected and (1) at least one daily performance affected. The distribution of the OIDPSC scores

supported this cut-off point. The reliability and validity of a Swedish version of the OIDP inventory has been established previously [19]. The predictor variables employed, year of measurement, their categorical coding (original and re-coded) and combined trajectory variables (mobility groups) are depicted in Table I. *Socio behavioral factors* were measured in terms of country of birth, level of education,

marital status, reported health status, smoking, regular dental attendance, social network, quality dental care and financial barrier to dental care. For the purpose of analyses, each variable was dichotomized. Except for education, country of birth and satisfaction with oral health, combined variables were constructed based on the 1992/97/02 and 2007 dummy variables.

Table I. Categories for listed predictor variables, original code [] and as recoded for analyses.

Variables/year of measurement	Original coding [] Recoding ()	Combined recoded variables
Satisfaction teeth/92	Very satisfied [1] Satisfied [2] Dissatisfied [3] Very dissatisfied [4] Satisfied (0) [from 1+2] Dissatisfied (1) [from 3+4]	
Country of birth/92	Sweden [0] Nordic countries [1] Other countries [2] Native country (0) [from 0+1] Foreign country (1) [from 2]	
Education/92	Elementary school [0] Lower school [1] High school [2] University [3] Higher (University) (0) [from 3] Lower (less than university) (1) [from 0+1+2]	
Civil status/92&07	Married/de facto [0] Single [1] Unmarried [2] Divorced [3] Widow/widower [4] Married/de facto (0) [from 0] Single (1) [from 1+2+3+4]	Stable married (0) Married-not married (1) Not married-married (2) Stable not married (3)
Self-reported health status/92 &07	Satisfied [0] Rather satisfied [1] Rather not satisfied [2] Not satisfied [3] Satisfied (0) [from 0+1] Not satisfied (1) [from 2+3]	Stable satisfied (0) Satisfied-not satisfied (1) Not satisfied-satisfied (2) Stable not satisfied (3)
Smoking habit/92&07	Daily smoking [0] Rare occasion smoking [1] Have smoked [2] Never smoked [3]	Stable no smoker 92/07 (0) Starting smoking 92/07 (1) Quitting smoking 92/07 (2) Stable smoker 92/07 (3)
Annual dental attendance/92&07	No [1] Yes [2]	Stable annual (0) Annual-not annual (1) Not annual-annual (2) Stable not annual (3)
Barrier dental care/97&07	No [1] Yes [2]	Stable barrier (0) Barrier-not barrier (1) Not barrier-barrier (2) Stable no barrier (3)
Quality dental care/92 &07	Good [0] Bad [1]	Stable good quality (0) Good-bad quality (1) Bad-good quality (2) Stable bad quality (3)
Social network/02&07	Limited [0] Extensive [1]	Stable limited (0) Limited-extensive (1) Extensive-limited (2) Stable extensive (3)

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences 15 (SPSS Inc., Chicago, IL) on the intact cohort ($n = 4143$). In addition to combined analyses, men and women were analyzed separately since life course influences might differ by sex [11].

Stability or change in socio-behavioral variables was described with cross-tabulation. Absolute stability was assessed by calculating the proportion of the total cohort who remained stable and changed towards the better and the worse across the survey period. Long-term (unadjusted) associations between socio-behavioral variables and ODPSC were assessed by cross-tabulation and Chi-square statistics. Oral well-being is known to track throughout middle and early old ages and a moderate continuation of socio-behavioral characteristics across the lifespan could be expected [6]. Thus, to ascertain whether socio-behavioral characteristics at age 50 have a long-term influence on ODPSC, satisfaction with teeth (used as a proxy for ODPSC) at age 50 and socio-behavioral characteristics at age 65 were adjusted for by stratified analyses. The relationship between all socio-behavioral mobility groups and having oral impacts or not whilst controlling for satisfaction with teeth, education, country of birth and sex at age 50 was analyzed by standard multiple variable logistic regression, SLR. In each SLR model OR and Nagelkerkes R^2 were calculated. Nagelkerkes R^2 is a pseudo R square that generalized the coefficient of determination. Its value can be between 0–1, where 0 denotes that the variables in the model do not explain anything of the variation and 1 means that the model completely explains the variation. Pair-wise interactions between main independents and sex were assessed and included if they met the significance criterion set at 0.05.

Results

According to the Central Bureau of Statistics Sweden, the sex distribution in 1992 of the survivors of the 1942 birth cohort was 48.9% females and 51.1% males. Among the 6346 respondents in 1992 (response rate 71.4%) females were over-represented (50.2%) [6,17]. A total of 2203 subjects at age 50 years (1992) did not participate in the postal follow-ups at ages 55, 60 and 65 years, providing a follow-up rate of 65.0%. The sex proportion in drop-outs and cohort participants differed, as 52% of the follow-up participants vs 47.0% of the drop-outs were females ($p < 0.001$). Based on their reporting in 1992, dropouts were less likely than the cohort participants to be native Swedish, married, perceive good oral health, brush more than twice a day, maintain all teeth, be satisfied with teeth and more likely to be daily smokers ($p < 0.001$).

A total of 26.9% (27.4% women and 26.4% men) reported experience with at least one oral impact (ODPSC > 0) at age 65. All socio-behavioral characteristics assessed throughout middle and early older ages, except education and dental attendance, showed a graded relationship with ODPSC in cross-sectional as well as longitudinal analyses. As shown in Table II, sex-specific analyses made little difference to the results, although long-term disparity in ODP as related to country of birth, dental attendance and social network was restricted to men. The long-term association between ODPSC at age 65 and socio-behavioral factors at ages 50, 55 and 60 remained significant with respect to economic barriers for dental attendance, quality dental care, health perceptions, smoking and marital status after adding statistical controls for contemporaneous socio-behavioral characteristics at age 65. The long-term effect of marital status and smoking was restricted to subjects who ended up unmarried and as smokers at age 65. After stratifying for self-perceived oral health (as a proxy for ODP) at age 50, the long-term predictions remained statistically significant with respect to marital status, satisfaction with health, smoking, economic barriers towards dental care, country of birth and social network. Long-term prediction of country of birth and social network was restricted to subjects having positive oral health perceptions at age 50.

As depicted in Table III, 91.1% and 1.3% of the subjects investigated remained satisfied and dissatisfied with quality dental care between ages 50–65 years, whereas 3.9% and 3.7% changed to be satisfied and dissatisfied, respectively. Similar patterns were observed for all other socio-behavioral characteristics investigated. Substantial proportions (75.4–78.4%) of subjects remained married, satisfied with health, non-smokers, annual dental attendees, having extensive social network and no economic barriers to dental care. The percentage of subjects who improved across time ranged from 2.5% (bad health/good health) to 13.6% (from smoking to not smoking), whereas subjects who deteriorated across time ranged from 0.8% (no smoking/smoking) to 13.5% (good health/bad health).

Country of birth, sex, satisfaction with teeth and self-reported number of natural teeth was included as potential confounders in standard logistic regression analysis, SLR. Independent combined variables that were statistically significantly associated ($p < 0.05$) with the outcome variables in unadjusted analyses were entered stepwise into the SLR (Table IV). Social combined variables in terms of marital status, reported health, social network, dental attendance barriers and reported quality dental care were entered in the first step, providing a model fit of Nagelkerke's R^2 of 0.15. All variables remained statistically significantly associated with ODPSC in step I, except country of birth and social network. Entering

Table II. Frequency distributions, % (*n*), of OIDPSC in 2007 by socio-behavioral characteristics (the percentage of those reporting having impact) assessed in 1992, 1997, 2002 and 2007, total sample and separately in men and women.

	Total	Men	Women
<i>Country of birth</i>			
Native (92) ^b	26.4 (996)	25.7 (463)	27.1 (533)
Foreign (92)	37.8 (74)**	42.1 (40)**	33.7 (34)
<i>Education</i>			
Higher (92)	28.8 (237)	28.2 (100)	29.3 (137)
Lower (92)	26.4 (828)	26.1 (401)	26.8 (427)
<i>Civil status</i>			
Married (92)	25.3 (842)	25.1 (409)	25.4 (433)
Unmarried (92) ^{a&b}	35.7 (226)**	34.3 (93)**	36.7 (133)**
Married (07)	25.2 (783)	24.7 (385)	25.6 (398)
Unmarried (07)	33.2 (276)**	34.4 (114)**	32.4 (162)**
<i>Health status</i>			
Satisfied (92)	25.3 (918)	24.7 (436)	25.9 (482)
Dissatisfied (92) ^{a&b}	44.4 (143)**	50.0 (62)**	40.9 (81)**
Satisfied (07)	23.6 (750)	23.1 (354)	24.1 (396)
Dissatisfied (07)	41.3 (309)**	41.5 (142)**	41.1 (167)**
<i>Smoking</i>			
No smoking (92)	24.7 (745)	23.3 (336)	26.1 (409)
Smoking (92) ^{a&b}	34.2 (322)**	37.0 (165)**	31.7 (157)**
No smoking (07)	25.8 (905)	25.1 (418)	26.5 (487)
Smoking (07)	35.7 (155)**	36.8 (78)*	34.7 (77)**
<i>Dental attendance</i>			
At least yearly (92)	26.5 (972)	25.8 (445)	27.1 (527)
Less than yearly (92)	31.8 (91)	32.1 (54)*	31.4 (37)
At least yearly (07)	25.4 (869)	24.2 (392)	26.4 (477)
Less than yearly (07)	37.1 (188)**	39.9 (107)**	33.9 (81)**
<i>Quality dental care</i>			
Good (92)	25.6 (951)	24.6 (435)	26.6 (516)
Bad (92) ^a	48.5 (96)**	53.8 (56)**	42.6 (40)**
Good (07)	24.7 (924)	23.9 (425)	25.5 (499)
Bad (07)	64.2 (124)**	67.0 (67)**	61.3 (57)**
<i>Social network</i>			
Limited (02)	31.9 (129)	32.3 (53)	31.7 (76)
Not limited (02) ^b	26.4 (932)*	26.0 (447)	26.8 (485)*
Limited (07)	33.0 (276)	35.2 (130)	31.2 (146)
Not limited (07)	25.2 (770)**	24.1 (362)**	26.2 (408)*
<i>Barrier attendance</i>			
Yes (97)	49.8 (160)	48.6 (69)	50.8 (91)
No barrier (97) ^{a&b}	24.7 (890)**	24.4 (424)**	25.1 (466)**
Yes (07)	57.2 (170)	60.1 (86)	54.5 (84)
No barrier (07)	24.4 (890)**	23.6 (411)**	25.1 (479)**

***p* < 0.001, **p* < 0.05.

^aRemained statistically significant after adjusting for 2007 socio-behavioral characteristics, ^bremained statistically significant after control for perceived oral health in 1992, 1997 and 2002, ^{a&b}remained statistically significant after adjusting statistically for both 2007 socio-behavioral characteristics and perceived oral health in 1992, 1997 and 2002.

Table III. Stability or change in socio-behavioral characteristics (% of total sample) between age 50 and age 65, age 55 and 65 and between age 60 and 65 (the total number in the age categories does not correspond to the total number of participants due to missing responses).

Socio-behavioural change group	Total % (n) (n = 4092)	Females % (n) (n = 2164)	Males % (n) (n = 1979)
<i>Marital status—aged 50–65 years (n = 4092)</i>			
Stable married	75.4 (3084)	72.6 (1553)	78.4 (1531)
Married—not married (downward)	8.6 (353)	2.9 (63)	3.6 (71)
Not married—married (upward)	3.3 (134)	10.1 (215)	7.1 (138)
Stable not married	12.7 (521)	14.4 (307)	11.0 (214)
<i>Satisfaction health—aged 50–65 years (n = 4047)</i>			
Stable satisfied	78.2 (3163)	76.8 (1628)	79.7 (1535)
Satisfied—not satisfied (downward)	13.5 (547)	13.3 (282)	13.8 (265)
Not satisfied—satisfied (upward)	2.5 (103)	3.0 (64)	2.0 (39)
Stable not satisfied	5.8 (234)	6.9 (147)	4.5 (87)
<i>Smoking—aged 50–65 years (n = 4072)</i>			
Stable not smoking	75.4 (3071)	75.3 (1608)	75.6 (1463)
Smoking—not smoking (downward)	13.6 (555)	14.0 (300)	13.2 (255)
Not smoking—smoking (upward)	0.8 (32)	0.7 (14)	0.9 (18)
Stable smoking	10.2 (414)	10.0 (214)	10.3 (200)
<i>Dental attendance—aged 50–65 years (n = 4064)</i>			
Stable annual attendance	83.3 (3384)	85.4 (1813)	80.9 (1571)
Annually—not annually (downward)	9.6 (390)	8.9 (189)	10.4 (201)
Not annually—annually (upward)	3.9 (160)	3.1 (65)	4.9 (95)
Stable not annually	3.2 (130)	2.6 (55)	3.9 (75)
<i>Quality dental care—aged 50–65 years (n = 4014)</i>			
Stable good quality	91.1 (3658)	91.6 (1921)	90.6 (1737)
Good—bad (downward)	3.7 (147)	3.7 (77)	3.7 (70)
Bad—good (upward)	3.9 (156)	3.7 (78)	4.1 (78)
Stable bad quality	1.3 (53)	1.0 (21)	1.7 (32)
<i>Social network—aged 60–65 years (n = 4012)</i>			
Stable limited	6.8 (274)	8.0 (167)	5.6 (107)
Limited—extensive (upward)	3.5 (142)	15.0 (313)	14.1 (270)
Extensive—limited (downward)	14.5 (583)	3.8 (80)	3.2 (62)
Stable extensive	75.1 (3013)	73.2 (1531)	77.1 (1482)
<i>Barrier dental care—aged 55–65 years (n = 4041)</i>			
Stable barrier	3.6 (145)	3.9 (83)	3.2 (62)
Barrier—no barrier (upward)	4.6 (186)	5.0 (106)	4.1 (80)
No barrier—barrier (downward)	4.1 (165)	3.8 (80)	4.4 (85)
Stable no barrier	87.7 (3545)	87.3 (1843)	88.2 (1702)

combined variables of dental attendance and smoking in step II, improved model fit marginally to Nagelkerke's R^2 of 0.16. Compared to subjects in the stable advantaged groups, those who were stable disadvantaged across time regarding marital status, reported health, smoking and reported quality of care were more likely to have oral impacts (OIDPSC > 0). The odds ratios were 1.4 (95% CI 1.0–1.7), 2.2 (1.5–3.1), 1.3 (1.0–1.7) and 5.0 (2.3–10.5), respectively. Compared to the stable advantaged groups, those who deteriorated with respect to health

perception, dental attendance and reported oral health care quality and those who quit smoking were also more likely to report oral impacts or deteriorated OHRQoL. Compared to their counterparts in the stable disadvantaged group, those who were stable advantaged (OR = 0.3, 95% CI 0.2–0.5) and those who improved (OR = 0.5, 95% CI 0.3–0.8) with respect to economic barriers to dental attendance were less likely to report oral impacts. A statistically significant two-way interaction with sex was observed for smoking status. Compared to men in the stable no

smoking group, men who quit smoking and men who were stable smokers had ORs of 1.7 (95% CI 1.3–1.8) and 1.5 (95% CI 1.4–1.9) for reporting oral impacts at age 65 (Table IV). For women change in smoking status did not influence statistically significantly on OIDP at age 65 (not shown in Table IV).

Discussion

Whereas most studies of a social divide in oral health have narrowed their attention to specific oral diseases [20,21], this study provided evidence of long-term influences of socio-behavioral status on OHRQoL at age 65, whilst at the same time ruling out some potentially alternative explanations. Tracking the transition period from middle to early older aged adulthood, low socio-behavioral status had a long lasting negative influence on OHRQoL, irrespective of how oral health was perceived at the start of the period at age 50 or where ending up in the socio-behavioral hierarchy at age 65. As shown in Table II, the long-term influence related to immigrant status was stronger in men than in women, suggesting that socio-behavioral position acts differently with respect to oral health through this transition period depending on individuals' sex [22]. Mason *et al.* [14] concluded, accordingly, that life course influences on OHRQoL in late adulthood seem to differ substantially between men and women. According to the present findings (Table II), men who reported dental attendance regularly at age 50 had less oral impacts at age 65 compared with their counterparts who visited dentists less frequently. Moreover, women and men who avoided dental care due to economic barriers at age 55 were more likely than their counterparts to report oral impacts at age 65. To the degree that dental attendance and economic barriers to dental attendance reflect access to dental care and low socio-economic status, this accords with previous findings suggesting that insufficient access to dental care explains impaired oral health in socially disadvantaged people and that higher income increases the likelihood of good oral health [20,21,23]. A pervasive long-term effect of socio-behavioral characteristics is noteworthy, considering that this cohort has benefited from highly subsidized fees regarding all kinds of treatment at the Swedish Public Dental Health and from the Swedish National Dental Health Insurance initiated in 1974. They grew up when free dental care in schools was introduced and were in their 30s when the national oral health insurance system for adults was introduced in Sweden. However, in Sweden, the public insurance has been independent of increases in dental care costs and has provided the largest compensation to younger and older (> 65 years old) subjects of the population [24]. During the 1990s, Sweden experienced turmoil in its welfare system, with the public subsidies for adult dental care

experiencing large cutbacks and with patient fees for various types of treatment increasing 2- and 3-fold [23]. This might have reduced the level or quality of healthcare services available to the population, hitting the lower socio-economic groups the hardest. Evidently, in 1993–1994, inequalities in access to healthcare appeared in Sweden for the first time since the 1960s [25].

Social mobility has been linked to variations in health outcomes [22]. The literature considering social mobility in oral health is relatively limited [12–16,26,27]. According to the upward social mobility hypothesis, improved social factors along the life-course should be oral health protective, whereas, according to the downward mobility hypothesis, decline in social circumstances would lead to worse oral health. According to the social origin hypothesis, early poor social disadvantage would have an enduring adverse effect on future oral health irrespective of the subsequent social situation [28]. The results of this study are in line with the social origin hypothesis, thus corroborating results reported previously [10,15]. As shown in Table IV, subjects who originated with a disadvantaged condition at age 50 were those most likely to experience oral impacts at age 65. Support for the downward mobility hypothesis was indicated in that subjects shifting from regular to non-regular dental attendance, from good to bad perceived health status and from good to bad quality care were more likely than their counterparts who remained advantaged to have oral impacts at age 65. The relationships presented in Table IV were equally strong for men and women except with respect to smoking, with the social origin hypothesis confirmed for men only.

This study draws strength from addressing the third age period demographically, from use of a population-based prospective dataset and from use of repeated measures of socio behavioral factors. Evidently, most studies rely on older adults' retrospective reports, suggesting that such studies might be compromised by poor recall and measurement errors. Of particular note is that the cohort design included all members of the 1942 cohort in two counties of Sweden and that the follow-up rate was reasonable (65% follow-up rate). Within the realm of survey research, follow-up rates of 50% have been considered adequate, 60% good and 70% very good [29]. Considering the loss to follow-up occurred according to MAR (missing at random) mechanism, evidence suggests that unbiased estimates are expected with a 60% follow-up rate [30]. Some of the limitations should be acknowledged. The measure of socio-economic position was limited to a number of indicators ignoring other potential indicators of social position. Although level of education is recognized as a good proxy for social position in middle aged, educational status did not associate with OIDPSC in the present cohort, suggesting possible

Table IV. Oral impacts at age 65 regressed on changes in socio-behavioral factors throughout the third age period from 50–65 (controlled for sex and perceived oral health at age 50).

	% (n)	Adjusted OR 95% CI Step I	Adjusted OR 95% CI Step II
Native country of birth	26.4 (996)	1	1
Foreign country of birth	37.8 (74)**	1.1 (0.6–1.4)	1.1 (0.7–1.4)
Married 92 & 07	25.1 (747)	1	1
Married 92 & unmarried 07	26.6 (90)	1.1 (0.7–1.7)	1.1 (0.7–1.6)
Unmarried 92 & married 07	27.5 (369)	1.0 (0.7–1.3)	0.9 (0.7–1.2)
Unmarried 92 & 07	37.5 (184)**	1.4 (1.1–1.8)	1.4 (1.0–1.7)
Good health 92 & 07	23.2 (711)	1	1
Good health 92 & bad health 07	38.2 (200)	1.6 (1.3–2.1)	1.6 (1.3–2.0)
Bad health 92 & good health 07	36.2 (34)	1.1 (0.7–1.8)	1.1 (0.6–1.7)
Bad health 92 & 07	47.9 (105)**	2.4 (1.6–3.1)	2.2 (1.5–3.1)
Economic barrier attendance 97 & 07	64.2 (88)	1	1
Barrier 97 & no barrier 07	39.2 (71)	0.5 (0.3–0.8)	0.5 (0.3–0.8)
No barrier 97 & barrier 07	51.0 (80)	0.7 (0.4–1.2)	0.7 (0.4–1.2)
No barrier 97 & 07	23.4 (801)**	0.3 (0.2–0.5)	0.3 (0.2–0.5)
Social network limited 02 & 07	34.5 (90)	1	1
Social network increased from 02–07	32.2 (182)	1.2 (0.8–1.7)	1.2 (0.8–1.7)
Social network decreased from 02–07	28.7 (39)	0.9 (0.5–1.5)	0.9 (0.5–1.5)
Social network high 02 & 07	25.0 (726)**	1.0 (0.7–1.4)	1.0 (0.7–1.4)
Good quality care 92 & 07	23.9 (812)	1	1
Decreased quality 92–07	43.0 (95)	2.7 (1.8–4.0)	2.7 (1.8–4.0)
Increased quality 92–07	41.9 (70)	1.2 (0.8–1.8)	1.2 (0.8–1.8)
Bad quality 92 & 07	82.6 (19)**	4.9 (2.4–10.2)	5.0 (2.3–10.5)
Annual dental attendance 92 & 07	25.3 (823)		1
Annual 92 & not annual 07	37.0 (139)		1.3 (1.0–1.6)
Not annual 92 & annual 07	26.5 (41)		0.8 (0.5–1.2)
Not annual 92 & 07	37.9 (47)**		0.9 (0.6–1.5)
No smoke 92 & 07	24.6 (728)		1
Smoke 92 & no smoke 07	32.8 (175)		1.2 (1.0–1.6)
No smoke 92 & smoke 07	36.7 (11)		1.7 (0.7–3.7)
Smoke 92 & 07	35.8 (143)**		1.3 (1.0–1.7)

** $p < 0.001$, * $p < 0.05$.

misclassification due to poor recall and social desirability. Due to the effect of non-response (~ 30% in 1992), the results are not inferentially representative of the total population concerning point estimates. Comparing the original cohort in 1992, with the cohort participating at each survey year revealed an over-representation on the part of the participants regarding factors reflecting higher education and with respect to females. Whereas the latter bias was considered by controlling for sex and undertaking sex-specific analyses, the presence of non-response and selection bias cannot be completely ruled out. It is probable, however, that the present findings are fairly representative of the original 1942 birth cohort residing in two counties that mirror the country of Sweden demographically and socially. This makes the present

findings relevant to policymakers. Finally, although the original OIDP was constructed for use in interviews, recent studies have shown a high level of agreement between interview and self-administered assessments with the child version of the OIDP. Moreover, the order of administration of the two modes did not affect the prevalence of child oral impacts reported [31].

Conclusions

Disadvantaged socio-behavioral condition at age 50 had a long lasting detrimental effect on OHRQoL, irrespective of oral health status at the start of the period or where ending up in the socio-behavioral hierarchy at age 65. Deterioration in socio-behavioral

circumstances was associated with increased oral impacts. Early protection against the effect of socio-behavioral adversity by imposing economic barriers, ensuring provision of high quality care and promotion of healthy lifestyles seems to have the potential to reduce oral impacts at older ages. Studies are needed to identify modifiable factors that predict future oral health outcomes in socially disadvantaged middle aged people to improve preventive as well as therapeutic strategies.

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