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Demographic and rural–urban variations in dental service utilization in Taiwan

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ABSTRACT

Introduction: This study assesses whether demographic and rural–urban variations in dental care service utilization still exist in Taiwan after 15 years of the implementation of universal health insurance coverage, which largely reduces financial barriers to dental care.

Methods: The data analysed in this cohort study were based on a random sample of one million beneficiaries retrieved from Taiwan's National Health Insurance Research Database (NHIRD) in 2005. The follow-up was made between 2005 and 2010. Poisson regression models were used to explore the associations of dental service utilization rates with urbanization and demographic characteristics.

Results: The highest and lowest rates of preventive dental care were obtained in people aged 55–64 years (579.2/1000 person-years) and <15 years (178.6/1000 person-years). The corresponding figures for curative care were 1592.0/1000 person-years (<15 years) and 757.2/1000 person-years (35-44 years). Compared with the people living in the least urbanized areas, those from the most urbanized areas presented significantly higher rates of preventive and curative dental services; a greater estimated rate ratio was noted for preventive services than for curative services (1.57 vs 1.42).

Conclusions: The urban–rural disparity in dental care service utilization still exists after 15 years of the implementation of the national health insurance in Taiwan, suggesting that factors other than affordability may play roles in such disparity.

Key words: curative dental treatment, Poisson regression, preventive dental treatment, Taiwan, rural–urban disparity.

Introduction

Oral health is not only about healthy teeth; it is also an integral part of overall health. Oral health can be achieved through effective preventive and curative dental services[1]. However, considerable evidence shows sociodemographic and rural–urban disparities in dental service utilization[2-4]. Incremental and persistent tooth loss is associated with poor access to professionally provided preventive services and poor option-taking in the receipt of dental treatment[5]. A study using county-level data suggested that older adults living in a county with a high dentist-to-population ratio were more likely to use dental services[2], highlighting the importance of adequate dental care provision. Poor oral health in rural areas is related to limited availability of dental services[4]. In addition, the cost of dental services is an important barrier to dental care attendance[6]; the issue of affordability in dental services has contributed substantially to poor oral health, especially in those socioeconomically advantaged individuals, including but not limited to people with low income and those with inadequate dental insurance coverage[7]. Unaffordability of dental services worsens oral health in several segments of population, including the elderly, poor children, minorities and those with severe systemic diseases or disabilities[8].

In 1995, the government of Taiwan introduced a national health insurance (NHI) program that covers all residents. The NHI program was intended to ensure accessibility to health care at a reasonable cost[9]. An observational study revealed that, after the introduction of the NHI program, the newly insured used more than twice the amount of outpatient visits and hospital admissions than before the implementation of the NHI; as a result, those previously uninsured showed the same amount of healthcare contacts as the previously insured group. The newly insured also experienced an increase in emergency department visits[10]. The NHI program extended the existing insurance coverage from 57% of the population (mostly the employed) to everyone, including children, the elderly and non-working adults, who are consequently the segments of the population who primarily benefited from the NHI program[11].

The implementation of the NHI program is expected to improve the affordability of healthcare services, including dental services, for socially vulnerable people, most of whom live in rural areas in Taiwan. In the context of the universal health insurance coverage in Taiwan that greatly removes financial barriers to dental care, this study aimed to assess whether sociodemographic and rural–urban variations in dental service utilization still exist in Taiwan after 15 years of the NHI implementation through examining the urban–rural disparity in preventive and curative dental service utilization. Dental service utilization by people by age and sex stratifications was also examined to determine the variation in utilization across demographic variables in Taiwan under the universal NHI system.

Methods

Data sources

The data analysed in this study were retrospectively retrieved from the claims of the NHI Research Database (NHIRD) provided by the NHI Administration (NHIA), Ministry of Health and Welfare. The NHIRD provided all inpatient and ambulatory medical claims for around 99% of Taiwanese people[12]. The NHIRD covered all inpatient and outpatient claims and medical orders, and information on healthcare providers, including medical institutions and healthcare workers. The identification numbers of all healthcare providers are encrypted to ensure privacy. The NHIA performs quarterly expert reviews on a random sample for every 50–100 ambulatory and inpatient claims to ensure the accuracy of claim files[13]. In this study, the claims data of ambulatory care visits were used; these data were from a representative sample of one million beneficiaries randomly selected from all beneficiaries registered in 2005. The age and sex distributions of this random sample are comparable to the entire population of Taiwan in 2005[14].

Study design and sample

This retrospective cohort study was based on the one million people randomly selected in 2005, and dental service

attendance information was retrieved from the ambulatory care claims between 2005 and 2010. Only 998 014 people who had completed information on age, sex and urbanization were retained in the analysis. Dental care visits were further classified into types of dental care (ie preventive care and curative care). Preventive care includes regular dental examinations and scaling. Curative treatment includes filling cavities, root canal therapy, periodontal treatment, dentures and other prosthetic treatments[15]. Preventive and curative dental care information was determined by using the medical order codes of the NHI medical claims. The prevalence of dental care visits was calculated as the ratio of number of dental care visits to total person-years observed from the study population in 2010. Patients' residential or employment areas were categorized into five levels of urbanization according to the classification scheme proposed by Liu et al[16].; these authors considered the following indicators in determining levels of urbanization: population density, proportion of residents with college or higher education, percentage of elderly (>65 years) people, proportion of agriculture workforce, and number of physicians per 100 000 people. Urbanization values of 1 and 5 indicate the most and least level of urbanization, respectively.

Statistical analysis

The person-years accumulated for each study subject were calculated from the first day of 2005 (or date of NHI enrolment) to the last day of 2010 (or date of NHI termination). First, the overall and specific prevalences of dental service attendance were presented according to various age, se, and urbanization stratifications, as well as the type of dental service attendance. The prevalence of dental care visit was then fitted into a Poisson regression model to assess the independent effect of age, sex and urbanization on dental service utilization by adjusting for calendar year. The statistical analyses were performed with Statistical Analysis Software v9.4 (SAS Institute Inc., www.sas.com).

Ethics approval

Access to research data has been reviewed and approved by the National Health Research Institutes Review Committee (NHIRD-102-021). Because the medical claims data for all personal identification numbers were encrypted, obtaining the informed consent from each study patient was waived.

Results

The utilization rate of preventive dental service was estimated at 455.8 per 1000 person-years in Taiwan, and the utilization rate of curative services was roughly doubled at 938.5 per 1000 person-years. Children aged 15 years or less showed the lowest rate of preventive services (178.6 per 1000 person-years), but they had the highest rate of curative services (1592.0 per 1000 person-years). Except for the ages 35-44 years and 65 years, older ages were generally associated with higher dental service utilization rate than people aged 15 years and older, regardless of the type of dental care. Males had lower rates of preventive (421.2 vs 489.6 per 1000 person-years) and curative services (862.6 vs 1013.0 per 1000 person-years) than females (Table 1). A clear gradient relationship was found between levels of urbanization and utilization rate of dental services (Fig1).

Table 2 shows the adjusted rate ratio (RR) of dental services in relation to age, sex and urbanization. Compared with elderly people (≥65 years), children (<15 years) had an obviously lower rate (RR=0.40) of preventive services but a higher rate of curative services (RR=1.84). All age groups except children and younger people aged 15-24 years were associated with higher rates of preventive services, with an age-specific RR ranging from 1.06 to 1.26. All age groups except children and those aged 55-64 years were associated with significantly low rates of curative services, with an age-specific RR ranging from 0.86 to 0.99. Furthermore, females had significantly higher rates of preventive (RR=1.14) and curative (RR=1.18) services than males.

Compared with those from the least urbanized areas, people from the most urbanized areas had the highest RRs of preventive and curative services but with a greater RR noted for preventive services (RR=1.57 vs RR=1.42). Regardless of the type of dental services, clear urbanization gradient relationships were found. Specifically, the RR of dental services increased with high levels of urbanization.

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Table 1: Dental service utilization rates according to sociodemographic characteristics

Variable	*n*	%	P-Y	Preventive dental services				Curative dental services			
				No. of people	No. of visits	Rate (per 1000 P-Y)†	95%CI	No. of people	No. of visits	Rate (per 1000 P-Y)†	95%CI
Age (years)											
<15	122 154	12.2	712 303.9	54 566	127 253	178.6	177.7–179.6	111 786	1 134 343	1592.0	1590.0–1595.0
15–24	141 205	14.1	820 687.6	98 831	326 342	397.6	396.3–399.0	107 524	669 071	815.3	813.3–817.2
25–34	170 596	17.1	944 872.5	128 631	489 836	518.4	517.0–519.9	125 583	798 884	845.5	843.6–847.3
35–44	162 954	16.3	930 592.9	116 506	456 068	490.1	488.7–491.5	114 153	704 635	757.2	755.4–759.0
45–54	160 185	16.1	932 546.3	115 005	509 329	546.2	544.7–547.7	115 649	809 491	868.0	866.2–869.9
55–64	110 706	11.1	641 936.9	77 953	371 838	579.2	577.4–581.1	80 221	620 501	966.6	964.2–969.0
≥65	130 214	13.0	702 508.4	70 124	310 751	442.3	440.8–443.9	78 320	599 089	852.8	850.6–854.9
Mean±SD	39.73±20.50										
Sex											
Male	494 792	49.6	2 807 435.3	310 250	1 182 371	421.2	420.4–421.9	346 259	2 421 817	862.6	861.6–863.7
Female	503 222	50.4	2 878 013.2	351 366	1 409 046	489.6	488.8–490.4	386 977	2 914 197	1013.0	1011.0–1014.0
Urbanization¶											
1	296 034	29.7	1 690 332.4	215 309	893 752	528.7	527.6–529.8	230 311	1 748 555	1034.0	1033.0–1036.0
2	315 327	31.6	1 801 161.8	213 422	843 069	468.1	467.1–469.1	235 373	1 721 202	955.6	954.2–957.0
3	168 338	16.9	951 687.9	107 669	403 966	424.5	423.2–425.8	120 489	853 523	896.9	894.9–898.8
4	132 026	13.2	751 862.3	79 307	291 476	387.7	386.3–389.1	91 866	647 359	861.0	858.9–863.1
5	86 289	8.6	490 404.1	45 909	159 154	324.5	322.9–326.1	55 197	365 375	745.0	742.6–747.5
Total	998 014	100.00	5 685 448.5	661 616	2 591 417	455.8	455.2–456.4	733 236	5 336 014	938.5	937.7–939.3

CI, confidence interval; P-Y, person-years. SD, standard deviation.
† Rate was calculated from the number of visits divided by the number of P-Y.
¶ Urbanization values of 1 and 5 indicate the most and least level of urbanization, respectively.

Table 2: Rate ratio of dental service utilization in relation to age, sex, and urbanization

Variable	Preventive services				Curative services			
	Crude estimates		Adjusted estimates		Crude estimates		Adjusted estimates	
	RR	95%CI	RR	95%CI	RR	95%CI	RR	95%CI
Age (years)								
<15	0.40	0.40–0.41	0.40	0.39–0.40	1.87	1.86–1.87	1.84	1.84–1.85
15–24	0.90	0.89–0.90	0.87	0.87–0.88	0.96	0.95–0.96	0.94	0.93–0.94
25–34	1.17	1.17–1.18	1.11	1.11–1.12	0.99	0.99–0.99	0.95	0.95–0.95
35–44	1.11	1.10–1.11	1.06	1.06–1.07	0.89	0.88–0.89	0.86	0.86–0.86
45–54	1.23	1.23–1.24	1.18	1.18–1.19	1.02	1.01–1.02	0.99	0.98–0.99
55–64	1.31	1.30–1.32	1.26	1.26–1.27	1.13	1.13–1.14	1.10	1.10–1.11
≥65 (reference)	1.00		1.00		1.00		1.00	
Sex								
Male (reference)	1.00		1.00		1.00		1.00	
Female	1.16	1.16–1.17	1.14	1.14–1.14	1.17	1.17–1.18	1.18	1.18–1.18
Urbanization†								
1	1.63	1.62–1.64	1.57	1.56–1.58	1.39	1.38–1.39	1.42	1.41–1.42
2	1.44	1.43–1.45	1.40	1.40–1.41	1.28	1.28–1.29	1.31	1.30–1.31
3	1.31	1.30–1.32	1.30	1.29–1.30	1.20	1.20–1.21	1.22	1.21–1.22
4	1.19	1.19–1.20	1.18	1.18–1.19	1.16	1.15–1.16	1.17	1.16–1.17
5	1.00		1.00		1.00		1.00	

CI, confidence interval; RR, rate ratio.
† Urbanization values of 1 and 5 indicate the most and least level of urbanization, respectively.

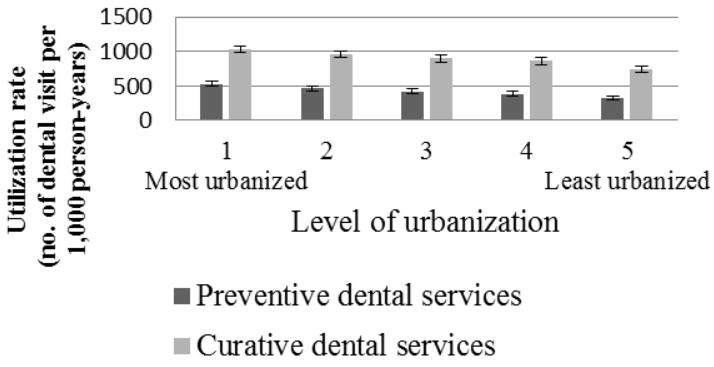

Figure 1: Relationship between level of urbanization and utilization rate of dental services.

Discussion

After 15 years of the NHI implementation, large disparities by demographics and geography in the use of dental services still exist in Taiwan. Such disparity is probably attributable to factors other than financial barriers. Female residents visited dentists more frequently than males; younger people (<24 years) received a very limited number of preventive dental services. Compared with the people living in the least urbanized areas, those from the most urbanized areas exhibited significantly higher rates of preventive and curative dental services; a greater estimated rate ratio was noted for preventive services than for curative services (1.57 vs 1.42). Although nearly every resident of Taiwan visited a dentist for curative care in a year as recommended[17], only 45.58% of people in Taiwan made one dental visit for preventive dental services.

Universal coverage of dental services at a reasonable cost is expected to make impressive strides towards improving welfare coverage and increasing affordability of dental care services. However, factors other than affordability may still account for the demographics and geography disparity in dental utilization under the universal health coverage. A Thai study found that, even with universal coverage, inequality and inequity in oral healthcare utilization still exist. The poor are more likely to access and utilize services at subsidized public facilities, particularly community hospitals, as opposed to the wealthier who tend to utilize services at private facilities[18]. Non-financial factors also include but are not limited to accessibility, distribution of oral health services, oral health knowledge and practices, and prevalence of oral diseases[19]. Inadequate public transport supply in an area may pose adverse influence on the access to dental services[20]. Although NHI's offering universal health coverage to all citizens and proper financial incentives have resulted in equal geographic distributions among the key healthcare providers in Taiwan, the distribution of dentists in Taiwan has remained unequal, with northern parts of Taiwan and urban areas accessing far more dentists than others[21,22]. The limited accessibility to dental services in remote and rural areas may contribute to the urbanization disparity in dental service utilization. Rural areas are often associated with low education levels, which are related to low levels of health literacy and poor use of healthcare services[23]. Not all studies have found associations between oral health literacy and dental utilization[24]; however, many studies have reported that increased oral health literacy is associated with improved oral health status[25]. Lower education level and oral literacy may have also accounted for the urban–rural difference in dental service utilization, especially utilization of preventive dental services, as observed in the present study.

This study noted that children (<15 years) in Taiwan had the least prevalence of preventive dental service utilization but had the highest prevalence of curative dental service. Previous studies found that caregiver education £12 years is associated with fewer preventive dental care visits by their children[26]. Inadequate awareness of the availability and necessity of dental care in early

childhood because of parents' attitude may limit children's receipt of recommended prophylactic visits[27]. Although the exact reasons for inadequate preventive oral care utilization by Taiwanese children are unknown, oral care providers caring for children should play a vital role as advocates of early and regular prophylactic dental visits by children.

The methodological strengths involved in this study included using a sample that is highly representative of the entire Taiwan population. The preventive and curative dental care services were also analysed separately, thereby allowing proper interpretation of the study results. With such a large sample size, the study was able to perform detailed stratified analyses according to age, sex, and geographic area[28].

Conclusions

The data showed an apparent urban–rural disparity in preventive and curative dental service utilization in Taiwan in 2010 after 15 years of the NHI implementation. The NHI program aims to improve affordability of medical care services, including dental services. Men and women of all ages in Taiwan generally made fewer than expected preventive dental visits. In addition, unmet preventive dental care remains one of the most urgent oral healthcare needs among Taiwanese children. Hence, actions aiming to improve oral health outcomes in underserved populations may help reduce oral health inequalities and ameliorate rural–urban disparity; and such actions are necessary within the healthcare workforce and the wide policy environment.

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