Oral health status and inequalities among ambulant older adults living in central Chile

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Objective: To assess the oral health status and treatment needs of older adults, living in the Valparaiso Region of Chile. ***Basic research design:*** A random sample of 354 older adults, aged 60 years or older, living independently in the community were examined orally by calibrated examiners and underwent a structured oral health interview. Data collection extended from October 2006 to June 2007. ***Results:*** This was a largely dentate population (80%) with a mean DMFT score of 21.6 (s.d. 5.7). While about 28% of the dentate sample had all their restorative needs unmet, 30.8% had all of their restorative needs met. Regarding periodontal health, 3.3% had sound periodontum; complex periodontal therapy (CPI 3-4) was needed by 43.1% of the sample. ***Conclusion:*** This study represents one of the largest data collections in oral health among older adults living in Chile. Participants seemed to have better oral health status than previously reported. Of particular relevance is the reduction of the decayed component and the increased number of sound teeth in the present sample. Participants also presented lower need for advance periodontal treatment. Yet, inequalities were apparent in the proportion of unmet restorative needs. Strategies to develop oral health care programmes focused on improving access to and use of preventive services for older adults are critical. Further research is indicated to get a more complete picture of the factors that shape the oral health of Chilean older adults.

Key words: Chile, inequalities, oral health, older adults, treatment needs.

Introduction

In 2002, 11.4% of the Chilean population was aged 60 years or older (Instituto Nacional de Estadisticas, 2003). By 2035, it is expected that this group will represent almost 18% of the population. This increase is particularly the case in the Valparaiso Region in central Chile, which currently has a larger older population than the rest of the country (13.4%). Chile is divided administratively in 15 Regions. The Valparaiso region is located contiguous to the region, where Santiago, the national capital, is located. The regional capital, the city of Valparaiso and its surroundings, are the second metropolitan centre of Chile, some 110 km west of Santiago.

The health of this ageing population poses challenges to both the community and the government. In 2007**,** the national government implemented the Explicit Health Guarantee (GES) for those 60-years and older to ensure that their access to health is not related to ability to pay. The GES includes 56 health conditions which are treated at no cost for the older population, including oral health conditions such as tooth loss and dental emergencies.

Nevertheless, at the time of the implementation of the GES, there was no recent study which could act as baseline to either compare the results of the GES or the effects of water fluoridation on older Chilean populations. The national reference data for this age group provides a view of the oral health in a sample of 65-74 years residents of Santiago. The study noted that almost all participants had a history of dental caries; mean DMFT of 26.1 — 14.3 missing teeth, 3.6 filled teeth and 8.2 decayed teeth. The study also revealed 34% of participants aged 65-74 years were edentulous. Another study conducted in the city of Valparaiso in 1986 (Badenier and Mariño, 1987) at about the time of the introduction of water fluoridation in that city, reported a mean DMFT of 25.7 in adults aged 60 to 85 years, with the missing component being the larger component (22.8). The study found that 32.7% of the study population was edentulous.

Data on the prevalence of periodontal disease suggest that older adults have high periodontal involvement (Gamonal et al, 1998). A large proportion (71%) had, on average, loss of periodontal attachment of four mm or more. Regarding oral soft tissue lesions, a study in a sample of older adults living in Santiago indicated a prevalence of 53% (Espinoza *et al.,* 2003).

Thus, little has been done to determine the oral health status of older adults in Chile, and it was deemed important to study the oral health needs of this age group, as they will undoubtedly place increased pressure on the public health system in the future (Harford, 2009). Consequently, the purpose of the present paper is to provide estimates of the prevalence of dental caries, periodontal disease, oral mucosal pathology, edentulism and treatment needs in an ambulant population of older adults. The paper also describes oral health inequalities among older adults living in central Chile.

Information from this study will allow the development of appropriate health policies and programs, as well as addressing priorities set by the Ministry of Health. In

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addition, this information was considered important in view of the current emphasis on health promotion from the Chilean government and the government's calls for the construction of baseline data in this area and for the strengthening of evaluative efforts (Ministerio de Salud, 2007).

Methods

This is a cross-sectional study of a random sample of older adults, residents of the Chilean Region of Valparaiso. Information from the National Bureau of Statistics (Instituto Nacional de Estadisticas, 2003) indicates that some 206,872 adults were the target population. Households were identified from area maps. From each area, sectors were selected randomly, and from each sector households were selected randomly. Following approval from the University of Valparaiso Ethics Committee, once a household was selected, one person aged 60 years or older was selected at random and invited to participate in the study.

Different research questions in this study required different sample sizes, however minimum requirements to undertake a cross-sectional prevalence study with a capacity to detect a 25% or greater reduction in the mean DMFT since 1986 (Badenier and Mariño, 1987), with a statistical power of 80%, yields 251 participants, at the level of significance of 0.05 (Cohen, 1988). The final sample was weighted to represent the regional population. That is, 60% would come from municipalities with more than 95,000 people ('Urban'); 25% from municipalities between 20,000 and 95,000 ('Non-metro centre') and 15% from rural municipalities 'Rural' (less than 20,000 population).

Once individual written consent was obtained, volunteers were asked to undergo a structured interview and a clinical examination. Interviews were conducted at the community health centres' facilities by the principal investigators of this study. Dental examinations were also conducted at the community health centres' facilities using overhead light, dental mirrors and Community Periodontal Index probes (World Health Organization, 1997). Clinical data were recorded following WHO criteria and recommendations for oral health data collection (World Health Organization, 1997). Participants with specific medical conditions such as heart disease, bleeding disorders and anticoagulant therapy were excluded from the periodontal examination. Data collection extended from October 2006 to June 2007.

A team of six examiners received training and calibration in making clinical measurements. Intra- and inter-examiner reliability was checked using Cohen's Kappa statistics. Inter-examiner reproducibility achieved in the duplicate examinations of 17 individuals and the intra-examiner reliability was assessed by the repetition of exams in 20–23 individuals by each examiner. In both cases kappa statistics were higher than 0.85, which indicates an almost perfect level of agreement, according to Landis and Koch's criteria (Landis and Koch, 1977).

Clinical data used in this analysis included: decayed teeth (DT), filled teeth (FT) and number of teeth present. Number of natural teeth was divided into four groups: 'No natural teeth"; '1 to 10 teeth'; '11 to 20 teeth'; and 'More than 20 teeth'. To further explore dental health status, the dental caries assessment included the proportion of unmet restorative needs. An index was computed to measure restorative needs by dividing the sum of carious teeth by the sum of carious and filled teeth - the restorative unmet normative needs index [DT/(DT + FT)] (Angelis and Rojas, 1982).

Periodontal status was recorded using the Community Periodontal Index (CPI) (World Health Organization, 1997). To assess soft tissue conditions, participants received a visual examination of the perioral area and a systematic examination of the oral mucosa. This assessment identified presence or absence of any oral mucosal lesions and made a tentative diagnosis of the lesion (Kramer *et al.,* 1980; World Health Organization, 1997).

In addition to age and gender, the following socio-demographic information was collected: Marital status classified into two groups: 'Married or in a *de-facto* relationship'; and 'Single, widow/widower or divorced'. Participants were classified according to their educational level using four categories: 'No formal education or incomplete or complete primary education'; 'Incomplete secondary education'; 'Complete secondary education'; and 'Post-secondary education'. Income was assessed by asking participants their monthly income. Income was reclassified as: 'Low' (RCH$ 170.000 or less a month) and 'Higher' (More than RCH$170.000 a month) [1 US$ = RCH $538.49 (March 2007)]. Participants were asked about their health insurance, in the categories of: 'No health insurance', 'Government health insurance'; and 'Private health insurance'. Private Health Insurance Plans (ISAPREs) are private firms in charge of financing and delivering medical services as an alternative to the public system. Affiliates must pay compulsory health care contributions. Dentistry is not normally included. However, those affiliated have access to a list of dentists who provide dental services to its members at reduced prices. Also, municipalities were classified using three categories: 'Urban'; 'Non-metro centre'; and 'Rural'.

To assess inequalities by municipality, the Excess Morbidity Index was used (Chen, 2002). Excess morbidity was defined as the number of people who would not have had the condition if the lowest rate of morbidity had prevailed in every group. For example, regarding edentulousness, the index of excess morbidity would indicate the percentage of edentulous persons that are estimated to be "excess" in one group compared to the group with the lowest prevalence. In this case, the Index is computed with the formula:

Index of Excess Morbidity = $[T_c - (S_c \times M_h)]/T_c$

T_c = Total number of participants with the condition in the comparison group

S_c = Sample size in the comparison group

M_h = Morbidity rate (prevalence of the condition in the reference group)

The analysis provides basic descriptive information on selected socio-demographic factors, and on the distribution of oral diseases and conditions, as well as information on unmet restorative needs, and excess morbidity in the population. Results were analysed using one-way analysis of variance (ANOVA). A significant ANOVA

was followed by post-hoc comparisons using Tukey's Honestly Significant Differences tests. For variables that were nominal or ordinal, differences between groups were subjected to Chi-square analysis. When a probability value was smaller than 0.05, the difference was considered to be statistically significant. Finally, data were analyzed using multiple linear regression analysis with a stepwise procedure to identify the variables that accounted for a significant proportion of the variance in participants' DMFT scores. Data were examined for violation of assumptions underlying multivariate methods prior to analyses. Data manipulation and analyses were done using SPSS PC (Version 15.0).

Results

A total of 354 older adults were examined and interviewed. (Table 1). Mean age was 68.5 years (s.d. 5.3), with 68.1% being female. The mean value of the DMFT index was 21.6 (s.d. 5.7) and ranged from 4 to 28. On the other hand, they had an average of 6.4 sound teeth. The average number of missing teeth was 17.9 (s.d. 8.1). Twenty-three participants (13.3%) had more than 20 natural teeth present, this includes one participant who had all his natural teeth. Another 33.1% had between 11 and 20 natural teeth; and 33.5% had between one and ten natural teeth present. Seventy-one (20.1%) were fully edentulous.

Gender was associated with number of missing teeth with females having significantly more missing teeth than males (p<0.05) (Table 1) Marital status was also significantly associated with number of missing teeth, with singles having more missing teeth than married participants (p<0.01). Participants living in rural municipalities had significantly more missing teeth than those living in non-metro centre, but not significantly more than those living in urban ones (p<0.05). Those with private health insurance had less missing teeth than those in other groups (p<0.01). In addition, those with at least some tertiary education had a significantly lower number of missing teeth than any other education group (p<0.001).

Dentate participants had, on average 2.9 (s.d. 3.4) filled teeth and a mean of 1.8 (s.d. 2.3) decayed teeth. Level of education was the only variable significantly associated with number of filled and decayed teeth (DFT) with those with at least some tertiary education having a significantly higher mean DFT than any other education group (p<0.001). More importantly, they had as an average 43.6% of their restorative needs unmet. While 30.8% had all their restorative needs met, 27.6% had all of their restorative needs unmet. Males had larger unmet restoratives needs compared to females (47.0% vs. 34.1%; p<0.01). Those with lower levels of education had more unmet needs compared to those in the higher education group (52.5% vs. 26.8%; p<0.01). No other variable reached statistical significance.

Table 1. Distribution of DMFT and its components: Mean (s.d.) scores by select socio-demographic variables in older adults living the Valparaiso Region, Chile.

Socio-demographic characteristics	n	Decayed and Filled teeth Mean (sd)#	Missing Teeth mean (sd)	DMFT mean (sd)
	354	4.7 (3.9)	17.9 (8.1)	21.6 (5.7)
Gender			*	*
Female	241	4.7 (3.9)	16.6 (8.3)	20.6 (6.1)
Male	113	4.6 (3.9)	18.5 (8.0)	22.1 (5.4)
Martial status			**	*
Married, de-facto	167	4.6 (3.8)	16.7 (8.1)	20.6 (6.1)
Single, widow/widower	186	4.7 (4.0)	19.1 (8.0)	22.6 (5.4)
Size of the Municipality			*	
Rural	49	3.6 (3.1)	20.2 (7.9)	22.8 (6.2)
Non-metro centre	93	4.8 (4.0)	16.7 (8.0)	20.9 (5.5)
Urban	212	4.8 (3.9)	17.9 (8.0)	21.7 (5.6)
Monthly income			***	***
Higher (more than RCH$ 170.000)	72	5.2 (4.1)	15.0 (8.3)	19.5 (6.3)
Low (RCH$ 170.000)	281	4.5 (3.8)	18.6 (8.0)	22.2 (5.4)
Type of health insurance			**	**
No health insurance	101	4.4 (3.3)	19.5 (8.0)	22.6 (5.8)
Public health insurance	169	4.4 (3.7)	18.2 (8.0)	21.7 (5.6)
Private health insurance	83	5.4 (4.5)	15.3 (8.2)	20.2 (5.5)
Level of education		***	***	***
No formal education/incomplete primary	161	3.7 (3.6)	19.8 (7.7)	22.6 (5.7)
Incomplete secondary	121	5.0 (3.5)	17.1 (8.0)	21.2 (5.6)
Secondary complete	39	4.9 (4.1)	18.0 (8.1)	20.0 (5.2)
Tertiary education	31	7.0 (4.6)	11.1 (6.9)	17.9 (5.3)

Dentate participants only.

* p< 0.05; ** p< 0.01; *** p<0.001

The clinical assessment indicated that a total of 282 participants (79.6%) were partially edentulous. Of these, 131 (29.7%) had no need of prosthetic appliances. Another 24.0% needed full dentures in the maxilla, and another 44.2% were in need of partial appliances in the maxilla. In addition, six participants (2.1%) were in need of fixed prosthesis only. Regarding the mandible, the majority (72.1%) of participants needed a partial dental appliance, whereas another 9.5% (n=81) were found to be in need of a full lower denture. Another 3.2% (n=9) needed fixed prosthesis in the mandible, and 43 participants (15.3%) had no need of prosthetic appliances. Among those found fully edentulous, while 18.4% had all their prosthetic needs satisfied, the majority (56.3%; n=40) of participants needed both appliances. Another 19.7% were in need of their lower full denture only, while another 5.6% needed their upper full denture only.

A combination of socio-demographic characteristics was entered into a multiple linear regression model to explain the variance in DMFT scores (Table 2). The DMFT score was independently associated with five variables: age, income, marital status and level of education, type of health insurance, and place of residency [$F_{(5,342)}=10.772$; $p<0.0001$]. As shown in Table 2, these five independent variables accounted for 12.3% of the variance in DMFT score (adjusted r^2=0.123). The resulting model indicated that, after controlling for other independent variables, participants who had the highest DMFS scores were older, living in low income household, more likely to be single or widow/widower,

and less likely to have health insurance. They were also more likely to live in rural municipalities.

Table 3 shows the prevalences of edentulousness among older adults by size of the municipality in which they live. These prevalences were 28.6%; 14.0%; and 20.8% among rural, non-metro centre and urban municipalities, respectively. Those living in rural municipalities had 51.0% excess morbidity compared to those living in non-metro centres (See example). In addition, those living in urban municipalities had 32.5% excess morbidity compared to those living in non-metro centres.

Worked example: The Index of Excess Morbidity = [Tc-(Sc x Mh)]/Tc

Tc: Total number of older adults with five or more missing teeth in the comparison = 14
Sc: Sample size in the comparison group = 49
Mh: Morbidity rate (prevalence of five or more missing teeth in the reference educational group) = 0.14
Hence, Index of excess morbidity = [14-(49* 0.14)]/14
= (14-6.86)/14
= 7.14/14
= 0.51 = 51%

Interpretation: 51% of older adults in the rural municipalities suffer from excess morbidity compared to those living in non-metropolitan municipalities, due to missing teeth.

Table 2. Final multivariate model identifying dental caries history among older adults living the Valparaiso Region, Chile, 2007.

Independent variable	Multiple regression coefficient B (Std. Error)	p
Age	0.247 (0.054)	0.0001
Income (Low =1; Higher=0)	2.311 (0. 716)	0.001
Marital status (married vs. single/widow)	-1.756 (0.581)	0.003
No health insurance (indigent) (No = 0; Yes = 1)	1.758 (0.635)	0.006
Rural municipalities (No = 0; Yes = 1)	2.050 (0.833)	0.014
Constant	2.891 (3.810)	0.449
Adjusted r^2 = 0.123		

Table 3. Prevalence of edentulousness, severe periodontal treatment need (CPI 3 and 4) by type of municipality.

Size of the Municipality	Rural	Non-metro centre	Urban	Total
Edentulous	14 (28.6%)	13 (14.0%)	44 (20.8%)	71 (20.1%)
Dentate	35 (71.4%)	80 (86.0%)	168 (79.2%)	283 (79.9%)
Total	49	93	212	354
Excess of Morbidity	51.0%		32.5%	
Severe periodontal treatment need (CPI 3 and 4)				
Yes	17 (56.7%)	13 (18.1%)	76 (52.8%)	106 (43.1%)
No	13 (43.3%)	59 (81.9%)	68 (47.2%)	140 (56.9%)
Total	30	72	144	246
Excess of Morbidity	68.1%		61.7%	

Regarding oral hygiene, 95% of the dentate sample presented visible dental plaque. A total of eight participants (3.3%) were assessed as having no periodontal treatment needs. Bleeding after probing occurred in 28 participants (11.4%), and 104 (42.3%) of the sample had supra- or sub-gingival calculus. Pockets greater than 3 mm were found in 106 participants (43.0%). Thirty-seven dentate participants (13.1%) were excluded from this assessment. Females were less likely to have severe periodontal needs (CPI 3 and 4) than males (p<0.01). None of the other socio-demographic variables were associated with periodontal status. However, the need for severe periodontal treatment (CPI 3 and 4), was 56.7%; 18.1%; and 47.2% among rural, non-metropoliran, and urban municipalities, respectively, indicating excess morbidity of 68.1% and 61.7% among those living in rural and urban municipalities, respectively, compared to those living in non-metro centres (Table 3).

In the majority of cases (65.8%) no oral mucosal lesions were found. Of those found with lesions, the great majority did not need to be referred to a specialist (i.e., ulcers, candidiasis). However, examiners detected four individuals with soft tissue conditions which required immediate specialist referral due to pathologies in their oral mucosal which were considered to have 'life-threatening' or potentially 'life-threatening' conditions (i.e. leukoplakia).

Discussion

The present study is the first to be published, in at least 10 years, on one of the most rapidly ageing and populated regions of Chile. Findings indicate that older adults living in the Valparaiso Region are entering older age retaining more natural teeth and with a lower prevalence of caries history than previous studies. Compared to the 1996 data on low and middle income participants from Santiago, there was a three-fold reduction of the decayed-filled component. However, of particular relevance is the increase in the mean number of sound teeth. The study also found a lower prevalence of periodontal involvement compared to other reports from Chile (Gamonal et al, 1998). These trends will result in improved oral function, health, and quality of life in this population. This would also indicate that attention should also be given to future workforce capabilities to deal with these demands in an ageing population.

Present findings indicate that soft tissue conditions are less prevalent than previously reported in older adults living in Santiago (Espinoza et al., 2003). Yet, the study found some participants with oral mucosal lesions considered to be potentially life threatening. This, combined with a lack of knowledge about signs and causes of oral disease, including oral cancers, should be of particular concern.

The present study was conducted in a region with 25 years of uninterrupted water fluoridation, thus reflecting the benefits of fluoride exposure in older ages. In addition, this better oral health status should be perceived together with the overall health improvement of the Chilean adult population in recent decades.

However, this overall improvement should not deter future gains or diminish the priority of oral health among older adults as a public health concern. Participants in this study presented an unacceptably high level of restorative needs. The average dentate participant had almost 40% of his/her restorative treatment needs unmet and 43% of the sample required advanced periodontal treatment.

More importantly, the study showed substantial inequalities in oral health outcomes. Inequalities in oral health were particularly present among participants with lower incomes, lower levels of education and among those living in rural municipalities. These results are generally consistent with those reported in the literature (Brennan et al., 1998), and require a proactive approach, which should include a range of interventions to deal with the causes of disadvantage. The number of remaining natural teeth has been commonly used as an oral health outcome to assess socioeconomic inequalities among older populations (Haugejorden et al., 2008). However, it was also found that those living in large cities tended to have consistently lower oral health outcomes compared to those living in non-metro centres, which contrasts with previous observations (Holst and Schuller, 2000).

Further exploration of these results is warranted to fully uncover the causal mechanism between socio-demographic inequalities and oral health outcomes, as misinterpretation of information on inequalities, or a wrong approach to overcome them, might only increase inequalities (Watt, 2007; Spencer and Harford, 2007). Furthermore, inequalities in oral health mirror those of general health (Watt, 2007) and persist throughout life into old age (Acheson, 1998).

In making these observations, the limitations of this study need to be recognized. This was a random sample of volunteers, who felt reasonably well and capable of independently managing most of their daily activities. Therefore, a self-selection bias might be present. Thus, it is not claimed that a definitive profile has emerged, rather an important step has been made towards providing a basis for better targeting programs and future research in older adults.

The present study represents one of the largest data collections on oral health among older adults in Chile. It supports the contention of a general improvement of oral health in the Chilean older population, and contributes to a deeper understanding of the background of oral health in older adults while highlighting areas of inequalities. Results show that Chile is in the midst of an epidemiological transition in oral health, moving from high rates of edentulism and tooth loss towards lower rates. Tooth retention and an ageing population, have impacts on oral health care services.

If good general health and a satisfactory quality of life are dependent on maintaining oral health, then policies need to be implemented so that oral health care services and preventive services and programs become affordable and accessible for an ageing population (Petersen and Yamamoto, 2005). Expansion of community-based programs would help to increase the numbers of dentate older adults managing their oral health needs, and in so doing, decrease disadvantages in oral health. Their provision is critical to reducing social inequalities in oral health among older adults.

References

Acheson, D. (1998): *Independent Inquiry into Inequalities in Health Report.* London: The Stationery Office.

Angelis, A.J. and Rojas, A.J. (1982): Dental caries and periodontal disease in an Indochinese refugee population. *Journal of Dental Research* **61**, 1233-1235.

Badenier, O. and Mariño, R. (1987): Magnitud de las enfermedades dentales en adultos mayores de 60 años. *Vejez y Envejecimiento* **2**, 34-37.

Brennan, D., Spencer, A.J. and Szuster, F. (1998): Rates of dental service provision between capital city and non-capital locations in Australian private general practice. *Australian Journal of Rural Health* **6**,12-17.

Chen, M. (2002): Oral health status and its inequality among education groups: comparing seven international study sites. *International Journal of Health Services* **32**, 139-161.

Cohen, J. (1988): *Statistical power analysis for the behavioral sciences*. Hillside, NJ: Lawrence Erlbaum Assoc. Inc.

Espinoza, I., Rojas, R., Aranda, W. and Gamonal, J. (2003): Prevalence of oral mucosal lesions in elderly people in Santiago, Chile. *Journal of Oral Pathology and Medicine* **32**, 571-575.

Gamonal, J.A., López, N.J. and Aranda, W. (1998): Periodontal conditions and treatment needs, by CPITN, in the 35-44 and 65-74 year-old population in Santiago, Chile. *International Dental Journal* **48**, 96 -103.

Harford, J. (2009): Population ageing and dental care. *Community Dentistry and Oral Epidemiology* **37,** 97-103.

Haugejorden, O., Klock, K.S., Astrom, A.N., Skaret, E. and Trovik, T.A. (2008): Socio-economic inequality in the self-reported number of natural teeth among Norwegian adults an analytical study. *Community Dentistry and Oral Epidemiology* **36**, 269-278.

Holst, D. and Schuller, A.A. (2000): Oral health changes in an adult Norwegian population: a cohort analytical approach. *Community Dentistry and Oral Epidemiology* **28**,102–111.

Instituto Nacional de Estadísticas. (2003): *Catastro de población adulta mayor. Adultos mayores por regiones, comunas y porcentajes*. Santiago: Instituto Nacional de Estadísticas. [cited 2008 Dec 13]. Available from: http://www.ine.cl/canales/chile_estadistico/estadisticas_sociales_culturales/adultosmayores/pdf/mayorescenso2002.pdf.

Kramer, I.R., Pindborg, J.J., Bezroukov, V. and Infiri, J.S. (1980): Guide to epidemiology and diagnosis of oral mucosal diseases and conditions. *Community Dentistry and Oral Epidemiology* **8**, 1-26.

Landis, J.R. and Koch, G.G. (1977): The measurement of observer agreement for categorical data. *Biometrics* **33**, 159–174.

Ministerio de Salud. (2007): *Guía Clínica salud oral Integral para adultos de 60 años*. Serie de Guías Clínicas Minsal **47**. Santiago (Chile): Ministerio de Salud.

Petersen, P.E. and Yamamoto, T. (2005): Improving the oral health of older people: the approach of the WHO Global Oral Health Programme. *Community Dentistry and Oral Epidemiology* **33**, 81-92.

Spencer, J. and Harford J. (2007): Inequality in oral health in Australia. *Australian Review of Public Policy*. [cited 2008 Dec 13]. Available from: http://www.australianreview.net/digest/2007/election/spencer_harford.html

Watt, R.G. (2007): From victim blaming to upstream action: tackling the social determinants of oral health inequalities. *Community Dentistry and Oral Epidemiology* **35**, 1-11.

World Health Organization. (1997): *Oral health surveys: basic methods*. 4th Ed. Geneva: WHO.