Original Research

# The Practice of Dentistry by Australian- and Overseas-Trained Dentists in Australia: Discriminant Analysis of key Predictors

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## ABSTRACT

*Introduction:* Overseas-trained dentists comprise at least one-fourth of the overall Australian dental workforce. This study examined characteristics and practice differences between Australian- and overseas-trained dentists to identify key predictors that best differentiate their dentistry practices.

*Methods:* Data for the study were from the Longitudinal Study of Dentist Practice Activity (LSDPA), a survey of a nationally representative random sample of dentists in Australia commencing in 1983-1984 and repeated every 5 years. Dentists were surveyed on a wide range of items including participant characteristics, practice patterns, practice inputs, direct demand, and productivity measures. Data were weighted to provide national estimates by age, sex, and practice type. Discriminant function analysis was used to examine the predictor variables that best distinguished between the two groups. Analysis was limited to the most recent wave of the study.

*Results:* A total of 1148 dentists (response rate = 67%) responded to the survey in 2009-2010; 648 cases were available for the discriminant analysis. The discriminant functions for the full sample and each of the 3 age groups (<35 years; 35-50 years; and 50+ years) were found effective to separate dentists into 2 groups (Australian and overseas), with the proportion of cases correctly classified being highest for the oldest age group (89.7% for 50+ years). Female gender, type of practice (working in public sector), and working in disadvantaged areas were significant predictors, with more prominence in the 35- to 50-year age group. Practice inputs, demand, and productivity measures offered less discriminative capacity between the dentists.

*Conclusion:* Overseas-trained dentists contribute towards providing dental care to underserved populations, the public sector, and in rural and remote locations. This study provided basis to argue that policies to encourage overseas-trained dentists to contribute towards areas of need locations have been successful, and key productivity measures were also similar to Australian-trained dentists.

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## Introduction

Australia is a popular destination for overseas-trained health professionals, including dentists.[1] Dentists with an overseas dental qualification (such as Bachelor of Dental Surgery,

Doctor of Dental Surgery, or Doctor of Dental Medicine) make up at least one-fourth of the overall dental workforce in Australia.[1,2] Historical variations exist in the magnitude and type of dentist migration in Australia, with at least 3 recognised patterns of migration. The first is a steady migration pattern of dentists from countries with a similar historical or cultural proximity to Australia such as the United Kingdom, Ireland, and New Zealand.[3] This north-north phenomenon of migration (ie, migration flows across well-developed countries) has remained fairly constant over the last 50 years, but with some spikes of increased inflows, especially in the late 1970s and early 1980s.[3,4] Over the last 2 decades, however, Australia has witnessed a dramatic increase of dentist migration from low- and middle-income countries.[5] Countries in the Indian subcontinent, Middle East, and South Asian countries dominated this influx, which presented challenges in assessment of qualifications, training to meet standards, and monitoring practice activity.[5–7] The third migration pattern is more of a limited selective variant, with focussed recruitment to fill gaps in public service provision, areas of need locations, and academic sectors.[5]

Overseas-trained dentists have reported high standards of work, career opportunities, and exceedingly high job satisfaction rates in Australia.[8] Gender variations have been noticed, with a larger proportion of female dentists migrating to Australia in recent years.[5] Female dentists in general tend to work more part-time and take more career breaks, shaping overall dentist practice activity in Australia.[9] Prior research has suggested a tendency to 'time-based' mobility patterns, with migrant dentists changing to work more in the public sector or rural and remote or disadvantaged areas in their initial stage of migration to Australia, but gradually preferring to work in the private sector or in major cities as they become more familiar with Australian life.[10]

In general, dentistry in Australia has been traditionally practised in solo practices, where the principal dentist is usually in charge of the entire clinical activity with some assistance from therapists, hygienists, dental assistants, and administrative personnel.[11] Collaboration and teamwork within the dental team comes as a cumulative experience that starts from education,[12] professionalism,[13] and ethics.[14] Overseas-trained dentists possibly arrive from dissimilar cultural and education environments, which would be reflected in their practice activity patterns in Australia.

To date, there have been few comparisons of overseas-trained and Australian-trained dentists. Prior studies have examined a sample of overseas-trained dentists and have offered comparisons to existing national surveys to provide some preliminary evidence.[3,5,8] These studies, however, lacked the ability to offer direct comparisons on practice activity between Australian- and overseas-trained dentists due to the nature of the sample. Such a comparison is important both from education and professional standpoints. The findings of such a study could contribute towards necessary training or support services to overseas-trained dentists and could improve the assessment, training, and regulation of overseas-trained dentists in Australia.[4] Accordingly, the aim of the current study was to examine characteristics and practice differences between dentists trained in Australia and overseas, with an intent to identify key predictors that best differentiate their practice of dentistry in Australia.

## Methods

Data were from the Longitudinal Study of Dentist Practice Activity (LSDPA), a survey of a nationally representative random sample of dentists in Australia.[15,16] Ethical approval for the LSDPA was provided by the Australian Institute of Health and Welfare (AIHW) and was conducted in accordance with the Declaration of Helsinki. The study was conducted as a mailed self-complete survey; hence, consent was implied through the return of completed surveys.

### Sampling and data collection

The LSDPA collections are based on a sample of 10% male and 40% female dentists randomly drawn from the dental registers of each state and territory in Australia in 1983-1984. Sample supplementation was achieved in a similar fashion for each successive wave of the study at 5-year intervals. To date, 6 waves of study data exist: 1983-1984, 1988-1989, 1993-1994, 1998-1999, 2003-2004, and 2009-2010.[17] The higher sampling fraction of female dentists was required due to the lower proportion of females in the dental workforce.

The response rates were 73%, 74%, 74%, 71%, 76%, and 67%, respectively, for each of the 6 waves of the study starting from 1983-1984. Dentists were surveyed using the Dillman Total Design Method (TDM) through mailed self-complete postal questionnaires.[18] Participants were approached first through a primary approach letter (including a newsletter incorporating results from previous waves), followed by the actual survey questionnaire and a follow-up reminder card at 2-3 weeks. Following which, 4 attempts were made to contact nonrespondents at 3-week intervals. Survey mailout and fieldwork was managed through Microsoft Access database system. The first author of the paper conducted the fieldwork, database development, and mail management for the 2009-2010 wave of collections. Further details on study methods, including sampling and data collection methods have been previously published.[16,17,19,20]

### Data items

Dentists were surveyed on a wide range of items including participant characteristics (demographic characteristics, education, family status), practice patterns (area and type of practice), practice inputs (hours worked, allied dental professionals employed, and hours contributed) direct demand (waiting time), and productivity measures (patients seen). A service log including patient activity for a typical day was included in the survey, which collected patient details and service provision. Practice measures were collected at up to 3 practice locations for a dentist.

### Data preparation

The place of training (ie, Australian or overseas [dependent] variable) was derived by examining the response to the university of graduation question, creating a new dichotomous response. Age was calculated using year of birth. Number of years following the graduation year (primary dental degree) was used in deriving the experience variable. Practice inputs,

direct demand, and productivity predictors were all calculated for the main location of practice. The postcode of main practice location was linked with Australian Standard Geographic Classification (ASGC) Remoteness Areas and Socio-Economic Indexes for Areas−Index of Relative Socio-Economic Disadvantage (SEIFA−IRSD) data. This provided 2 new variables relevant to the relative remoteness and socioeconomic status of practice location. Data preparation, deriving variables, merging data to other data sets, and univariate explorations of data were conducted using R statistical package (including: dplyr, ggplot2, psych, and frequency).[21]

### Weighting

The data for the 2009-2010 wave used in the current analysis were weighted using total number of practising private general dental practitioners from the dental board registration statistics in 2009. The use of weights adjusted the sample to age-specific population distribution of male and female dentists. Therefore, the estimates of practice activity are representative of Australian private practice dentists who were active in the workforce around the time of the LSDPA survey.

### Data analysis

This article presents cross-sectional analysis of the most recent wave of the study. Bivariate analysis of predictor variables with the outcome variable (trained in Australia or overseas) were first conducted for the full sample. Mean values were examined for the continuous predictor variables, along with $t$-test for equality of means, with equal variances not assumed. Frequencies were examined for the discrete predictor variables, along with $\chi^2$ test for significance. $P$ value was set at .05. This analysis was then repeated for each of the 3 age groups (younger than 35 years, 35 to 50 years and 50+ years).

Discriminant analysis[22,23] was conducted between selected predictor variables and the dependent variable. Differences due to confounding among predictors was examined through correlations and collinearity statistics. Pearson correlation was used to examine correlations between variables; tolerance and variance inflation factor (VIF) scores were examined for collinearity. In addition, domain knowledge based on the literature of practice activity and migrant dentists in Australia informed the selection of predictors for the discriminant analysis. The codes used in the discriminant analysis for both the predictor and dependent variables are provided in Tables 1 and 2. The selected predictors for discriminant analysis is available in Table 3.

The discriminant function analysis creates a linear combination of predictor variables that best separates the groups into dentists trained in Australia or overseas. The analysis is useful both in predicting group membership and in describing effects of grouping variables.[22,24,25]

$$D(x) = a + b1x1 + b2x2 + b3x3 + \ldots + bnxn$$

$D(x)$ = Discriminant function of observation/case ($x$)
$a$ = constant
$b1,b2,b3\ldots bn$ = unstandardized discriminant coefficients
$x1,x2,x3\ldots xn$ = predictor variable values

The discriminant analysis procedure calculates a discriminant score for each observation using the preceding equation.[22] Unstandardized discriminant coefficients used as multipliers of the predictor variables are useful in calculating the centroid values but have little practical significance. Standardised discriminant coefficients provide a good indication of the relative importance of the variables in predicting group classification. The signs of the centroid values seen along with the signs of the standardised coefficients provide a sense to the direction of relationship of the predictor variable to the classification groups (ie, similar signs of predictor variable coefficients and centroid values indicate direct relationship, and the opposite is true for inverse relationship). The effectiveness of the discriminant function is identified by the number of cases correctly classified, distance between the group centroids, Eigen values scores, and Wilks Lambda. The data for the discriminant analysis included only dentists with no missing values in any of the selected predictor variables. The discriminant analysis procedure was conducted using IBM SPSS Ver 25.[26]

## Results

A total of 1148 dentists responded to the survey in 2009-2010, equalling a response rate of 67%. A total of 1013 were private general practitioners included in the analysis ($n = 321$ were younger than 35 years old; $n = 411$ were 35-50 years old; $n = 281$ were 50+ years old).

Table 1 presents bivariate associations of place of training (Australia or overseas) with continuous independent variables, including personal characteristics, practice inputs, direct demand, and productivity measures of the sample. Mean values are presented for the full sample and across the 3 age groups. In the full sample, the number of chairside assistants used showed association with place for training. Age and experience (ie, number of years after graduation) were associated with place of training, but only among the younger age group (younger than 35 years).

Table 2 presents bivariate associations of place of training with discrete independent variables; frequencies are presented for the full sample and across the 3 age groups. In the full sample, gender, country of birth, type of practice, and SEIFA-disadvantaged categories were associated with place of training. Gender and type of practice differences were prominent across all age groups, with a larger proportion of females among overseas-trained dentists and more overseas-trained dentists working in the public sector than Australian-trained dentists.

### Discriminant function analysis

A total of 648 complete cases were available for the discriminant analysis, after eliminating dentists with missing values in the predictor variables. The discriminant analysis of selected predictor variables and place of training is provided in Table 3, which includes the standardised canonical discriminant coefficients, group centroid values, Eigen value, Wilks Lambda, and the proportion of cases being correctly classified by the discriminant function. Selected predictors

**Table 1 – Mean values for continuous independent variables and coding used in discriminant analysis (Aust. trained and overseas trained dentists).**

| Independent variables | Full sample | | <35 years | | 35 to 50 years | | >50 years | | Codes |
|---|---|---|---|---|---|---|---|---|---|
| | Aust. trained | Overseas trained | Aust. trained | Overseas trained | Aust. trained | Overseas trained | Aust trained | Overseas trained | |
| **Personal characteristics** | | | | | | | | | |
| Age | 45.6 | 46.1 | 29.1 | 30.9* | 42.6 | 43.3 | 58.8 | 58.7 | Years |
| Experience | 21.5 | 22.1 | 5.6 | 7.3* | 18.5 | 19.5 | 34.2 | 34.3 | Years |
| **Practice inputs (main location)** | | | | | | | | | |
| Hours worked per week | 33.9 | 32.5 | 33.3 | 33.0 | 34.0 | 32.4 | 34.2 | 32.4 | Hours |
| Chair side assistants | 2.1 | 1.9* | 2.3 | 2.2 | 2.1 | 1.9 | 2.0 | 1.8 | Number |
| Allied dental professional | 1.7 | 1.8 | 1.8 | 2.0 | 1.8 | 1.9 | 1.5 | 1.7 | Number |
| Receptionists/secretaries/ other staff | 1.6 | 1.6 | 1.7 | 1.6 | 1.7 | 1.6 | 1.4 | 1.6 | Number |
| All chair side assistant hours | 50.1 | 42.8 | 51.8 | 43.5 | 51.6 | 43.8 | 47.6 | 40.9 | Hours |
| All allied dental professional hours | 31.2 | 35.2 | 37.5 | 40.7 | 30.1 | 34.9 | 26.7 | 32.3 | Hours |
| All receptionist/secretary/ other staff hours | 38.9 | 35.5 | 41.3 | 40.8 | 39.8 | 34.6 | 36.3 | 32.8 | Hours |
| **Direct demand (main location)** | | | | | | | | | |
| Wait for appointment | 4.7 | 4.9 | 4.2 | 5.1 | 4.1 | 3.9 | 5.6 | 5.9 | Weeks |
| **Productivity (main location)** | | | | | | | | | |
| Patients per week | 53.1 | 57.5 | 45.4 | 50.6 | 54.4 | 51.7 | 57.2 | 68.9 | Number |

Aust.= Australian.

Note: Tables present weighted estimates.

\* $P < .05$. T-Test for equality of means.

had low correlation scores; variance inflation factor scores ranged between 1.07 (for busyness of practice) and 1.97 (hours worked per week), suggesting no collinearity.

The distance between the group centroid values was the smallest for the age group younger than 35 years (-0.26 to 1.00), and largest for the age group 50+ years (-0.42 to 1.66). This indicates that the ability of the discriminant function to separate the dentists into 2 groups (Australian and overseas) was higher in the 3 age groups. The number of cases being correctly classified by the discriminant function also appeared highest in the older age groups (89.7% for 50+ years; 80.1% for 35-50 years; 80.8% for younger than 35 years). Further the Eigen values for the 50+ age group ($\lambda = 0.70$) suggests an effective discriminant function for this age group; while the Eigen values for the 35-50 age group ($\lambda = 0.48$) is moderately effective, and the younger 35 age group ($\lambda = 0.26$) a less effective discriminant function than the oldest age group. This finding is also shown in the Wilks Lambda value being low for the older age groups ($\wedge = 0.59$ for 50+; $\wedge = 0.68$ for 35-50; $\wedge = 0.79$ for younger than 35). The effectiveness of the discriminant function of the full sample to classify the dependent variable into 2 groups was better in comparison to the younger than 35 group, based on distance among the group centroid, Eigen values, and Wilks Lambda scores. However, the discriminant function for the full sample was not as effective in comparison with the 35-50 and 50+ age groups.

The sign of the centroid values for the Australian-trained dentists was negative and for overseas-trained, it was positive in each of the discriminant functions. Country of birth is a key predictor in the full sample and across all age groups, appearing prominent both in magnitude and direction of the coefficients and significance.

Gender, type of practice, and SEIFA-disadvantaged categories were the other key predictors in the full sample that

showed significance. Overseas-trained dentists were more likely to be female (0.12), more likely to practise in the public sector (0.25), and more likely to work in disadvantaged areas (-0.10) than Australian-trained dentists. The variables that did not reach significance were equally important, and the magnitude of the coefficients needs to be considered in interpretation. Overseas-trained dentists are likely to be older in age (0.17), use fewer chairside allied dental hours (-0.17), but use more administrative staff hours (0.14) than Australian-trained dentists. Further, patients have to wait longer (-0.22), but overseas-trained dentists also see more patients per week (0.19) than Australian-trained dentists.

Across the 3 age groups, gender, type of practice, and SEIFA-disadvantaged categories presented a similar direction of relationship as the full sample. This relationship appeared more prominent in the 35-50 age group, with these 3 predictors (gender, type of practice, and SEIFA-disadvantaged categories) appearing significant. Overseas-trained dentists were likely to be younger in the younger than 35 age group, but older in the 50+ age group than Australian-trained dentists. The magnitude, direction, and significance of the discriminant coefficients in the 35-50 age group were similar to the full sample coefficients and relationship with centroid values. Some differences were noted in the direction of the coefficients of centroid values of the 50+ age group, especially in the area of practice (0.21). This could mean that overseas-trained dentists in the 50+ age group are likely to work more as specialists or academics or managers than Australia-trained dentists.

## Discussion

The findings of the study showed gender, type of practice (public or private sector), and practice location in a SEIFA-disadvantaged

**Table 2 – Frequencies of discrete independent variables and codes used in the discriminant analysis (Aust. trained and overseas-trained).**

| Independent variables | Full sample | | <35 years | | 35 to 50 years | | >50 years | | Codes |
|---|---|---|---|---|---|---|---|---|---|
| | Aust. trained | Overseas trained | Aust. trained | Overseas trained | Aust. trained. | Overseas trained | Aust. trained. | Overseas trained | |
| **Sex** | | * | | | | * | | * | |
| Male | 67.2 | 54.4 | 51.0 | 47.6 | 60.8 | 44.2 | 83.5 | 70.0 | 1 = yes |
| Female | 32.8 | 45.6 | 49.0 | 52.4 | 39.2 | 55.8 | 16.5 | 30.0 | 2 = yes |
| **Country of birth** | | * | | * | | * | | * | |
| Born in Australia | 63.4 | 3.6 | 48.3 | 3.6 | 59.8 | 2.7 | 76.3 | 4.6 | 1 = yes |
| Born elsewhere | 36.6 | 96.4 | 51.7 | 96.4 | 40.2 | 97.3 | 23.7 | 95.4 | 2 = yes |
| **Work status** | | | | | | | | | |
| Full-time | 67.8 | 66.6 | 74.2 | 72.0 | 71.0 | 67.1 | 60.8 | 62.7 | 1 = yes |
| Part-time | 32.2 | 33.4 | 25.8 | 28.0 | 29.0 | 32.9 | 39.2 | 37.3 | 2 = yes |
| **Perceived busyness** | | | | | | | | | Scale |
| About as busy | 63.6 | 62.9 | 64.6 | 62.1 | 66.8 | 67.3 | 59.8 | 58.3 | 1 |
| Less busy | 17.6 | 15.0 | 24.9 | 23.3 | 15.1 | 13.1 | 15.2 | 12.0 | 2 |
| Busier | 18.8 | 22.0 | 10.5 | 14.5 | 18.1 | 19.6 | 25.0 | 29.7 | 3 |
| **Area of practice** | | | | | | | | | |
| General practitioners | 82.0 | 81.3 | 92.6 | 90.0 | 78.8 | 85.1 | 78.2 | 71.4 | 1 = yes |
| Others | 18.0 | 18.7 | 7.4 | 10.0 | 21.2 | 14.9 | 21.8 | 28.6 | 2 = yes |
| **Type of practice** | | * | | | | * | | | |
| Private | 85.5 | 78.9 | 81.1 | 77.4 | 88.7 | 77.5 | 85.2 | 81.4 | 1 = yes |
| Public | 14.5 | 21.1 | 18.9 | 22.6 | 11.3 | 22.5 | 14.8 | 18.6 | 2 = yes |
| **Remoteness category** | | | | | | | | | |
| Main cities | 79.7 | 76.1 | 78.7 | 72.4 | 86.5 | 82.1 | 73.7 | 71.7 | 1 = yes |
| Rest of state | 20.3 | 23.9 | 21.3 | 27.6 | 13.5 | 17.9 | 26.3 | 28.3 | 2 = yes |
| **SEIFA Disadvantaged** | | * | | | | | | | Scale |
| First Quintile (Most disadvantaged) | 8.2 | 11.4 | 6.4 | 14.1 | 7.1 | 8.4 | 10.4 | 13.0 | 1 |
| Second Quintile | 14.1 | 19.7 | 13.9 | 21.1 | 10.5 | 16.9 | 17.7 | 22.1 | 2 |
| Third Quintile | 20.9 | 26.0 | 22.8 | 26.0 | 19.5 | 24.2 | 20.8 | 28.1 | 3 |
| Fourth Quintile | 23.1 | 13.3 | 24.1 | 20.4 | 25.8 | 15.7 | 19.9 | 6.1 | 4 |
| Fifth Quintile (Least disadvantaged) | 33.7 | 29.5 | 32.8 | 18.4 | 37.0 | 34.8 | 31.1 | 30.8 | 5 |

Aust = Australian; SEIFA = Socio-Economic Indexes for Areas.
Note: Tables present weighted estimates.

* $P < .05$. $\chi 2$ test for significance.

area were the main predictor variables that showed capacity to differentiate between Australian and overseas-trained dentists' practice in Australia. The discriminant function was effective in the older age groups, and the differences between Australian and overseas-trained dentists, appeared more pronounced in the 35-50 age group.

The study was based on nationally representative LSDPA collection that occurred in 2009-2010. The period between the time of the final wave of the LSDPA and the current article requires thoughtful consideration. A few changes have occurred over the last 10 years, mainly in the assessment and examination processes of overseas-trained dentists in Australia,[7,27,28] dropping dentists from the occupations on the demand list of the Australian immigrations registry,[27] discontinuing the 457 temporary visas for all migrants,[29] and plans to improve Australian dental student engagement in areas of need locations.[30] However, migration researchers have consistently argued that although these changes might influence short-term migrant decisions, over the long term migration is likely to continue as a global phenomenon.[4,31,32] Previous research in Australia and New Zealand has suggested that a large proportion of recent migrants, younger and female migrants, arrive from countries such as India, Philippines, Indonesia, Indonesia, Iran, and Egypt.[5,10,33] Australia as being a migrant country and a popular destination

based on historical trends, we argue is likely to remain a favourable destination of highly skilled personnel, including dentists. It is possible that the changes to the Australian Dental Council examination and 457 visas could temporarily influence migration decisions of a certain type of migrants (especially from the low-and middle-income countries). However, further research will be required to see how new policy decisions have contributed to the changes in migration patterns in Australia.

The LSDPA collections are the oldest and largest known collection of dentist practice activity in Australia that has influenced policy and planning decisions for the last 4 decades.[34,35] Data from the study are weighted to reflect the age and sex distribution of private general practitioners in Australia, who comprise of more than three-quarters of the dental workforce in the country.[17,36] The response rates were very high (around the 70% vicinity). Overall, it is likely that the findings can be generalised to represent the Australian context. The number of complete cases being available for discriminant analysis was $n = 648$; no major differences were observed between the full sample and the sample available for discriminant analysis (Supplementary Tables 1 and 2, available online).

It should also be noted that the changes that occurred in national registration and the temporary inability to link the

**Table 3 – Discriminant analysis between Australian trained and overseas-trained dentists.**

| Independent variables | Standardised discriminant coefficients | | | |
| --- | --- | --- | --- | --- |
| | Full sample $n = 648$ | <35 years $n = 222$ | 35-50 years $n = 258$ | >50 years $n = 167$ |
| Age | 0.17 | 0.40* | 0.17 | -0.28 |
| Hours worked per week | -0.07 | 0.02 | -0.10 | -0.21 |
| Chair side assistant hours | -0.17 | -0.52 | -0.13 | 0.08 |
| Receptionist/secretaries/other staff hours | 0.14 | 0.53 | 0.13 | -0.12 |
| Waiting time | -0.22 | -0.15 | -0.10 | -0.43 |
| Patients per week | 0.19 | 0.27 | 0.12 | 0.12 |
| Gender | 0.12* | 0.11 | 0.20* | -0.07 |
| Country of birth | 0.95* | 0.78* | 0.91* | 0.96* |
| Work status | 0.05 | 0.26 | 0.00 | -0.09 |
| Busyness of practice | 0.06 | 0.06 | -0.08 | 0.10 |
| Area of practice | -0.01 | 0.26 | -0.22 | 0.21 |
| Type of practice | 0.25* | 0.27 | 0.25* | 0.33 |
| Remoteness category | 0.05 | 0.11 | 0.04 | 0.07 |
| SEIFA Disadvantaged (Quintiles) | -0.10* | -0.06 | -0.14* | -0.17 |
| **Centroid values** | | | | |
| Australian-trained | -0.32 | -0.26 | -0.38 | -0.42 |
| Overseas-trained | 1.18 | 1.00 | 1.24 | 1.66 |
| **Eigenvalue** | 0.38 | 0.26 | 0.48 | 0.70 |
| **Wilks' Lambda** | 0.72 | 0.79 | 0.68 | 0.59 |
| Percentage of cases correctly classified | 79.9 | 80.8 | 80.1 | 89.7 |

SEIFA = Socio-Economic Indexes for Areas.
Note: Tables present weighted estimates.

* $P < .05$. Test of equality of group means.

LSDPA collections have led to no new collections following the 2009-2010 survey.[37] Future research will need to find innovative means to continue or commence new dentist practice collections. The use of routinely available data through electronic health record data and data linkage of certain private practice networks are possible solutions.

The Box M test was significant in each of the discriminant functions, suggesting the covariance matrices of the dependent variables are unequal. However, this test is highly sensitive ($P$ value set at .001),and is based on the assumption that samples sizes are equal.[22] The test is arguably also not robust in the current study; therefore, Eigen values and Wilks Lambda values are more useful.[22] Considering the scores of the Eigen values and the Wilks Lambda values being significant in each of the discriminant functions, we can argue that the separation of cases by the predictor variables was effective, and valid inferences can be made. As an alternative to discriminant analysis, logistic regression analysis can also be argued to produce similar findings because the effect variable is mainly comprised of 2 factors. However, discriminant function analysis was considered suitable as the study question was to examine the predictive capacity of the explanatory variables. Though discriminant analysis is found more applicable for continuous predictor variables, careful interpretation can reduce bias in the examination of numerically coded discrete variables in the discriminant outputs.[24,25]

The effects of the predictor variables appeared more pronounced with the 35- to 50-year age group. Differences in gender, type of practice, and SEIFA-advantaged areas were significant, with overseas-trained dentists likely to be more female, working in public practices, and disadvantaged areas compared with Australian-trained dentists. Our previous study on migrant dentists in Australia provided suggestive evidence that more than half of all oversea- trained dentists fell within the 35- to 54-year age group.[5] Qualitative evidence suggests that dentists are likely to migrate after gaining some level of experience or training in their home country and not immediately after graduation.[6,7,38] The process of assessment and registration as dentist in Australia also takes considerable time,[7,28] increasing the representation of overseas-trained dentists in this age group. Overseas-trained dentists who migrated through the examination and assessment pathway were recent migrants and were contributing more to the public sector and disadvantaged areas of Australia. This provides some basis to argue that the policies to encourage overseas-trained dentists to contribute towards areas of need location in Australia (such as public sector schemes or rural and remote areas) have been successful. Although the contribution and value overseas-trained dentists bring to dental service provision to Australia is immense, it is also necessary to identify support services, career pathways, professional development, and social and cultural inclusiveness of migrant dentists working in areas of need locations.

It was also not surprising to notice differences between male and female dentists across the full sample because feminization of migration has been reported in several health professions including dentists.[1,5,39] The effect of feminization of migration is to be understood not just as a difference in practice provision between Australian- and overseas-trained dentists but also as complementary to the dental profession as a whole, which has seen improvement in female participation in the workforce. In general, females work more part-time, take more career breaks, and more likely to be based in the public sector compared with male dentists.[9,23,40] Policy

decisions to influence the short-term movement or support structures for overseas-trained dentists in Australia should consider this gender variation in migration of dentists.

The discriminant analysis did not find any significant differences in practice inputs, direct demand, and productivity measures between dentists trained in Australia or overseas. Although the magnitude of the discriminant coefficients could offer some suggestions on the direction of the relationship, careful interpretation is required. One could argue that in these key measures overseas-trained dentists are more likely to mimic the practice patterns of Australian-trained dentists. This is also a good indication of success in the selection of overseas-trained dentists mainly in the Australian Dental Council assessment and examination process that have led to the adoption of an Australian practice culture among overseas-trained dentists. The older age group (50+ years) showed no significant differences in key predictors, suggesting that age (and most likely experience) can further reduce differences in practice activity patterns between Australian- and overseas-trained dentists. Our prior study has suggested that it takes at least 10 years (since migration to Australia) to better understand the Australian way of life and practice culture in Australia.[10] The age variations in predictor variables in this study provides necessary evidence on key differences in practice activity, areas where future focus needs to be strengthened in terms of both support to overseas-trained dentists and in meeting oral health service demands in Australia.

## Conclusion

The findings of the study indicate that overseas-trained dentists contribute towards providing dental care to underserved populations, public sector, and rural and remote locations. The study also provides a basis to argue that policies that encourage overseas-trained dentists to contribute towards areas of need locations in Australia (such as public sector schemes or rural and remote areas) have been successful. Key productivity measures of overseas-trained dentists also mimic Australian-trained dentists, suggesting that overseas-trained dentists have been able to integrate well into the practice culture in Australia. Gender, type of practice, and location of practice are necessary elements to be included in the policy and planning of the future oral health workforce and in providing support to both current and future migrant dentists in Australia.

## Author contributions

MB, DB, & AJS were equally involved in the conceptualisation, design, and development of the study. MB also collected the data for the study, conducted data analysis, and wrote the paper. WS provided expert advice on data interpretation and analysis. All authors have read the draft paper, provided feedback, and have contributed to the final submission. The data used and/or analysed during the study are available from the corresponding author on reasonable request. Adherence to institutional guidelines on access to data is mandatory.

## Conflict of interest

None disclosed.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.identj.2021.01.002.

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