

# Differences in complete denture longevity and replacement in public and private dental services: A propensity score-matched analysis of subsidised dentures in adult Australians across 20 years

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## Funding information

Financial support for the data linkage with the Registry of Births, Deaths and Marriages was provided by the La Trobe Rural Health School Graduate Researcher Support Scheme

## Abstract

**Objectives:** To examine the differences in treatment outcomes for patients who received subsidised complete dentures in private dental clinics and in public dental clinics over 20 years in Victoria, Australia.

**Methods:** Between 2000 and 2019, 187 227 complete dentures were provided to eligible public patients by the Victorian public dental system. Of these, approximately 52% were provided to public patients in private clinics through the voucher system. Of the 97 107 participants who received denture care in private clinics, 70 818 were matched 1:1 by propensity score (PS) quantiles with participants who received denture care in public clinics. The PS matching balanced the characteristics between these two groups. Subsequently, a conditional logistic regression model investigated the binary outcome of denture replacement whilst a conditional Poisson regression modelled the number of years to denture replacement. A frailty Cox regression after PS matching investigated denture survival over time.

**Results:** Dentures provided in public clinics had a mean time to replacement of 5.5 years (SD: 34.0) and 25.9% were replaced during the observation period. In the first year of denture service, incidence rate per person year (IR) for complete denture replacement in public clinics was 0.04 (95% CI: 0.04–0.04). Dentures provided in private clinics had a mean time to replacement of 6.5 years (SD: 3.8) with 29.4% replaced during the observation period. In the first year of denture service, the IR for complete denture replacement in private clinics was 0.02 (95% CI: 0.02–0.02), which was less than half that of the public IR. Multivariate analyses found that although private dentures were more likely to be replaced during the observation period than those provided in the public sector (odds ratio [OR]: 1.31, 95% CI: 1.28–1.35,  $p < .001$ ), they had greater longevity (incidence rate ratio [IRR]: 1.23, 95% CI: 1.23–1.24,  $p < .001$ ). Longer longevity of private dentures was also supported by the frailty Cox regression showing that private dentures had a reduced hazard of denture replacement over

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time (better survival) in comparison to public dentures (hazard ratio [HR]: 0.94, 95% CI: 0.92–0.97,  $p < .001$ ). Probabilistic sensitivity analysis supported the study findings. **Conclusions:** Increased denture longevity, higher rates of denture replacement and lower rates of early denture replacement were associated with receiving denture care in private clinics as compared with dentures provided in the public sector.

#### KEYWORDS

edentulous/edentulism, prognosis, propensity score, removable prosthodontics

## 1 | INTRODUCTION

Dental care is excluded from Australia's universal public healthcare scheme (Medicare) for most of the population. Public dental services in Australia are available to children and low-income adults who receive some form of government assistance.<sup>1</sup> Dental care is the least subsidised form of healthcare in Australia,<sup>2</sup> and the limited resources available mean that public dental services are characterized by long waiting periods, emergency care and extractions.<sup>3</sup>

At times, Australian public dental clinics issue vouchers to eligible patients, enabling them to receive publicly funded care at a private dental clinic of their choice. Staff vacancies<sup>4</sup> may limit a public clinic's capacity to provide services. Vouchers are typically issued at times where the short-term demand for services exceed the capacity of the public clinic,<sup>5</sup> or when short-term additional funding allows the provision of additional dental services.<sup>6</sup> The decision to issue a voucher is made by the public clinic manager, in order to facilitate appropriate volumes of service provision. It is not made by treating practitioners on a case-by-case basis after examination of the patient, and patients are not entitled to request a voucher. Vouchers make up between 7% and 15% of services provided each year, and was as high as 23% during 2013–2014 when additional Commonwealth funding was provided.<sup>4,6</sup> Treatment is provided by the private practitioner on a fee-for-service basis, and the practitioner is reimbursed by the public dental clinic. Vouchers provides patients with greater choice over the practitioner, timing and location of dental treatment received<sup>7</sup> and are well regarded by patients.<sup>8</sup>

The use of the public voucher scheme is becoming more common in Australia.<sup>9</sup> Analysis of voucher use has identified differences in service provision patterns between public and private oral health practitioners.<sup>1</sup> Public voucher patients were treated by private practitioners on a fee-for-service basis receive more items of service than patients treated in public clinics. Dental Health Services Victoria (DHSV) reported that patients treated in a private setting with a public voucher received 51% more items of general dental services and 17% more emergency services than patients treated in public clinics.<sup>1</sup> Voucher use is also more costly to governments than publicly provided care. A review of national dental waiting lists, published in 2016, found that, even at a below-average fee schedule, and based on the treatment patterns of public practitioners, the provision of care by private practitioners on a fee-for-service basis would be twice as costly as those provided in public clinics.<sup>10</sup>

Little is known about the differences in clinical outcomes of public and private dental care provided to similar patient population.<sup>7</sup> Without service sector specific measurable outcomes, public dental providers are unable to determine if the increased costs of private care result in better outcomes for patients. Differences in the disease experience,<sup>11</sup> education, insurance and socio-economic status<sup>9</sup> of private and public patients confound comparison the outcomes of treatment in these two different settings. The public voucher scheme provides an opportunity to examine treatment outcomes of private and public care in a single large population-based sample over a 20-year observation period.

We hypothesised that there would be no difference in complete denture longevity or replacement rates for dentures provided in private or public practice, after the balancing of the baseline characteristics with propensity score matching and after adjusting for available covariates that could have affected the investigated outcomes.

The aim of this population-based study was to examine differences in denture replacement rates and longevity of complete dentures in a population of patients receiving subsidised complete denture care in public and private dental care settings in Victoria, Australia.

## 2 | METHODS

### 2.1 | Ethics statement

The study protocol received ethics approval by the La Trobe University Human Ethics committee (HEC19112) and followed STROBE guidelines.<sup>12</sup> We identified patient-level data, obtained from the electronic dental records of all adults who accessed publicly funded complete denture treatment in either a public clinic or a private clinic in Victoria, Australia, were provided by Dental Health Services Victoria (DHSV). Given the advanced age of the study population, the date of death for participants was obtained by linkage with the Victorian Registry of Births, Deaths and Marriages dataset.

### 2.2 | Data sources and study population

Eligible patients were adults ( $\geq 18$  years) who received a complete denture(s) (maxillary or mandibular or pair) between 01/01/2000

and 31/12/2019. Patients with implant supported dentures were excluded.

Complete denture treatment is provided by salaried dentists, dental prosthetists, specialist prosthodontists and students, working within more than 50 public agencies or clinics located in metropolitan, regional and rural areas in Victoria. Dental prosthetists in Victoria, Australia, are independent practitioners and are not required to work under the supervision of a dentist. Not all public clinics employ dental prosthetists. Dentures are also provided by private practitioners, working in private clinics, who are reimbursed on a fee-for-service basis by the relevant public dental clinic. Patients who receive a voucher are free to select any practitioner of their choice to provide the CD. The fee paid does not vary by practitioner type, and the materials used by both dentists and dental prosthetists are assumed to be the same.

Patients eligible for public dental care and who wish to receive a complete denture are required to contact a public dental clinic. After assessment and confirmation of eligibility, patients are placed on a denture waiting list. In 2019, the mean waiting time for a denture was 19 months,<sup>13</sup> and there is a co-payment fee, which represents approximately 7% of the full private cost of a CD. Up to half of public dentures provided are to 'priority' patients (Aboriginal or Torres Strait Islander, mental health clients, homeless, refugee or asylum seekers) who are not subject to this wait time, and who are not subject to the co-payment.<sup>13</sup> When a patient reaches the top of the waiting list, allocation to a public or private practitioner is determined by the manager of the public dental clinic and depends on staff availability and service demand.<sup>5</sup> Patients are not entitled to choose whether to be treated in a public clinic or with a voucher in a private clinic.<sup>5</sup>

In a sample that could receive a complete denture from either the public or private sector, the exposure of interest was receiving a complete denture in private practice, and the outcome measure was denture longevity. Denture longevity was defined as the period of time between the date of provision of a CD and the date of its replacement with another CD. Participants were followed from the date of provision of a complete denture until the first occurrence of its replacement with another complete denture or till death, whichever occurred first. For patients who experienced multiple replacements, the interval up to the first replacement was considered. The decision to replace a denture, in this population, is commonly made by the patient. A patient can contact any public clinic and, providing they are eligible for public care, can request new complete dentures and place their name on the denture wait list without examination. The Victorian public dental service places no restrictions on the reason or how frequently an edentulous person may seek dentures, stating 'These (edentulous) clients usually require new dentures if they are requesting them'.<sup>14</sup> In addition, patients who present to a public clinic with denture concerns may be placed on the denture waiting list by their treating practitioner.

The date of denture provision, age at the time of denture provision, sex, indigenous status, country of birth, participant's residential postcode, type of practitioner who provided treatment (dentist

or dental prosthetist), registration status of practitioner (student or qualified practitioner), location of care provision (in a public clinic or private clinic) and type of complete denture provided (pair of CDs, maxillary CD or mandibular CD) were collected from the participant's dental record. Geographic location<sup>15</sup> and Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD)<sup>16</sup> were determined by the participants' residential postcode. Student registration refers to both students in dentistry and dental prosthetics. Students learning to qualify as practitioners provided services in public clinics only. The public clinic responsible for the participant's care was de-identified in the data and represented by a code only. As such, the different public clinics could be distinguished from each other, but no further information was provided. Eligibility and co-payment criteria were the same for all participants eligible for public care, whether treatment was provided at a public clinic, or at a private clinic utilising a voucher.

## 2.3 | Statistical analyses

### 2.3.1 | Propensity score analysis

Propensity score analysis is a method developed by Rosenbaum and Rubin to control for selection bias and confounding in observational studies.<sup>17</sup> It generates a score (propensity score [PS]) that describes the probability of a study participant receiving either treatment or an exposure, based on their pre-treatment covariates. The PS can then be used to control for confounding arising from the differences in these pre-treatment covariates, on the treatment outcomes measured. It allows researchers to compare treatment outcomes in exposure groups that have been matched according to their baseline characteristics. However, unmeasured covariates cannot be balanced and may affect treatment outcomes.<sup>18</sup>

### 2.3.2 | Construction of the propensity score

Logistic regression was used to generate a PS<sup>18</sup> for each participant as the estimated probability of receiving a complete denture in a private clinic accounting for the following pre-treatment baseline covariates: age, sex, indigenous status, denture type, country of birth, geographic location,<sup>15</sup> and Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD).<sup>16</sup> The model also accounted for correlation within 56 different public dental clinics using the cluster sandwich (Huber-White estimator) method.

### 2.3.3 | PS balance diagnostics and matching strategy

Standardized differences in covariates included in the PS construction model were estimated to assess covariate balance before and after propensity score matching and to quantify the difference in

the prevalence of each covariate between patients who had their complete dentures made in the private sector and those whose dentures were made in the public sector. A standardized difference of less than the absolute value of 0.1 was considered negligible.<sup>18</sup>

After the PS construction, private cases were randomly matched 1:1 to public counterparts from the same sample by 25 PS quantiles. Subsequently, conditional regressions were run to investigate outcomes, whilst accounting for the provider type, provider registration status, denture repair status and denture relines status, which were not accounted for in the PS model. Given the matched study design, a conditional logistic regression model was used to investigate the dichotomous outcome of denture replacement.<sup>19</sup> A conditional Poisson regression model was used to model the number of years to denture replacement, as the event (time to denture replacement) in this dataset followed a Poisson distribution.<sup>20</sup> A frailty Cox model<sup>21</sup> was also generated after PS construction and matching. The proportional hazard assumption was tested using Schoenfeld residuals.

## 2.4 | Sensitivity analysis

Using Stata's `episensi` command, we ran probabilistic sensitivity analysis (PSA)<sup>22,23</sup> with 20 000 simulations to account for unmeasured confounding and uncertainty in number of replacements performed in either the private or public sector during the first 2 years following denture provision.

Specialist prosthodontists comprised less than 0.5% of the practitioners who provided dentures in this sample and in the analyses these were combined with dentists. The statistical analyses were conducted using Stata SE/15.1, reported *p* values were two-sided and a *p* value of .05 was considered statistically significant.

## 3 | RESULTS

The baseline characteristics of patients who received private dentures differed from those who received treatment in a public clinic. Patients who received a voucher for private care were older, more likely to be female, to be receiving a pair of complete dentures rather than a single denture, to be living outside a major city and were more likely to be born in Australia or New Zealand. The difference in baseline characteristics between public and private denture participants is demonstrated by the standardized difference for the measured baseline characteristics (Table 1).

Across the 20-year observation period, 90 120 participants received complete dentures in a public clinic and 97 107 received complete dentures in a private clinic. Of the latter, 70 818 private participants were matched 1:1 by PS strata with public patients. The matching included 141 636 individuals being 75.6% of the original 187 227 sample. The PS matching balanced the baseline characteristics between the two compared groups as shown in Table 1 and Figure 1.

Dentures provided in public clinics had a mean time to replacement of 5.5 years (SD: 4.0) and 25.9% of these dentures were

replaced during the observation period. Dentures provided in private clinics had a mean time to replacement of 6.5 years (SD: 3.8) and 29.4% of the dentures issued were replaced during the observation period (Table 2).

The early denture replacement proportion, which refers to dentures which were replaced within 2 years of issue, was 3.6% for private dentures and 5.9% for those provided in public clinics (Table 2). During the first year of denture service, the denture replacement rate (incidence rate per person year [IR]) among public participants was 0.04 (95% CI: 0.04–0.04) which was almost twice that of private participants (IR: 0.02, 95%CI: 0.02–0.02), and remained higher for the 2<sup>nd</sup> and 3<sup>rd</sup> year of denture life (Figure 2, Table A1).

Following the PS matching and after accounting for type of practitioner, registration of practitioner, repair status and relines status, a conditional logistic regression found that private dentures were 31% more likely to experience replacement than dentures provided in public practice (odds ratio [OR]: 1.31, 95% CI: 1.28–1.35, *p* < .001). However, private dentures were 23% more likely to have greater longevity than public dentures as shown in the conditional Poisson regression (incidence rate ratio [IRR]: 1.23, 95% CI: 1.23–1.24, *p* < .001). A multivariate frailty Cox model found that privately provided dentures had a reduced hazard of denture replacement over time in comparison to public dentures (hazard ratio [HR]: 0.94, 95% CI: 0.92–0.97, *p* < .001) (Table 3). The proportional hazard assumption was not violated following the PS matching. Probabilistic sensitivity analyses supported the study's main findings. Dentures provided in the public clinic were 62% more likely than those issued in the private sector to be replaced within the first 2 years from denture provision (OR = 1.62, 95% CI 1.17–2.22; Figure A1).

## 4 | DISCUSSION

This population-based study is the first to compare clinical outcomes for public dental services delivered by public and private providers. Complete dentures provided to public patients on a fee-for-service basis by private practitioners lasted more than a year longer than complete dentures provided in public clinics. During the first year of denture service, the rate of replacement for publicly provided dentures was almost twice as high as that for private dentures and remained significantly higher for the 2<sup>nd</sup> and 3<sup>rd</sup> years of denture service. Over the 20-year observation period, dentures provided in a private setting had longer longevity and were more likely to be replaced than those provided in a public setting.

The difference in denture outcomes between public and private practitioners in this study is not well explained by the examined covariates. Patients listed on the public denture waiting list pay the same fee whether the denture is finally provided by the public or private sector. In our study, the proportions of care provided by dentists and dental prosthetists in both sectors were similar and we assume that practitioners in both sectors had similar training and registration requirements. Nonetheless, the largest identified difference between the two groups in this study was the clinical setting. In this study,

TABLE 1 Baseline characteristics of study participants before and after propensity score matching

	Before matching		<i>d</i>	After matching		<i>d</i>
	Public	Private		Public	Private	
<i>n</i> (%)	90 120 (48.1)	97 107 (51.9)		75 256 (50.0)	75 256 (50.0)	
Mean age, years(SD)	66.3 (13.8)	68.0 (12.3)	-0.135	67.0 (13.3)	67.1 (12.9)	-0.015
Sex						
Female	46 676 (52.8)	56 007 (57.7)		40 406 (54.5)	40 971 (54.5)	
Male	41 702 (47.2)	40 984 (42.3)	0.099	33 803 (45.6)	34 169 (45.5)	0.002
Indigenous status						
Indigenous	1150 (1.3)	633 (0.7)		693 (0.9)	627 (0.8)	
Non indigenous	87 043 (98.7)	95 608 (99.3)	0.066	73 395 (99.1)	73 763 (99.2)	0.010
Denture type						
Pair CD	46 572 (52.7)	62 816 (64.7)	-0.266	42 731 (56.8)	43 041 (57.2)	-0.008
Maxillary CD	39 064 (43.4)	31 621 (32.6)	0.224	29 743 (39.5)	29 556 (39.3)	0.005
Mandibular CD	4484 (5.0)	2670 (2.8)	0.116	2782 (3.7)	2659 (3.5)	0.009
Provider type						
Dentist	32 846 (37.0)	29 256 (34.4)	-0.053	27 383 (36.9)	23 613 (35.9)	-0.020
Dental prosthetist	55 2885 (62.2)	55 702 (65.5)	0.069	46 265 (62.4)	42 042 (64.0)	0.034
Specialist prosthodontist	754 (0.9)	72 (0.1)	-0.112	531 (0.7)	48 (0.1)	-0.103
Provider registration						
Fully qualified	86 437 (96.7)	85 055 (99.8)		72 205 (96.8)	65 723 (99.9)	
Student	2918 (3.3)	160 (0.2)	-0.238	2401 (3.2)	102 (0.2)	-0.240
Geographic location						
Major city	53 697 (59.7)	46 681 (48.1)	0.234	41 662 (55.5)	40 981 (54.6)	0.018
Inner regional	23 367 (26.0)	34 202 (35.3)	-0.202	21 818 (29.0)	22 114 (29.4)	-0.009
Outer regional & remote	12 825 (14.3)	16 079 (16.6)	-0.064	11 652 (15.5)	12 016 (16.0)	-0.013
Country of birth						
Australia and New Zealand	54 815 (64.3)	67 861 (72.4)	-0.175	48 821 (67.4)	48 999 (68.2)	-0.015
Europe and Americas	21 586 (25.3)	20 411 (21.8)	0.083	17 834 (24.6)	17 496 (24.3)	0.007
Middle East, Africa and Asia	8909 (10.4)	5482 (5.9)	0.169	5735 (7.9)	5408 (7.5)	0.015
Age category						
18–50 years	12 607 (14.0)	9091 (9.4)	0.145	8978 (11.9)	8682 (11.5)	0.012
51–60 years	12 831 (14.3)	11 557 (11.9)	0.070	10 104 (13.4)	10 122 (13.5)	-0.001
61–70 years	24 608 (27.3)	29 187 (30.1)	-0.061	21 432 (28.5)	21 600 (28.7)	-0.005
71–80 years	26 727 (29.7)	33 403 (34.4)	-0.102	23 610 (31.4)	23 614 (31.4)	<0.000
80 years or more	13 297 (14.8)	13 849 (14.3)	0.014	11 097 (14.8)	11 218 (14.9)	-0.004
IRSAD quintile						
(Wealthiest) 1	19 946 (22.2)	19 161 (19.8)	0.060	15 961 (21.2)	16 058 (21.4)	-0.003
2	17 793 (19.8)	24 488 (25.3)	-0.131	16 298 (21.7)	16 424 (21.9)	-0.004
3	17 569 (19.5)	20 050 (20.7)	-0.028	14 965 (19.9)	15 096 (20.1)	-0.004
4	18 168 (20.2)	16 646 (17.1)	0.079	14 206 (18.9)	14 363 (19.1)	-0.005
5	16 414 (18.3)	16 646 (17.2)	0.029	13 702 (18.2)	13 171 (17.5)	0.018

Note: CD, complete denture; *d*, standardized difference; IRSAD, Index of Relative Socio-economic Advantage and Disadvantage.

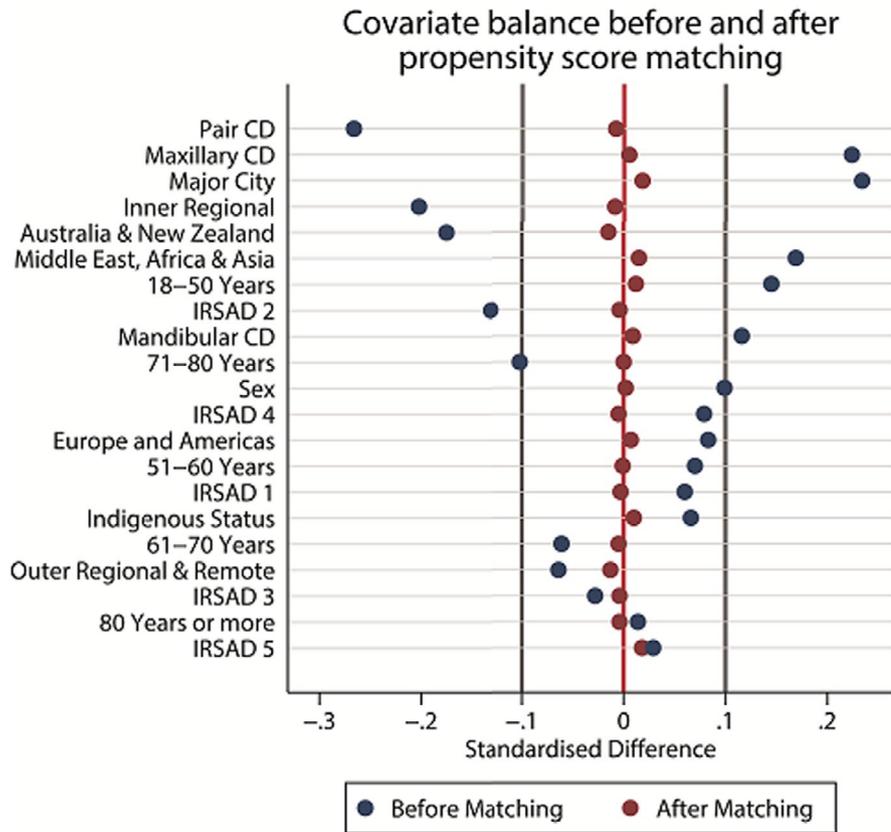


FIGURE 1 Change in standardized bias (d) of covariates after Propensity Score Matching

	Public	Private	p
CD issued (n)	90 120	97 107	
Replaced <2 years n (%)	5338 (5.9)	3527 (3.6)	
Total CD replacements n (%)	23 380 (25.9)	28 556 (29.4)	<.001
Mean longevity of CD which were replaced (years [SD])	5.54 (4.0)	6.55 (3.8)	<.001
Mean time under observation (years [SD])	7.75 (5.4)	9.64 (5.5)	<.001

TABLE 2 Mean longevity, failure range and time at risk by denture type

Abbreviations: CD, complete denture; SD, standard deviation.

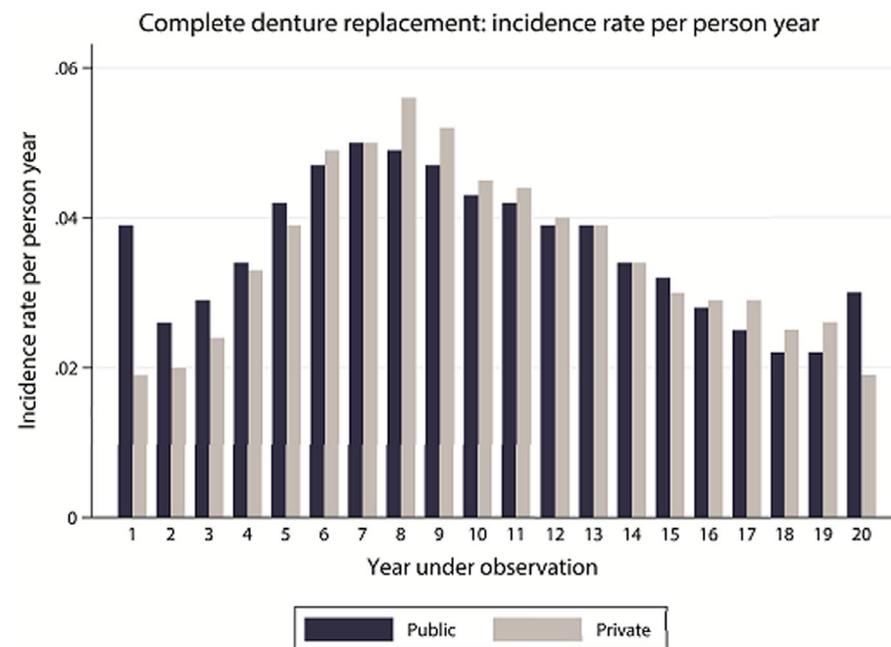


FIGURE 2 Complete denture replacement: incidence rate per person year

TABLE 3 Multivariate regression estimates for complete dentures by clinic setting

Conditional Logistic (Models odds of CD replacement)	OR	95%CI	p
Univariate			
Public	1		
Private	1.24	1.21–1.27	<.001
Multivariate			
Public	1		
Private	1.31	1.28–1.35	<.001
Dental prosthetist (ref. dentist)	0.66	0.64–0.69	<.001
Student (ref. fully qualified)	0.87	0.76–1.00	.058
Denture repair (ref. No denture repair)	2.45	2.28–2.63	<.001
Denture relined (ref. No denture relined)	1.88	1.75–2.03	<.001
Poisson (Models time to CD replacement)	IRR	95% CI	p
Univariate			
Public	1		
Private	1.24	1.24–1.25	<.001
Multivariate			
Public	1		
Private	1.23	1.23–1.24	<.001
Dental prosthetist (ref. dentist)	0.78	0.77–0.78	<.001
Student (ref. fully qualified)	0.67	0.66–0.69	<.001
Denture repair (ref. No denture repair)	1.06	1.05–1.07	<.001
Denture relined (ref. No denture relined)	1.02	1.01–1.03	<.001
Frailty cox (models CD survival over time)	HR	95% CI	p
Univariate			
Public clinic	1		
Private clinic	0.89	0.86–0.91	<.001
Multivariate			
Public clinic	1		
Private clinic	0.94	0.92–0.97	<.001
Dental prosthetist (ref dentist)	0.92	0.89–0.96	<.001
Student registration (ref. fully qualified)	1.49	1.27–1.74	<.001
Denture was repaired (ref. No denture repair)	1.42	1.33–1.53	<.001
Denture was relined (ref. No denture relined)	1.46	1.36–1.58	<.001

Abbreviations: CD, complete denture; CI, confidence interval; HR, hazard ratio; IRR, incident rate ratio; OR, odds ratio.

public practitioners received salary payments, whilst private practitioners were reimbursed on a fee-for-service basis, which was set at approximately half of the market rate.<sup>24</sup> Differences in methods of practitioner reimbursement have been found to affect the types and quantity of service provided,<sup>25</sup> however, little is known about its effect on treatment outcomes. Previous research has found little evidence that factors such as age, sex, socio-economic status, medical history, method of denture construction or the technical quality of the dentures have a strong correlation with denture success.<sup>26</sup> There is some evidence that denture treatment success is associated with the quality of the practitioner–patient relationship, the convenience in accessing care and cost of treatment.<sup>27</sup> Given that patients needing a denture may report a preference for care in private clinics,<sup>28</sup> often reporting

greater satisfaction with access, availability and convenience of private settings,<sup>29</sup> such positive attributes of private care may make some contribution to the differences in outcome.

The proportion of private dentures in our sample which experienced early replacement compared favourably with published results;<sup>30,31</sup> however, the early replacement proportion for publicly provided CDs was significantly higher, as was the denture replacement incidence rate. Early replacement may be considered a 'device failure' which is defined as 'the nonperformance or inability of a component or system to perform its intended function for a specified time under specified environmental conditions'.<sup>32</sup> Early replacement of complete dentures is likely to represent an inconvenience to patients and an unnecessary cost to public providers. Identification of the causes and nature of early

replacement may provide opportunity for service improvement and cost savings, and the causes warrant further investigation.

During the 20-year observation period, more than 70% of participants did not replace their dentures. A larger proportion (29.4%) of private patients replaced their dentures during the observation period, in comparison with public patients (25.9%), and these replacements tended to occur later in the lifespan of the denture. CD patients are known to persist with worn and clinically unsatisfactory dentures for long periods, unaware of the negative effects of old and worn dentures on their OHRQoL, mucosal health, mastication, speech and appearance.<sup>33-37</sup> Complete denture patients are typically elderly and disadvantaged which contributes to poor patterns of dental service use.<sup>38</sup> Cost, social conditions, general health and low expectations of denture function also limit dental service usage.<sup>39</sup> Complete denture patients in this study were not subject to any form of recall; so, the effects of supplier induced demand are unlikely to have played a role in the observed difference. Further investigation is warranted to identify the factors associated with differences in denture replacement rates in these two service settings.

#### 4.1 | Strengths and limitations

The strengths of this study lie in its population-based provenance, the large sample, longitudinal design and prolonged observation period and the use of propensity score matching. The study also has limitations. The data were not collected for the purpose of research and were based on fee codes rather than clinical records. The information on covariates was limited, and the reasons for denture replacement were not provided. Propensity score matching was used to balance measured covariates; unmeasured covariates were not balanced and residual confounding cannot be excluded.<sup>40</sup> However, probabilistic sensitivity analyses that we conducted accounting for unmeasured confounding supported our main findings. Study participants may have sought denture replacement outside the Victorian public dental system, and this would not have been captured in the dataset. Experience levels may have differed between settings, but we were unable to validate this from the national workforce dataset. Information on the denture materials or denture fabrication techniques in the different settings was not provided; however, the materials used in complete denture construction have changed little in recent decades,<sup>41</sup> and variations in fabrication techniques have not been found to affect long term denture outcomes.<sup>42</sup> Denture quality, as assessed by dental practitioners, is not clearly associated with patient reported denture satisfaction or denture acceptance.<sup>43,44</sup>

## 5 | CONCLUSION

Complete dentures provided to public patients by private practitioners on a fee-for-service basis had better survival than those provided by public practitioners. Privately provided CDs had greater longevity, lower rates of early replacement and a greater proportion were

replaced during the observation period. Further investigation that considers the experience level of the practitioner, the materials used in denture fabrication, and an assessment of the patient's subjective experience during service provision is warranted, to determine their effect on denture outcomes. A qualitative analysis addressing both patient and practitioner factors associated with early denture replacement should also be considered.

#### ACKNOWLEDGEMENTS

We acknowledge the Department of Health and Human Services as the data custodian of the Victorian Dental Health Program Dataset, and we wish to thank Dental Health Services Victoria (DHSV) and Dr Martin Whelan, Manager Data Analysis at DHSV, for his assistance with data retrieval and de-identification. Open access publishing facilitated by La Trobe University, as part of the Wiley - La Trobe University agreement via the Council of Australian University Librarians. WOA Institution: La Trobe University Blended DEAL: CAUL 2022.

#### CONFLICT OF INTEREST

The authors report no conflicts of interest regarding this study.

#### AUTHOR CONTRIBUTIONS

Marietta Taylor involved in conceptualization, methodology, software, validation, formal analysis, data curation, writing—original draft, visualisation and funding acquisition. Mohd Masood involved in writing—review and editing and supervision. George Mnatzaganian involved in conceptualisation, methodology, software, validation, formal analysis, writing—review and editing, visualisation, supervision and funding acquisition. All authors gave their final approval and agree to be accountable for all aspects of the work.

#### DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

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**How to cite this article:** Taylor M, Masood M, Mnatzaganian G. Differences in complete denture longevity and replacement in public and private dental services: A propensity score-matched analysis of subsidised dentures in adult Australians across 20 years. *Community Dent Oral Epidemiol.* 2022;00:1–10. doi:[10.1111/cdoe.12744](https://doi.org/10.1111/cdoe.12744)

APPENDIX 1

TABLE A1 Complete dentures: replacement rate per person year

Years under observation	Public				Private			
	Person-time (years)	Failures (n)	IR	95% CI	Person-time (years)	Failures (n)	IR	95% CI
0-1	85 015	3325	0.04	0.04-0.04	94 271	1798	0.02	0.02-0.02
1-2	76 651	2013	0.03	0.03-0.03	88 359	1729	0.02	0.02-0.02
2-3	68 784	2013	0.03	0.03-0.03	81 960	1975	0.02	0.02-0.03
3-4	61 170	2094	0.03	0.03-0.04	75 899	2511	0.03	0.03-0.03
4-5	53 795	2243	0.04	0.04-0.04	69 407	2729	0.04	0.04-0.04
5-6	46 655	2211	0.05	0.05-0.05	63 149	3074	0.05	0.05-0.05
6-7	40 381	2008	0.05	0.05-0.05	54 887	2726	0.05	0.05-0.05
7-8	34 699	1696	0.05	0.05-0.05	49 201	2746	0.06	0.05-0.06
8-9	29 734	1389	0.05	0.04-0.05	44 035	2281	0.05	0.05-0.05
9-10	25 454	1099	0.04	0.04-0.05	38 372	1724	0.05	0.04-0.05
10-11	21 379	898	0.04	0.04-0.05	33 509	1468	0.04	0.04-0.05
11-12	17 499	688	0.04	0.04-0.04	28 664	1134	0.04	0.04-0.04
12-13	14 262	557	0.04	0.04-0.04	22 967	897	0.04	0.04-0.04
13-14	11 471	395	0.03	0.03-0.04	18 182	611	0.03	0.03-0.04
14-15	9015	290	0.03	0.03-0.04	13 408	397	0.03	0.03-0.03
15-16	6850	192	0.03	0.02-0.03	9892	291	0.03	0.03-0.03
16-17	5081	129	0.03	0.02-0.03	7817	225	0.03	0.03-0.03
17-18	3520	78	0.02	0.02-0.03	5617	143	0.03	0.02-0.03
18-19	1969	43	0.02	0.02-0.03	3242	83	0.03	0.02-0.03
19-20	637	19	0.03	0.02-0.05	741	14	0.02	0.01-0.03

Note: Italics indicates statistically significant difference.  
 Abbreviations: CI, confidence interval; IR, incidence rate per person year.

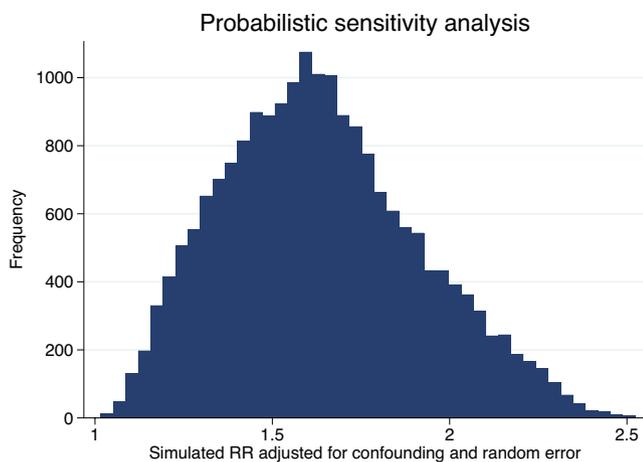


FIGURE A1 Probabilistic sensitivity analysis.