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ORIGINAL ARTICLE

Oral health in a convenience sample of Chinese older adults living in Melbourne, Australia

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Abstract
Objectives To present data on the dental and periodontal status of a convenience sample of 101 ambulant China-born older adults who now live in Melbourne. These older adults participated in a study to assess the prevalence of specific oral diseases.
Methods Participants were interviewed in Cantonese using a structured questionnaire and received an oral examination to assess dental and periodontal status using the DMFS/T and CPI indices, respectively.
Results This sample was largely a dentate one (94.1%); with a mean Decayed, Filled and Missing tooth surfaces (DMFS) score of 57.5 (SD 37.9). Approximately, 80% of the dentate sample had all their restorative needs met; 25% had a sound periodontium; 41% needed oral hygiene instruction plus scaling, while 6.3% required complex periodontal therapy. Compared with existing data on the oral health of older adults in Australia, Chinese immigrant older adults appear to have lower DMFS scores, a lower number of untreated decayed surfaces, a lower prevalence of gingivitis, and less need for complex periodontal treatment.
Conclusion These tentative findings provide an initial assessment of the risk of oral diseases among a group immigrant older adults. This study highlights the need to collect relevant information in order to identify factors that influence the oral health of older immigrants to Australia.

Keywords Oral health · China-born · Older adults · Immigrant health · Australia

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Introduction

In 2006, 13.3% of the population in Australia, was aged 65 years and more, with 41% of these born overseas (Australian Bureau of Statistics 2007). The China-born population has grown to become one of the largest migrant communities in Australia as reflected in the 2006 census report (Australian Bureau of Statistics 2009). Moreover, it is one of the fastest growing groups among new arrivals (Department of Immigration and Citizenship 2009). Increasing at an average rate of 5.3% per year since 1996, the 2006 Census recorded 203,100 Australian residents born in China.

Recent Chinese migration to Australia has occurred in waves. One group of 65–75 year-olds arrived as young adults; another arrived as older adults under the family reunification program (Thomas 2003); while a third group, who came mostly as entrepreneurs or skilled migrants from Hong Kong and Macau, dominated immigration in the early 1990s. Immigration from this region diminished substantially, shortly before and after the reunification of these territories with China (Chi-Wai 2006).

China-born immigrants are concentrated in capital cities, such as Sydney, Melbourne and Brisbane (Department of Immigration and Citizenship 2009). The 2001 distribution by State and Territory showed New South Wales had the largest number (85,450) of Chinese immigrants, followed

by Victoria (36,760) (Department of Immigration and Citizenship 2009). Although Mandarin is the official language of China, in Victoria more than 30% of Chinese immigrants speak Cantonese. Furthermore, for those 55 and older, there are more Cantonese than Mandarin speakers in Victoria (Victorian Office of Multicultural Affairs 2003).

Good oral health is an important factor for older people's quality of life, helping them remain independent and fully participating in the community (Australian Institute of Health and Welfare 2006). While there has been increasing focus on the oral health needs of older Australians, little information is currently available regarding their oral health status, treatment needs and patterns of oral health services use by these culturally and linguistically diverse (CALD) older persons in Australia. Thus, current data do not allow us to form conclusions about the oral health status of CALD groups living in Australia. Despite this lack of data, immigrants living in Australia are generally regarded as having more oral diseases (Australian Health Ministers' Conference 2004).

This study aims to provide information about the dental and periodontal status, and treatment needs of a Cantonese speaking, China/Hong Kong-born population, 55 years and older, living in Melbourne. The study will explore the relationship between socio-demographic characteristics and oral health status. The study was also designed to integrate these findings with existing health data in Australia.

This information is needed for appropriate planning and delivery of dental services to ensure optimal dental care for all Australians, particularly older Chinese, who, despite their significant number, are in danger of being overlooked by policy makers (Parikh et al. 2009). Furthermore, China represents 20% of the world's population and many Southern Chinese have immigrated to Western countries in the last 15 years (Ohio University Libraries 2008). Thus, this information is not only of local importance, but also has broader international significance.

Methods

The investigators recruited active, independent-living, China/Hong Kong-born adults, 55 years or older, living in Melbourne, who were part of the Chinese Health Foundation of Australia network. Our sample size was based on nine independent variables that accounted for 15% of the variance in the dependent variable. In order to achieve this, a sample size of 100 will yield a power of 0.81, that is, an 81% chance of explaining that proportion of the variance at a P value of 0.05 (Cohen 1988). Therefore, the research team planned to recruit 100 older adults who fit the research criteria.

A bilingual (Cantonese–English) research assistant contacted clubs in the Melbourne network of Chinese elders, explained the project to potential participants, and recruited volunteers. After signing a written consent form, participants were interviewed in Cantonese using a structured questionnaire. This included questions on sociodemographic characteristics; self-reported oral health status, utilization of oral health services, oral hygiene practices, and oral health attitudes and knowledge. Questions were developed in English and translated into Cantonese following Brislin's methodology (Brislin 1970).

Participants also received an oral examination by a trained and calibrated dentist. Dental examinations were conducted at the clubs or community facilities using overhead light, dental mirrors, and Community Periodontal Index probes (World Health Organization 1997). Clinical data were recorded at the tooth surface level following criteria and recommendations from well-established methods for oral health data collection (World Health Organization 1997; National Center for Health Statistics 1987). Radiographic examinations were not performed. The examiner had been previously trained and calibrated using World Health Organization (WHO) criteria. Data collection took place August to October 2007. The study received approval from the University of Melbourne's Human Research Ethics Committee.

Measures

In addition to age and gender, the following socio-demographic information was collected: living arrangement (classified into four groups: 'Living alone'; 'living with spouse'; 'living with spouse and daughter/son'; and 'living with daughter/son only and living with others'). Educational level was recoded using four categories: 'No formal education or primary education'; 'Incomplete secondary education'; 'Completed secondary'; and 'post-secondary education'. Occupation before retirement was re-classified into four groups based on the Australian Industrial Occupations criteria (Australian Bureau Statistics 1997): 'professional and management'; 'paraprofessional and tradespersons'; 'clerk, salesperson, machine operator, driver'; and 'homemaker and inadequately defined occupations.' Residence was classified as either Box Hill (an area of relative social advantage), or North Melbourne (an area of relative social disadvantage). Year of arrival in Australia was also recorded. However, as the actual length of residence in the receiving country varies, the proportion of life spent in Australia was computed using the of the respondent's length of residence and actual age (Martin et al. 1987).

Self-reports of health were also obtained: Participants were asked to classify their oral health status compared to

others their age on a 5-point ordinal scale, ranging from "Much better" to "Much worse." However, because of a lack of responses in the extreme categories, responses were collapsed into two categories "Better" and "Worse." Participants were also asked to classify their general health using a one-item measure from the Medical Outcomes Study Short-Form 12 (Ware et al. 1996). Respondents answered on a five-point ordinal scale ranging from "Excellent" to "Poor."

A checklist of twelve medical conditions (diabetes, epilepsy, stroke, lung diseases, psychiatric treatments, kidney problems, arthritis, mobility problems, heart conditions, allergies, auditory conditions, and liver diseases) was used to compute a medical history score by adding affirmative answers to these conditions.

Two variables were included to capture access to health care services: visit to dental providers during the last 12 months; and possession of a Commonwealth Health Care or Pensioner Benefit Card (coded 'Yes/No'). Cardholders are entitled to a range of concessions, including reductions in the cost of medicines and specific health services: physician, dentist, and ambulance.

Data obtained in the clinical examinations included: number of decayed surfaces (DS), filled surfaces (FS) number of natural teeth present. These data were used to compute Decayed, Missing, and Filled Surfaces (DMFS[1]) and Teeth (DMFT) indices. The DMFS index represents the sum of *tooth surfaces* (S) that are decayed (D), missing (M), and filled (F). The DMFT index represents the sum of permanent teeth (T) with caries history. To further explore dental health status, the dental caries assessment included the proportion of unmet restorative needs. To measure restorative needs, the "restorative unmet normative needs" index was computed by dividing the sum of carious surfaces by the total number of carious and filled surfaces: [DS/(DS + FS)] (DiAngelis and Rojas 1982; Todd and Gelbier 1991).

The Community Periodontal Index (CPI) was used to assess periodontal status (WHO 1997). All index teeth present, and not indicated for extraction, were examined and scored as: no need for care (healthy), bleeding gingiva on gentle probing (bleeding), presence of dental calculus (calculus), presence of 4–5 mm gingival periodontal pockets (shallow pockets), or 6 mm or deeper gingival pockets (deep pockets).

In addition to the CPI, the position of the gingival margin in relation to the cemento-enamel-junction was measured using the WHO methodology. "Loss of attachment," that is, the apical migration of the level of attachment (and hence the level of alveolar bone), is regarded as an invariant destructive component associated with periodontal disease (Goodson 1990). A score of 0 means an attachment loss of no more than 3 mm. A score of 1 indicated that participants had an attachment loss between 4 and 5 mm, whereas a score of 2 indicates a loss between 6 to 8 mm, and 3 means an attachment loss of 9–11 mm, while 4 indicates an attachment loss 12 mm or more. Thus, scores of 2–4 indicate serious periodontal destruction.

Oral hygiene was established using the Plaque Index (PI) (Silness and Löe 1964). The PI is based on the presence and amount of soft debris deposits on selected teeth. Each of the four surfaces of the teeth (buccal, lingual, mesial and distal) is given a score from 0 to 3. Zero indicates 'No plaque' while a score of 1 indicates that a film of plaque may be seen only after application of disclosing solution or by using the probe on the tooth surface. A score of 2 indicates moderate accumulation of soft deposits within the gingival pocket, or on the tooth and gingival margin, which can be seen with the naked eye. Finally, a score of 3 indicates an abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin. In summary, we used five clinical measures of oral health status: DMFT, DMFS, CPI, Loss of Attachment, and PI.

Data analysis

Basic descriptive information on selected socio-demographic factors are reported, as well as information on dental status, unmet restorative needs, and aspects of periodontal status in the population. Results were analyzed using a one-way analysis of variance (ANOVA). A significant ANOVA was followed by post hoc comparisons using Tukey's tests. Pearson correlations were performed for univariate associations between continuous variables. For variables that were nominal or ordinal, differences between groups were subjected to Chi-square analysis. When a probability value was 0.05 or smaller, the finding 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' DMFS scores. A stepwise logistic regression analysis (LRA) was performed to obtain a better picture of the effect of the selected variables on periodontal health. Data were analyzed using SPSS V 17.0, and were examined for violation of assumptions underlying multivariate methods prior to analyses (Tabachnick and Fidell 2000).

[1] In people 30 years and older the M-component of the DMFT index includes teeth missing due to dental diseases, but also for other reasons (periodontal diseases, trauma, etc.) (World Health Organisation 1997). Therefore, the DMFS/DMFT should be interpreted with caution in the elderly.

Table 1 Distribution of decayed, filled and missing tooth surfaces (DMFS), decayed and filled tooth surfaces and missing teeth: mean (standard deviation) scores by select socio-demographic, self-assessed, and immigration variables in older Chinese immigrants living in Melbourne, Australia, 2007

Individual characteristics	*N*	Decayed, missing and filled surfaces Mean (SD)	Decayed and filled surfaces Mean (SD)	Missing teeth Mean (SD)
	101	57.5 (37.9)	12.0 (11.4)	9.7 (8.9)
Age group		***		***
55–64 years	24	39.0 (28.6)	9.2 (8.7)	6.3 (6.1)
64–74 years	46	52.0 (34.4)	14.1 (11.7)	8.06 (7.9)
75 years and older	31	80.1 (39.2)	10.9 (12.5)	14.9 (8.9)
Gender				
Female	62	56.6 (38.7)	13.6 (12.3)	9.2 (9.1)
Male	39	59.0 (36.9)	9.4 (9.4)	10.6 (8.7)
Level of education		**	*	**
No formal/incomplete primary	22	81.9 (42.4)	6.4 (6.4)	16.4 (8.73)
Incomplete secondary	12	58.7 (33.4)	13.8 (14.1)	9.5 (7.7)
Secondary complete	36	54.4 (37.2)	14.9 (12.5)	8.4 (8.7)
Tertiary education	30	44.8 (28.6)	12.1 (10.9)	6.9 (6.5)
Living arrangement		**		**
Alone	27	79.1 (39.8)	9.7 (11.8)	15.0 (9.8)
With spouse only	43	46.8 (34.1)	12.1 (11.3)	7.4 (7.8)
With spouse and children	8	74.1 (45.8)	12.0 (13.15)	13.4 (11.1)
Other arrangements	23	46.5 (27.3)	14.4 (10.8)	6.7 (5.7)
Location		*		*
North Melbourne	23	72.3 (41.9)	9.2 (10.3)	13.5 (10.3)
Box Hill	78	53.2 (35.8)	12.8 (10.3)	8.7 (8.2)
Self-assessed general health status			*	
Much better or better	24	53.4 (30.1)	14.7 (13.2)	8.2 (6.6)
About the same	34	61.3 (43.2)	7.3 (7.4)	11.6 (9.9)
Worse or much worse	43	56.9 (37.8)	14.1 (12.1)	9.1 (9.1)
Dental visits				
12 months or less	34	58.6 (41.6)	10.4 (10.0)	10.3 (9.7)
More than 12 months	67	57.0 (36.2)	12.8 (12.1)	9.4 (8.5)
Self-assessed oral health status		*		*
Much better or better than peers	39	48.3 (38.6)	12.9 (13.6)	7.5 (8.8)
About the same	36	56.4 (38.3)	11.3 (10.1)	9.7 (9.0)
Worse or much worse	26	73.0 (32.3)	11.5 (9.9)	13.2 (8.3)
Emigrated from				*
Hong Kong	46	62.8 (40.8)	11.7 (11.4)	8.5 (7.6)
Canton	54	52.0 (33.8)	12.4 (11.7)	10.9 (9.8)

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

Results

A total of 101 older adults volunteered to participate in the study. Table 1 summarizes the DMFS and components by socio-demographic variables and immigration characteristics. The mean age of the sample was 70.3 years (SD 8.4). Almost 71.3% were between ages 55 and 75. The majority was female (61.4%). More than 60% had completed secondary education, with 30% having higher degrees. The largest proportion lived with their spouses (42.6%), and worked in professional or managerial occupations (36.6%). The majority lived in Box Hill (77.2%). A quarter of participants (24.7%) arrived in Australia before 1985; another 41.6% arrived between 1985 and 1994 and the remaining 33.7% after 1994.

General health

When asked about their general health, one-third of participants (33.7%) rated it as 'Good'; 23.8% as 'Excellent' and 30.7% as 'Fair'. 12 elders rated their health as 'Poor.' Over a third (38.6%) of participants self-assessed their oral health

as "Much better" or "Better" than others the same age, while 35.6% reported being "About the same," and 25.8% as being "Worse" or "Much worse" than others their age.

The most commonly reported medical conditions were heart disease (36.6%), auditory problems (33.7%), joint problems (19.8%), diabetes (15.8%) and kidney diseases (8.9%). Almost a quarter (23.8%) reported no medical conditions, 26.6% reported 1, 22.8% reported 2, and only 26.8% between 3 and 6 chronic medical conditions. The majority never smoked (89.1%); only 2% reported currently being a smoker.

With regard to health care access and use, the majority (78.2%) reported having a health card, and 66.3% had not seen a dental care provider in the previous 12 months. Only age and possession of a health card were associated with use of services ($P < 0.03$). Health card holders were older than non-holders. On the other hand, frequent users were younger than non-users (69 vs. 73 years).

Dental caries experience

DMFS values ranged from 1 to 128, with a mean of 57.5 (SD 37.9) surfaces affected. The distribution of participants by DMFS score showed that three individuals had no history of caries. Based on individual DMFS components, participants had a mean of 11.5 (SD 11.5) filled surfaces and 0.47 (SD 1.9) decayed surfaces. The M (missing) component had the largest share of DMFS scores (45.6; SD 40.6 tooth surfaces). The average number of missing teeth among this sample was 9.7 (SD 8.9). Six participants (5.9%) were fully edentulous. On the other hand, 9.9% had all their natural dentition and 19% had more than 20 natural teeth. Age was positively associated with number of missing teeth ($P < 0.001$). Level of education was negatively associated with number of missing surfaces ($P < 0.001$). Those who had only a primary school education or less had more missing teeth than those with more education ($P < 0.01$). Living arrangement was significantly associated with number of missing teeth; those living alone had more missing teeth than older adults who lived with others ($P < 0.01$). Possession of a health card and living in North Melbourne (i.e. a proxy for lower income) were related to number of missing teeth ($P < 0.001$ and $P < 0.05$, respectively) (see Table 1).

Most sociodemographic and immigration variables were not associated with number of filled or decayed surfaces. The exception was location, with those living in North Melbourne having more decayed surfaces than those living in Box Hill (a higher income group) (1.04 vs. 0.29 respectively; $P < 0.05$). When considering teeth as the unit of study, the overall mean DMFT score was 15.24. That is, an average of more than 15 teeth had a history of disease (i.e., filled or decayed) or missing teeth.

Table 2 Final multivariate model predicting decayed, filled and missing tooth surfaces (DMFS) in older Chinese immigrants living in Melbourne, Australia, 2007

Independent variable	Multiple regression coefficient *B* (SE)	*P*
Age	1.65 (0.39)	0.0001
Occupation before retirement (professional/managers)	−20.14 (6.73)	0.003
Living with spouse only	−16.54 (6.56)	0.013
Smoking	20.95 (10.35)	0.046
Constant	−46.14 (28.34)	0.107
Adjusted $R^2 = 0.275$		

The results also revealed relatively low unmet restorative needs in this population. Overall, the average dentate participant had only about 10% of his/her restorative needs unmet; 4.4% of the dentate sample had at least half of their restorative needs unmet. Among those with unmet needs, most required a one surface restoration (75.0%).

DMFS was independently associated with four sociodemographic variables: age, living arrangement, occupation before retirement, and smoking history [$F(4,96) = 10.47$; $P < 0.0001$]. These characteristics were entered into a multiple linear regression model to explain the variance in DMFS scores. As shown in Table 2, these three independent variables accounted for 27.5% of the variance in DMFS score (adjusted $R^2 = 0.275$). The resulting model indicated that, after controlling for other independent variables, participants who had the highest DMFS scores were older, less likely to have been in professional and managerial occupations, less likely to be living with a spouse, and more likely to be smokers.

Oral hygiene

All dentate participants showed signs of dental plaque on their gingival margins and adjacent tooth surfaces. Over one-third (35.2%) had plaque that was identified only by running the CPI probe across the tooth surface adjacent to the gingival margin. Half (50.5%) had soft deposits which could be seen with the naked eye. The remaining (14.3%) showed abundant plaque.

Periodontal health

Among dentate participants, 24 (28.9%) were assessed as having no periodontal treatment needs. Gingival bleeding upon probing was observed in 34 participants (41.0%), and supra- or sub-gingival calculus in four (4.8%) older adults. Pockets greater than 3 mm, but less than 5 mm, were found in 15 participants (18.1%). Only a small percentage (7.2%) had pockets greater than 5 mm. The percentage distribution

Table 3 Periodontal status in older Chinese immigrants living in Melbourne, Australia, 2007

Oral hygiene	% ($n = 95$)[a]
Score 0 (No plaque)	0.0
Score 1 (Plaque visible only after probing)	35.2
Score 2 (Moderate accumulation of plaque, which can be seen with the naked eye)	50.5
Score 3 (Abundance of plaque)	14.3
Community periodontal index (CPI)	
Healthy	25.3
Bleeding on probing	35.8
Calculus	4.2
Shallow pockets (4 mm or less)	15.8
Deep pockets (greater than 4 mm)	6.3
Excluded	12.6
Loss of attachment (LoA)	
0–3 mm	32.6
4–5 mm	27.4
6–8 mm	24.2
9–11 mm	0.0
More than 11 mm	3.2
Could not assess LoA	12.6

[a] Dentate participants only

of dentate participants according to the highest CPI score in any sextant is shown in Table 3.

More than one-third of dentate older adults (37.3%) did not show any loss of attachment (LoA) beyond 3 mm. The remainder showed LoA in at least one of the sextants examined, with LoA greater than 3 mm, but lower than 6 mm in 31.3% of participants; 27.7% with LoA levels between 6 and 8 mm. Only three (3.6%) had LoA beyond the 8 mm threshold, all of them greater than 11 mm (Table 3). 12 dentate participants were excluded from CPI and loss of attachment assessments because they did not satisfy the criteria of having more than 2 teeth present on each of the sextants.

To explore the probability of having a LoA greater than 3 mm, a sign of advanced periodontal disease, a logistic regression analysis was performed. The final model contained three significant predictors: level of education, self-assessed general health status and plaque index scores [$\chi^2(3) = 19.22$; $P < 0.0001$]. After controlling for the other independent variables included in the model, level of education was a significant predictor; those who had only completed their secondary education had greater loss of attachment than those with a bachelor degree or higher. Those with at least a secondary education were almost five times more likely to have visited the dentist than participants with other levels of education (OR = 4.95; 95% CI 1.55 to 15.80). Those who self-assessed their general health as better or much better were less likely to have advanced periodontal disease (OR = 0.21; 95% CI 0.06–0.66) than other groups. Those with a higher PI scores were more likely to also have advanced periodontal disease (OR = 4.09; 95% CI 1.39–11.97). The variance in LoA greater than 3 mm accounted for using the full model was 27.8% (Nagelkerke $R^2 = 0.278$) (See Table 4).

Discussion

As expected, mean DMFS scores were consistently related to some socio-demographic variables (i.e., age, education, occupational status, living arrangement) as commonly described in the literature. Nonetheless, the present results did not show statistically significant differences in oral health status by gender. Data also indicate that members of the Chinese population living in Melbourne are reaching old age with at least some of their natural teeth. Only 5.9% of participants were found to be edentulous. Nevertheless, the missing teeth (MT) component of the DMFT index is still high in this group of older adults. The present findings also demonstrate a generally less extensive and less severe periodontal involvement. Oral hygiene improvements were needed by all participants.

These findings contrast with reports and assumptions about systemic and oral health in immigrant older adults living in Australia. Participants in this sample (albeit a smaller number of individuals) had better oral health status

Table 4 Regression coefficient, odds ratios and 95% confidence interval for odds ratios for the factors predicting loss of attachment in older Chinese immigrants living in Melbourne, Australia, 2007

Independent variable	β coefficient	Odds ratio	95% Confidence interval
Level of education			
Completed secondary education only versus Bachelor degree or higher	1.61	4.95	1.55–15.80
Self-assessed general health versus others			1.00
Much better, better	−1.56	0.21	0.06–0.66
Worse, much worse			1.00
Oral hygiene (plaque index)	1.37	4.09	1.40–11.97
Constant	−1.63		

compared to their counterparts (55–74 years old) who were born in Australia, as reported by the National Survey of Adult Oral Health (Australian Institute of Health and Welfare 2007). On the other hand, their mean DMFT score was similar to other studies conducted among Chinese populations in the Guangdong Province of Southern China (Lin et al. 2001) and Hong Kong (Hong-Kong Government 2003).

In the same manner, lower periodontal involvement in this sample is consistent with findings from the oral health survey in Hong Kong (2003) and reports of Chinese older immigrants in Canada and the US (Persson et al. 2004). A low risk of periodontal disease and few cases of advanced periodontal destruction was also reported by Baelum and her collaborators (1997) among older adults living in China. Furthermore, access to oral health care and conventional oral hygiene presence/absence were unrelated to these findings (Baelum et al. 1997).

While care should obviously be taken in making comparisons between groups, the results of this study suggest a generally healthy group of immigrants in terms of medical conditions; heart disease, diabetes, and arthritis were less common than those reported for this age group in Australia (Australian Institute of Health and Welfare 2008). However, hearing disorders were found to be more frequent among these older adults. Nonetheless, these immigrant older adults tended to rate their general health lower than the native-born Australian population (Australian Institute of Health and Welfare 2008). This may be a reflection of cultural influences in self-reporting (Leung et al. 2007). Interestingly, the pattern of self-assessed health status was similar to that observed in a population study in China (Shi et al. 2008) and among Chinese migrants in Canada (Leung et al. 2007).

The sample represented an independent living population of older Chinese who had similar educational levels and better financial adequacy than the average older Chinese immigrant population. In fact, the Australian literature reports that migrants, in particular the Chinese community, have an overall higher educational attainment compared to those born in Australia (Australian Bureau of Statistics 2008). However, this high level of education is not necessarily reflected in their level of income, and China-born elders are found in a greater proportion in the lower end of the income range; their weekly incomes are lower than those of their Australia-born peers (Australian Bureau of Statistics 2008). The present findings cannot be generalized to other immigrant groups in Australia; our focus was only on Chinese immigrants. In addition, due to potential selection bias of the present sample, comparisons with representative data of epidemiologic studies from Australia or China (particularly when some of the data were self-reported) should be undertaken with caution.

Participants for this study were recruited from Chinese organizations and this may introduce an additional bias. However, the Australian data report that it is usual for older Chinese to participate in senior clubs and use specific Chinese services organized by the community (South Eastern Region Migrant Resource Centre 2010). These organizations help in many areas, including reducing perceived isolation due to their lack of English. Still, people with different interests may not participate in ethnic organizations. Thus, while our data may have limitations, it represents a substantial sample of community-dwelling older adults; we have less reason to believe that this is an unusually healthy group of China-born older adults. In addition, although most participants had immigrated to Australia later in life, it is possible that the selective nature of immigration policies may have created a "healthy migrant effect" (Lai 2004; Leung et al. 2008), which may have influenced our results.

While the overall sample size was adequate for our analysis, further empirical work with a larger sample is needed for a more precise detection of main effects and interactions. Therefore, our conclusions should be seen in that light. We do not claim to have found a definitive profile of health among immigrants to Australia; rather, this study represents a contribution to the literature on improving the oral health and health care access of older immigrants in Australia, and a basis for future research. Our results support calls for more research to understand better what factors affect systemic and oral health, as well as health behaviors. Future studies should assess with a representative sample what factors explain the oral and systemic health of immigrants, and differences between this group and the native-born Australian population.

The importance of immigration patterns, personal history, social networks and living arrangements have all been highlighted in other studies (Mariño et al. 2002). Our findings here and in earlier research suggest that these elements may reflect the richness of the cultural construct and the complexity of any link with health experience. Because these factors do not affect all members of a group in the same way, the examination of acculturation experience is crucial for providing culturally competent services and programs (Mariño et al. 2001). With this information, health providers can most appropriately target programs and policies to reduce disparities in access to preventive services and treatment for all Australians.

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Conflict of interest The authors declare that they have no competing interests.

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