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Article type : Original Article

Perceptions of dental treatment need in Australian-born and migrant populations

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Running title: Differing perceptions of dental treatment need

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/eos.12373](https://doi.org/10.1111/eos.12373)

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Eur J Oral Sci

Abstract

The objective of this study was to investigate differences in self-perceived and dentist-determined treatment need in Australian-born and migrant residents of Australia. Participants in the National Survey of Adult Oral Health 2004-06 were categorised into six groups by country of birth. Interview and examination data were used to analyse differences between self-perceived and the 'gold standard' examiner-determined treatment need, and to compare the accuracy of self-reporting by country of birth. Self-reported treatment needs, defined as the need for a restoration and/or extraction, were cross-tabulated with clinically-observed conditions and compared using a multivariable logistic regression model. Concordance between self-reported and clinically-determined need differed significantly for migrants from Europe and the United Kingdom and Australian-born individuals. In the logistic regression model stratification by examiner-determined need revealed significantly greater reporting of treatment need by Asian-born migrants than the Australian-born reference group. The results of this study demonstrate that self-perceived treatment need was less than the examiner-determined findings in European and United Kingdom migrant groups and Australian-born individuals. Additionally, Asian migrants were more likely than Australian-born individuals to over-report treatment need for a filling and/or extraction.

Key words: Perceived, treatment need, oral health, migrants, Australia

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Introduction

As of 2007, one quarter of the Australian population had been born overseas (1). Disparities in the oral treatment needs of migrant populations in Australia have been described in previous studies (2-5). Overseas-born individuals have a similar life-time dental caries experience (DMFT) to Australian-born individuals, but a greater proportion of decayed teeth indicate unmet treatment need (2). Migrant populations also have more periodontal disease than reported in the Australian population (2, 4, 6). Both untreated dental caries and periodontal disease have been identified in Greek, Italian, Chinese, Vietnamese, and Kampuchean-Laotian migrant communities as well as in refugee and asylum seeker groups (3, 4, 6-11)(3, 9-11).

Like other developed countries with ageing populations, Australia relies on migration as a means of population growth (1). In Australia, dental care is one of the top five most costly disease groups for health expenditure (12). Effective management of chronic conditions, including oral diseases, will need to focus on prevention and early management of risk factors, much of which relies on timely and equitable access to health care, particularly for vulnerable populations (13).

Migrants experience a number of barriers to accessing health care and understanding how these factors contribute to unmet treatment need is crucial for efficacious health strategies (14). In 1985, the Fédération Dentaire Internationale proposed a list of possible barriers to access of care at the levels of the individual, profession, and society (15). Despite this, very little has been published to examine barriers at the level of the individual; that is, the ability to recognise a dental problem that may require treatment and how this influences the receipt of dental care (16-18). The inability to accurately assess one's need for dental treatment and seek care as a result could be a cause of unmet treatment need. Unmet need may not just be the result of barriers that prevent access to care, but also because individuals fail to recognise the need for treatment and thus never seek the treatment they require.

Migrants are considered vulnerable populations and often experience many barriers to accessing health care. Financial and language barriers and the degree of acculturation have been proposed as reasons for unmet treatment need in these populations in Australian studies (19, 20). However, despite disparities in dentist-determined treatment need, few studies have attempted to examine the influence of self-perceived treatment need on the health needs in migrant populations (10, 11, 21-23).

Determining any lack of concordance between the treatment need determined by health professionals and that recognised by the individual may assist in improving health. Where such differences exist, addressing health literacy may be vital to improving accuracy of self-perceived treatment need. Measures such as these may result in greater numbers of those with unmet treatment need seeking care. Reducing unmet treatment need is associated with improvements in quality of life and can improve general health (24, 25). Equitable access to health care and improved health of vulnerable populations has also been associated with higher personal income and economic growth of countries (26). The use of targeted and evidence-based programs have been shown to improve access, reduce inequalities in health and improve health outcomes, and result in more effective and sustainable funding for health care (27). However, in order to develop these programs, there needs to be a greater understanding of how a variety of factors may contribute to unmet treatment need in groups such as those with migrant backgrounds.

This study investigated differences between self-perceived and dentist-determined treatment need in Australian-born and migrant residents of Australia. It was hypothesised that migrants from countries with greater cultural and language differences from Australia would have greater inaccuracies in self-perceived treatment need than Australian-born individuals; that is, poorer concordance between these two measures. Further analyses were also conducted to determine the nature of differences in perceptions; that is, differences in self-reported treatment need and dentist-determined findings.

Methods

The National Survey of Adult Oral Health (NSAOH) 2004-06 was a cross-sectional study of a representative sample of Australian adults that used a three-stage, stratified clustered sampling design to select people from the target population of Australian residents aged 15 years and older. This process was completed randomly with sampling probability proportional to population size (28).

Trained interviewers from the University of Adelaide research offices telephone interviewed sampled individuals. Participants who completed the interview and who reported having one or more of their own natural teeth were invited to undergo an oral examination by dentists who used a standardised protocol to record information about their clinical oral status (28). Full details of the sampling, examination protocol, and survey participation have been described in previous reports (28).

NSAOH participants were asked “In which country were you born?” Six ‘country’ of birth categories were used: Australia, United Kingdom (including Ireland), Europe (not including the United Kingdom or Ireland), Asia, New Zealand/ Oceania, and Other. The ‘Other’ category combined responses from countries unable to be grouped as part of the larger country of birth categories, principally due to their small contribution to the overall Australian population, and primarily consisted of migrants from North and South America, Africa, and the Middle East.

The measure of treatment need for this study was need for a filling or extraction for treatment of dental caries. Self-perceived treatment need was assessed in dentate respondents by asking the question “Currently which of the following treatments do you think you need to have: Any filling(s)? Any extraction(s)?” with response choices being: “Yes”, “No” or “Don’t know”. A response of “Yes” to either of these questions was recorded as the participant perceiving need for a dental filling (restoration) and/or an extraction.

The examinations were conducted in a supine position in standard dental chairs with illumination provided by the chair’s overhead dental light and by intra-oral mirrors with their own battery-powered light source. Treatment need was decided by the presence of a retained root fragment (sound or decayed), caries (coronal or root), and/or an unsatisfactory restoration. A positive score for any of these outcomes was recorded as examiner-determined treatment need.

Covariates included sex (male/female), age, whether a language other than English was spoken at home (yes/no), the highest level of education attained, total annual household income, health care card status (yes/no), private health insurance status (yes/no), and self-reported oral health. Participants were allocated to four age groups: ‘15-34 yr’, ‘35-54 yr’, ‘55-74 yr’, and ‘75+ yr’. Their highest level of education was divided into ‘Year 12 or less’, ‘Other’, or ‘University’. The ‘Other’ category for education included certificate or diploma courses (1-2 yr), trade, certificate, apprenticeship and vocational training, and CAE/teacher’s college/nursing courses. Total annual household income was categorised into the three groups of Low (less than \$40,000), Moderate (\$40,000 to \$80,000), and High (greater than \$80,000). Self-reported oral health was divided into two groups: ‘Good’ or ‘Poor’. Participants were asked the question “how would you rate your own dental health. Would you say that it is: excellent, very good, good, fair, poor?” (28). The ‘Good’ category included the responses of ‘good’, ‘very good’, and ‘excellent’. The ‘Poor’ category included the ‘fair’ and ‘poor’ responses.

Statistical analyses

The responses for self-perceived and examiner-determined treatment need were paired and cross-tabulated by country of birth category, and positives and negatives were compared. Data was analysed using McNemar's tests, with an alpha value of 0.05. Differences in perceived treatment need among country of birth categories were assessed by comparing 95% confidence intervals for true positive and negative values. Multi-variable logistic regression models were used to analyse self-perceived treatment need by country of birth and to control for covariates.

The study sample was then stratified by examiner-determined treatment need in order to compare inaccuracies in reporting by country of birth category using three models: (i) an overall model of self-perceived treatment need, (ii) a model for no self-perceived treatment need where there was examiner-determined treatment need (under-reporting of treatment need), and (iii) a model for self-perceived treatment need where there was no examiner-determined treatment need (over-reporting of treatment need). Odds ratios were compared using 95% Wald confidence limits. SAS version 9.1 (Research Triangle Institute, Research Triangle Park, NC) was used for the analyses.

Results

Participation rates for the National Survey of Adult Oral Health 2004-06 have been described in detail previously (28). Over five and a half thousand (5591) participants with recorded country of birth and examination data were included in the study. The proportions of participants in this study for the defined country of birth categories were reflective of the relative proportions of these migrant populations in the Australian population with the exceptions of greater proportions of migrants from the United Kingdom in our sample with under-representations of migrants from the New Zealand/ Oceania and Other categories (1).

The demographic characteristics of participants by country of birth groups are shown in **Table 1**. Language other than English spoken at home was highest among European and Asian migrants. Level of education and income differed across the groups as did health care card holder status. Migrants from the United Kingdom and Europe had the highest proportion of individuals with health care cards.

Self-perceived and examiner-determined treatment need

Self-reported need for a restoration and/or extraction ranged from 32.3% to 41.8% (**Table 2**). Examiner-determined treatment need was higher than self-report for all country of birth groups, ranging from 42.1% to 49.5%, with under-reporting of treatment need across all groups. Australian-born individuals were found to have the lowest self-reported and examiner-determined treatment need across the sample. Migrants from New Zealand and Oceania (41.8%) reported the greatest treatment need but European migrants had the highest examiner-determined treatment need (49.5%).

Agreement between self-perceived and examiner-determined treatment need

Self-reporting of treatment need was lower than examiner-determined treatment for the “Australia”, “Europe”, and “United Kingdom” groups (**Table 2**). Through cross-tabulating participant responses against examination findings, agreement was calculated by comparing ‘true positive’ (self-reported treatment need and examiner-determined treatment need) and ‘true negative’ results (self-reported ‘no’ treatment need and examiner-determined no need for treatment). Participants generally were able to more accurately report the lack of treatment need, with agreement ranging from 40% to 60% across the country of birth groups for reported treatment need and 65% to 80% for no treatment need (**Fig. 1**). There were no differences in the accuracy of reporting of treatment need migrant and Australian-born people. However, migrants from Asia (65.2%; 95% CI: 57.1-73.2) were less likely to accurately report the need for no treatment than Australian-born individuals (79.7%; 95% CI: 78.1-81.2).

Factors affecting self-perception of treatment need

In the first multivariable logistic regression model (Model 1, **Table 3**), perceived need for a restoration and/or extraction was associated with age, health care card status, private health insurance status, and the highest level of education but not country of birth. All younger age groups had a greater perceived treatment need than the oldest one. Likewise, individuals eligible for a health care card and those with no private health insurance were more likely to perceive the need for a restoration and/or extraction, as were those with Year 12 or less as their highest level of educational attainment.

The second multivariable logistic regression model (Model 2, **Table 3**) represented self-perception of no need of treatment where an examiner had determined the need for treatment. This model examined the under-reporting of treatment need and found

associations with age, health care card status, and health insurance status but not country of births. All younger age groups were less likely to under-report need of treatment than participants 75 years or older. Likewise, those with a health care card or with no private health insurance were less likely to under-report need for a restoration and/or extraction than those not eligible for a health care card and people with private insurance respectively.

Model 3 (**Table 3**) represented over-reporting of treatment need. Using the Australian-born group as a reference, Asian migrants were more likely to over-report treatment need. Over-reporting of treatment need was also found to be associated with younger age, absence of health insurance, and moderate annual household income.

Discussion

The findings of this study demonstrate that self-perceived treatment need was less than examiner-determined findings for European and United Kingdom migrant groups and Australian-born individuals. After controlling for covariates, Asian migrants were found to be significantly more likely to over-report treatment need than Australian-born individuals. However, for all other migrant groups there was no difference in the accuracy of reported treatment need when compared to Australian-born individuals.

The inability to recognise the presence of pathology or need for treatment may be a contributing factor to unmet treatment need as there may not be the realisation of the need to seek treatment or initiate this process. Therefore, where unmet treatment need has been identified, it may be plausible that lack of oral treatment awareness may be a barrier to access of health care.

This can have wider implications for the health care system. Despite pushes within the dental profession for interventions to have more of a preventive approach, a large proportion of dental care is completed episodically and initiated in response to the patient's perception that they require some form of treatment. Only 44.5% of the Australian population visit dentists for check-ups on a regular basis (28). There are also limitations within both the private and public sector to provide emergency dental care. Under-reporting of treatment need may prevent early interventions for problems. The eventual exacerbation of these problems is likely to be associated with greater financial cost to the individual and health care system in addition to potential impacts on general health and quality of life.

Conversely, over-reporting can result in inefficiencies in health care provision. For example, where limited appointments are available seeking treatment when it is not required

may result in appointments being provided to individuals who may not actually require care while others have their care delayed. Oral health awareness and patient education can play an important role in promoting preventive dental care and, by doing so, also increase self-awareness of oral problems and when care is necessary.

In this study, health literacy in migrant residents was compared to Australian-born individuals using perceptions of treatment need and the accuracy of this self-reported need in comparison to examination findings. The presence of dental caries, a broken tooth, or an unsatisfactory restoration was used to indicate treatment need in both the self-reported and examiner-determined measures. We favoured this over other measures, such as periodontal disease, because dental pain for the lay person is commonly taken to represent decay and infection and thus the need for a filling or extraction. As a result, even in populations with low oral health literacy, it would be expected that pain or the tactile sensation of a hole in a tooth would be recognised as a trigger for seeking dental treatment. Previous studies have suggested that estimated treatment need was more accurate for this measure than other oral conditions such periodontal disease (29).

The accuracy of perceived need for a filling or extraction reported here appears to be similar to that demonstrated in the limited available literature in this area (30). The findings from this study were expected to be slightly worse in accuracy since previously published papers have not used paired data in analyses. In addition, previous studies have primarily used cavitated carious lesions as the clinical determinant of treatment need than the more extensive criteria used in this study. It would be assumed that cavitated lesions would have a higher symptomatic burden for the patient in terms of pain and tactile sensation of the cavity itself resulting in greater awareness of treatment need, whereas we decided to include the more extensive criteria to reflect a dental professional's determination of treatment need whether this be a restoration or extraction or oral hygiene advice and a topical fluoride treatment that may be applicable for earlier lesions. Accuracy of perceived or self-reported treatment need in migrant groups has not been described in the literature.

There are deficiencies associated with of the technique used to assess accuracy of perceived treatment need that may lead to over- or under-reporting of treatment need. Firstly, with regards to reporting of treatment need, confusion may arise from other symptoms, such as a loose tooth due to periodontal disease, being interpreted as an indication for a dental extraction. This would have reflected as over-reporting of treatment in this study. Conversely, asymptomatic and long-standing dental issues, which are not regarded as problems for the individual may be interpreted in our data as over-reporting of treatment

need. For example, an asymptomatic and uninfected retained root may not have been reported as needing treatment by a patient but would be determined as requiring treatment from the criteria used in our protocol. Likewise, determining the need for a filling or extraction by the examiner was solely reliant on a dental examination without the diagnostic adjuncts such as radiographs. Thus, problems associated with symptoms but not identified through the clinical examination would have reflected in over-reporting of treatment need despite the actual presence of pathology.

It was hypothesised that migrant groups from countries 'similar' to Australia were likely to have equivalent or similar levels of awareness of their treatment need to Australian-born individuals whereas those from countries likely to have language and cultural differences, such as those from Asia and Europe, demonstrated greater differences in their perception of treatment need. This was demonstrated by inaccuracies in self-perceived treatment need by Asian migrants. Because of the possible influence of communication problems, a language other than English spoken at home was identified and used as a covariate throughout the analysis.

A shortcoming of this study was that differences in unmet treatment need between migrant groups and Australian-born individuals had not been previously identified in this sample. This may have been reflected in the lack of differences between migrant groups, particularly those from Europe, and Australian-born individuals in this study, or the fact that more distinct differences were not found for Asian migrants. Likewise, it was difficult to account for the influence of acculturation and length of stay on unmet treatment needs and perceptions of migrant groups. Gao and McGrath, for example, has previously identified positive associations between acculturation and the utilisation of dental services (23). The lack of available information precluded investigations of this nature in our study but represent another area for future research. Similarly, the use of updated data would reflect changes in migration patterns and the relative impact these would have depending on their proportions in the population.

It was interesting, however, to note that inaccuracy of self-perceived treatment need was not confined to migrant groups. The bivariate analysis identified differences between examiner-determined and self-reported treatment need for the Australian-born group. This raises more widespread concerns about levels of unmet treatment need and oral health awareness within the wider Australian community outside the migrant groups that were the focus of this study. Poor health literacy due to unintentional selection bias within the

Australian-born group in our sample may have also contributed to the absence of differences in comparisons with migrant groups.

There were limitations within the study design in defining different migrant populations. The available literature has not described suitable methodologies to allow grouping of migrant populations by cultural and language considerations in large population-based studies. As a result, country of birth was used in this sample based on the collection of these data as part of the wider National Survey of Adult Oral Health 2004-06. Categorisation by continental region was necessary based on the country of birth responses in the sample and was thought to best reflect cultural and language similarities between neighbouring countries in certain geographic regions. The United Kingdom was separated from the rest of European migrants because of historical, language, and cultural similarities to Australia and because of the relatively high migration rates to Australia. Similarly, New Zealand and other Oceanic and Pacific nations were grouped because of significant differences from other migrant groups but relative coherence because of geographical, language, and ethnic links. The Other category was necessary because of low responses from other migrant groups within the study sample. These reflected lower proportions of these groups in the overall Australian population but warrant future research because of the higher rates of refugees and asylum seekers from these countries (1). Such groups have been identified as those of greatest unmet need and for which there is a greater urgency in determining contributing factors to the existence of this disparity (3, 9-11, 31).

Despite attempts to group migrants based on cultural and language considerations, any method categorising heterogeneous population groups has inherent deficiencies. For example, migrant groups that form a greater proportion of the population are likely to overwhelm smaller migrant groups in any analyses. Likely examples of this in our sample include the high proportion of individuals of Italian and Greek heritage within the European migrant group. Although similarities exist between Mediterranean nations, combining these two nationalities does not provide adequate recognition of more subtle language and cultural differences that exist. Additionally, the responses of migrants from these two nations are likely to negate those of other European nations from different continental regions that will exhibit significant cultural differences. This is likely to be evident within the Asian group where the three largest migrant groups by country of birth are China, India, and Vietnam. Thus although these countries show greater similarities to each other than those of European nations, analyses will not be able to account for the significant diversity between different Asian regions. The classifications utilised in this study, however, do enable a more

descriptive analysis than previously published cross-sectional population studies of migrant oral health but indicate the need for further research focused on collecting data to better reflect differences in migrant residents of multicultural countries such as Australia.

Understanding individual migrant populations is essential to addressing the health problems that exist in these groups. More importantly, it is vital to the development and implementation of strategies aimed at reducing health inequalities that separate these groups from the rest of the population. In an attempt to address deficiencies in the existing literature, this study focused on health literacy and awareness and has identified that inaccuracies in perceived treatment need may contribute to unmet treatment need in certain migrant groups. Our results are also suggestive of the influence of traditional barriers of access to care, such as socioeconomic status. However, it raises the prospect that addressing these traditional barriers alone may be insufficient to reduce unmet treatment need in these migrant groups if health literacy in these populations is not managed.

Improving oral health awareness is largely reliant on health promotion and education. Migrant populations, however, are diverse and can vary in the influence of cultural and language factors requiring that strategies are appropriate and take these differences into account. Communication, for example, has been previously identified as a barrier that influences perception of oral health and utilisation of dental services (21, 32, 33). Although speaking a language other than English at home was not found to influence accuracy of perceived treatment need in this study, it has been associated with greater unmet treatment need in the literature (2, 34). Population-based surveys have a tendency to develop a bias towards selecting English-speaking individuals thus potentially negating the significance of language barriers (28).

In addressing disparities in health of migrant groups, all modifiable factors, whether personal, social, environmental, or organisational, should be considered as part of possible interventions (35, 36). In multicultural societies, the lack of social cohesion between migrant groups and the rest of the population cannot be ignored with regards to its potential impact on accessing health care (37). These countries largely rely on the integration and acculturation of migrants to access health care systems but provide minimal support for this process. Likewise, the reliance of developed countries on migration to sustain population growth is resulting in increased proportions of their resident populations having been born overseas (1). Ignoring the opportunity to address these problems early may result in substantial challenges for health care systems as migrant populations grow as a proportion of the total population of developed countries in a similar manner to problems associated with ageing populations.

In the interests of providing equitable health care to all vulnerable populations, greater support and programs need to be targeted towards these groups, thereby providing mechanisms to help them overcome barrier that may prevent them from accessing care (27). Health literacy and awareness needs to be considered amongst conventional factors such as communication, cultural differences, social circumstances, economic disadvantage, and education. Considering the relative impact of these factors on different migrant groups is an important direction in future research to address current health disparities.

Future research directions should also include oral health surveys that not only aim to report on the state of health of the population but also identify disparities in health and unmet treatment need in the community, particularly within smaller population groups such as migrants and refugees. Likewise, when unmet treatment need is identified in populations, this should be accompanied by further research to investigate the reasons for the existence of these disparities whether they are linked to differences in oral health awareness and accuracy of perceived treatment need, as suggested in this study, or due to other barriers that may exist in accessing health care. The implications of health literacy for the health of migrant populations should also be considered outside the area of oral health, with investigations to determine whether they may also be applicable to differences in other health measures in migrant groups. Further consideration of these reasons is required to assist in the development of initiatives to address the unmet treatment need in these groups.

In conclusion, self-perceived treatment need was less than the examiner-determined treatment need in European and United Kingdom migrant groups and Australian-born individuals. Asian migrants were more likely than Australian-born individuals to over-report treatment need for a filling and/or extraction.

Acknowledgements

This project was completed as part of the Bachelor of Science in Dentistry (Honours) program at the School of Dentistry, The University of Adelaide and supported by the Herbert Gill-Williams Scholarship. The National Survey of Adult Oral Health 2004-06 was supported by grants from the National Health and Medical Research Council (Project Grant #299050/#349512; Capacity Building Grant #349537), the Department of Health and Ageing (Population Health Division) of the Commonwealth Government of Australia, the Australian Institute of Health and Welfare, Colgate Oral Care, the Australian Dental Association and the US Centers for Disease Control and Prevention Research Participation Program. The authors

would also like to acknowledge the significant contribution of Professor Gary D Slade to this project.

Conflicts of interest

The authors declare no conflicts of interest

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Table 1. Characteristics of sample participants

	Europe (n=299)	UK (n=535)	Australia (n=4234)	NZ & Oceania (n=103)	Asia (n=233)	Other (n=97)
Male (%)	38.5	44.1	39.5	35.0	40.3	29.9
Age groups						
15-34 yr (%)	5.4	4.3	23.0	27.2	23.2	30.9
35-54 yr (%)	30.4	33.8	40.3	52.4	48.5	40.2
55-74 yr (%)	55.5	52.3	31.3	17.5	25.8	26.8
75+ yr (%)	8.7	9.5	5.5	2.9	2.6	2.1
Speak language other than English (%)	60.2	0.9	3.0	12.6	66.1	37.1
Highest level of education						
Year 12 or less	38.1	29.8	37.8	35.0	30.0	22.9
University (%)	35.5	27.5	29.7	32.0	16.3	53.1
Other ^a (%)	26.4	42.7	32.5	33.0	53.7	24.0
Household income						
Low (<\$40k)	62.5	55.6	41.9	30.1	47.8	36.8
Mod (\$40-80k)	26.4	27.4	34.4	33.3	33.3	36.8
High (>\$80k)	11.2	17.0	23.8	36.6	18.8	26.4
Health care card holders (%)	43.1	43.3	28.6	28.2	29.6	26.8
Private health insurance (%)	37.3	46.9	50.0	42.2	38.0	46.9
Self-reported good oral health ^b (%)	32.2	39.1	44.4	36.9	29.2	48.5

^a Responses included certificate/diploma course (1-2 yr), trade certificate/apprenticeship/ vocational, CAE/teacher's college/nursing

^b Includes self-reported responses of 'Good', 'Very good' and 'Excellent'

Table 2. Comparison^c of self-perceived and examiner-determined treatment need

Country of birth	Self-reported treatment need (%)	Examiner-determined treatment need (%)	P-value ^d
Australia	32.3	40.5	<0.01
Europe	32.8	49.5	<0.01
United Kingdom	35.0	42.1	<0.01
NZ & Oceania	41.8	45.6	0.61
Asia	38.6	42.1	0.49
Other	35.1	39.2	0.61

^c Comparisons involved tests of agreement between the paired self-reported and examiner-determined responses with regards to the treatment need finding

^d P-values calculated from McNemar's Test

Table 3. Odds ratios^h for self-perception of treatment need

	Model 1 (OR (95% CI)) ^j	Model 2 (OR (95% CI)) Under-reporting ^k	Model 3 (OR (95% CI)) Over-reporting ^m
Sex			
Female	0.97 (0.85 – 1.11)	1.15 (0.95-1.40)	1.09 (0.90-1.33)
Male	Ref.	Ref.	Ref.
Age			
15-34 yr	3.07 (2.15 – 4.40)	0.23 (0.14-0.37)	2.04 (1.19-3.47)
35-54 yr	2.64 (1.90 – 3.68)	0.29 (0.19-0.44)	1.85 (1.11-3.07)
55-74 yr	1.57 (1.16 – 2.14)	0.56 (0.37-0.83)	1.34 (0.83-2.16)
75+ yr	Ref.	Ref.	Ref.
Health-care card status			
Eligible	1.40 (1.17 – 1.67)	0.68 (0.52-0.87)	1.27 (0.97-1.66)
Ineligible	Ref.	Ref.	Ref.
Health insurance			
No	1.34 (1.16 – 1.54)	0.76 (0.62-0.94)	1.37 (1.13-1.66)
Yes	Ref.	Ref.	Ref.
Language other than English spoken at home			
No	1.20 (0.90 – 1.60)	0.87 (0.57-1.33)	1.15 (0.78-1.70)
Yes	Ref.	Ref.	Ref.
Highest education qualification			
University	0.82 (0.69 – 0.97)	1.48 (1.15-1.90)	0.98 (0.77-1.24)
Other	1.07 (0.92 – 1.25)	1.05 (0.84-1.30)	1.19 (0.95-1.49)
Year 12 or less	Ref.	Ref.	Ref.
Annual household income			
High	0.81 (0.64 – 1.01)	1.37 (1.00-1.89)	0.89 (0.65-1.22)
Moderate	1.12 (0.93 – 1.35)	1.06 (0.81-1.37)	1.35 (1.03-1.77)
Low	Ref.	Ref.	Ref.

Country of birth

Europe (not UK)	0.95 (0.68 – 1.33)	1.42 (0.87-2.31)	1.25 (0.79-1.98)
United Kingdom	1.14 (0.91 – 1.42)	0.85 (0.62-1.17)	1.11 (0.82-1.51)
NZ and Oceania	1.15 (0.72 – 1.82)	0.88 (0.45-1.73)	1.13 (0.58-2.19)
Asia	1.38 (0.96 – 2.00)	1.20 (0.69-2.08)	1.90 (1.18-3.06)*
Other	1.31 (0.79 – 2.19)	0.93 (0.43-2.02)	1.54 (0.78-3.03)
Australia	Ref.	Ref.	Ref.

^h Multivariate logistic regression model

^j Odds ratios for self-reported need for a restoration and/or extraction

^k Self-reporting of no treatment need where the examiner determined need of treatment (over-reporting)

^m Self-reporting of treatment need where the examiner determined no need of treatment (under-reporting)

*Statistically-significant result

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Title:

Perceptions of dental treatment need in Australian-born and migrant populations

Date:

2017-12-01

Citation:

Lim, M. A. W. T., Crocombe, L. A. & Do, L. G. (2017). Perceptions of dental treatment need in Australian-born and migrant populations. EUROPEAN JOURNAL OF ORAL SCIENCES, 125 (6), pp.479-486. <https://doi.org/10.1111/eos.12373>.

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