



The use of fluoride varnish and its determining factors among children with disability in Taiwan

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ARTICLE INFO

Article history:

Received 30 November 2010

Accepted 14 December 2010

Available online 13 January 2011

Keywords:

Disability

Fluoride varnish

Preventive dental care

Children

Oral health care

ABSTRACT

The oral health of children with disability is often not as good as that of other children. In view of improving their oral health, this study aims to explore the utilization of fluoride varnish services among children with disability in Taiwan and its relevant influencing factors. With children under the age of 5 as subjects, this study is conducted based on the database of Ministry of the Interior, Executive Yuan, ROC in 2008, coupled with information gathered between 2006 and 2008 on preventive health care and health insurance from the Bureau of Health Promotion and the National Health Research Institute, respectively. In addition to descriptive statistics and bivariate analysis, this study examined the factors determining the use of fluoride varnish with logistic regression analysis. Research revealed that fluoride varnish is used by up to 9.84% of children with disability; the use increases with age and decreases with increased level of disability, but is remarkably higher in those with catastrophic illness/injury. The probability of fluoride varnish use is lower among those living in areas of lower urbanization (levels 5–7) and higher among those whose parents have higher premium-based monthly salaries. Recommendations include (1) providing a differential pricing scheme for fluoride varnish based on the level of disability of the child, (2) promoting proactively among dentists to carry out regular fluoride varnish in rural areas and collaboration with pediatricians to provide convenient services and (3) targeting families in low socioeconomic brackets, improving knowledge of fluoride varnish.

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1. Introduction

Due to physical and psychological barriers, patients with disability may be unable to communicate their physical complaints accurately, thus reducing their access to health care. There is also a need for longer consultation times with increased complexity, leading to delay or even neglect of necessary treatments. Such phenomenon also applies to the utilization of preventive health services (Diab & Johnston, 2004; Lin, Yen, & Wu, 2005). Healthy People 2010 has made health promotion among disabled individuals a focus area. Studies in the past have revealed that children with disability are in greater need of treatment and prevention of oral diseases; their oral health is poorer than average school children (Hennequin, Moysan, Jourdan, Dorin, & Nicolas, 2008; Macnab, Romus, Benton, & Gaqnon, 2008). Rodrigues, Masiero, Novo,

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and Simionato (2003) discovered that children with cerebral palsy (CP) have much higher decayed, missing and filled permanent surfaces (DMFS) and dental plaque index compared to children without CP. De Camargo and Antunes (2008) concluded that children with CP show a poorer dental status compared to age and geography-standardized non-CP children, with up to 49.5% of them having had at least one tooth affected by untreated caries. Disparity in dental hygiene status is also seen between children with and without disability (Liu et al., 2010). Therefore, the improvement of oral health has become an important subject in the field of preventive medicine for children with disability.

It is evident that early prevention planning for children leads to significant improvement in oral health, increasing caries-free children from 8% to 32% (Macnab et al., 2008). Rodriguez, Garcillan, Rioboo, and Bratos (2002) also proved that children with disability showed visible reduction of decayed, missing, and filled teeth (DMFT) index following the implementation of an oral health prevention plan. Thus, preventive measures play an important role in the oral health of children with disability. Houtrow, Kim, Chen, and Newacheck (2007) highlighted the differences in preventive health service utilization among children with intellectual and/or developmental disability (IDD) and those without IDD. In spite of the increased susceptibility to oral diseases, Chi, Momany, Kuthy, Chalmers, and Damiano (2010) observed that the rate of preventive dental service utilization is much lower among IDD children compared to non-IDD children. In order to effectively improve the oral health of children with disability, it is necessary to conduct a large-scaled evaluation of the utilization of oral preventive service and its influencing factors.

From the beginning of July 2004, fluoride varnish was made one of the important oral preventive health services provided by the Department of Health in Taiwan. Children under five years old are eligible for the biannual dental examination coupled with fluoride varnish. Fluoride varnish is now globally recognized and approved by dental experts for its prevention against dental caries. According to the statistics as of the end of 2008, the rate of fluoride varnish among Taiwanese children is only 10.36%, indicating that a majority of the children have yet to utilize this service (Department of Health, 2009). Physical and psychological barriers are potential factors affecting disabled children's ability to access fluoride varnish services. However, further studies are required to confirm this. In view of the disparity in the access of oral preventive health services between children with and without disability and the lack of national studies on the utilization of fluoride varnish services, a discussion on the utilization of fluoride varnish services among Taiwanese children with disability and the analysis of relevant determining factors will be conducted in this study.

2. Materials and methods

2.1. Data source and processing

With children under the age of 5 as participants, this study is conducted based on the database of Ministry of the Interior, Executive Yuan, ROC 2008, coupled with information gathered between 2006 and 2008 on preventive health care and health insurance from the Bureau of Health Promotion and the National Health Research Institute, respectively. The variables recorded include: (1) demographic characteristics: gender, age, aboriginal status; (2) health and disability status: catastrophic illness/injury, relevant chronic illnesses (including cancer, endocrine and metabolic diseases, mental disorders, diseases of the nervous system, diseases of the circulatory system, diseases of the respiratory system, diseases of the digestive system, diseases of the genitourinary system, diseases of the musculoskeletal system and connective tissue, disorders of the eye and adnexa, infectious disease, congenital anomalies, diseases of skin and subcutaneous tissue, diseases of blood and blood-forming organs, diseases of the ear and mastoid process); (3) classification of disability: type of disability, severity of disability; (4) the utilization of children's preventive health services; (5) fluoride varnish status: any usage of fluoride varnish, frequency of usage. As parents are pivotal in influencing the children's health care utilization, variables pertaining to their parents were also acquired. This includes gender, age, residence, premium-based monthly salary, and low-income household status.

2.2. Subjects

According to the 'Disability Rights Protection Acts' of Taiwan, disability can be classified into 18 categories, namely visual impairment, hearing impairment, balance impairment, sound or speech impairment, physical disability, mental retardation, major organ malfunction, facial injury, persistent vegetative state, refractory epilepsy, dementia, autism, chromosomal abnormalities, congenital metabolic disorders, other congenital defects, multiple disabilities, chronic mental illness and other disabilities caused by rare diseases recognized by central health authorities. Three categories of disability are deemed less suitable or too small in sample size and thus are excluded from this study: persistent vegetative state (18 individuals), dementia (1 individual), and chronic mental illness (4 individuals), all of whom have not utilized the fluoride varnish. Severity of disability is classified into 4 groups: very severe, severe, moderate, and mild. Table 1 provides an example of the selection criteria. A total of 7604 children (<5 years old) with disability have been identified to have met the requirement for fluoride varnish services.

2.3. Statistical analysis

All data were analyzed with the SAS version 8.2. This study firstly involves a descriptive analysis of the identified variables. Frequency of fluoride varnish use and the differences in their percentage of each variable will be examined using *t*-

Table 1
Study subjects finding criteria.

Age	Birth date	Observed period for using fluoride varnish
0–1 years	2008/01/01	2008/01/01 to 2008/12/31
	2007/12/31	2007/12/31 to 2008/12/30
	⋮	⋮
1–2 years	2007/01/02	2007/01/02 to 2008/01/01
	2007/01/01	2008/01/01 to 2008/12/31
	2006/12/31	2007/12/31 to 2008/12/30
2–3 years	⋮	⋮
	2006/01/02	2007/01/02 to 2008/01/01
	2006/01/01	2008/01/01 to 2008/12/31
3–4 years	2005/12/31	2007/12/31 to 2008/12/30
	⋮	⋮
	2005/01/02	2007/01/02 to 2008/01/01
4–5 years	2005/01/01	2008/01/01 to 2008/12/31
	2004/12/31	2007/12/31 to 2008/12/30
	⋮	⋮
4–5 years	2004/01/02	2007/01/02 to 2008/01/01
	2004/01/01	2008/01/01 to 2008/12/31
	2003/12/31	2007/12/31 to 2008/12/30
4–5 years	⋮	⋮
	2003/01/02	2007/01/02 to 2008/01/01

test, one-way ANOVA, and χ^2 test to check for statistical significance. Lastly, logistic regression analysis is used to examine influencing factors on the usage of fluoride varnish.

3. Results

Males made up 63.77% of the sample. The children aged between 4 and 5 years old constitute the largest group (33.5%). 1.54% of the sample are aborigines and 64.74% of the sample do not have any catastrophic illness/injury. In terms of the classification of disability, intellectual disability made up the largest group (19.41%) followed by multiple disabilities (19.17%), and a majority of the sample suffered from mild disability (36.03%). 85.01% of the sample have utilized preventive health services in the past. A majority of the children's parents are aged between 31 and 40 years old. Individuals living in areas of level 2 urbanization form the largest group (25.62%). The parents with premium-based monthly salary of NT\$16,500–22,800 form the largest group (40.33%). 4.41% of the children's parents belong to low-income household (Table 2).

The percentage of children with disability who utilized fluoride varnish is 9.84%, slightly below the national average of 10.36%. The use of fluoride varnish is the highest among children aged between 4 and 5 years (12.79%) and the percentage of use increases with age. The percentage of use among those with catastrophic illnesses is 11.3%, significantly higher than those without catastrophic illnesses (8.87%). Among the sufferers of relevant chronic illnesses, children with diseases of the musculoskeletal system and connective tissue exhibit the highest usage (13.61%). Among the different categories of impairment, children with facial injuries have the highest usage (17.31%) while visual impairment is only 5.73%. Those with mild disability show a greater usage (12.88%) compared to other levels of disability; a direct relationship between the increase of severity and the decrease in usage is seen. 10.19% of those who had children preventive health services in the past have use of fluoride varnish while those without children preventive health services have only 7.81%. Among the parents, children of insured females show a greater usage compared to their male counterparts. The use of fluoride varnish is higher in children whose parents are aged 31–40 years (11.33%) compared to other age groups. Also, the use of fluoride varnish is the highest in those residing in areas graded level 1 of urbanization (11.86%). When categorized according to their parents' premium-based salary, those with premium-based monthly salary of NT\$76,500–87,600 show the greatest utilization (16.78%) (Table 2).

In terms of the frequency of use of fluoride varnish, disabled children aged 3–5 years is significantly higher than other age groups ($p < 0.05$), showing positive correlation between age and frequency of use. The average frequency of use among individuals with catastrophic illness (0.12) is significantly higher than those without ($p < 0.05$). The use of fluoride varnish is higher among sufferers of mental disorders, respiratory system diseases, musculoskeletal and connective tissue diseases as well as diseases of the ear and mastoid process. The average usage of those with mild disability (0.14) is significantly higher than other severities ($p < 0.05$). Past users of the children preventive health service show higher frequency of fluoride varnish use (0.11). Utilization is significantly higher ($p < 0.05$) among children whose parents are aged 31–40 years (0.12). Residents in areas of level 1 urbanization have a significantly greater usage frequency (0.13) than residents of levels 5–7

Table 2

Chi-square analysis of the use of fluoride varnish in children with disability during 2007–2008.

Variables	N = 7604	%	Used fluoride varnish		Did not use fluoride varnish		χ^2 p-Value
			n ₁ = 748	%	n ₂ = 6856	%	
Gender							0.969
Female	2831	37.23	278	9.82	2553	90.18	
Male	4773	62.77	470	9.85	4303	90.15	
Age							<0.001 [*]
<1 years	527	6.93	1	0.19	526	99.81	
1–2 years	923	12.14	43	4.66	880	95.34	
2–3 years	1487	19.56	128	8.61	1359	91.39	
3–4 years	2040	26.83	240	11.76	1800	88.24	
4–5 years	2627	34.55	336	12.79	2291	87.21	
Aboriginal status							0.218
Aboriginal	110	1.45	7	6.36	103	93.64	
Non-aboriginal	7494	98.55	741	9.89	6753	90.11	
Catastrophic illness/injury							0.001 [*]
Yes	2833	37.26	320	11.30	2513	88.70	
No	4771	62.74	428	8.97	4343	91.03	
Relevant chronic illnesses							
Cancer							0.268
Yes	42	0.55	2	4.76	40	95.24	
No	7562	99.45	746	9.87	6816	90.13	
Endocrine and metabolic disorder							0.280
Yes	556	7.31	62	11.15	494	88.85	
No	7048	92.69	686	9.73	6362	90.27	
Mental disorder							<0.001 [*]
Yes	3669	48.25	414	11.28	3255	88.72	
No	3935	51.75	334	8.49	3601	91.51	
Diseases of the nervous system							0.181
Yes	2069	27.21	219	10.58	1850	89.42	
No	5535	72.79	529	9.56	5006	90.44	
Diseases of the circulatory system							0.976
Yes	486	6.39	48	9.88	438	90.12	
No	7118	93.61	700	9.83	6418	90.17	
Diseases of the respiratory system							0.001 [*]
Yes	2359	31.02	273	11.57	2086	88.43	
No	5245	68.98	475	9.06	4770	90.94	
Diseases of the digestive system							0.180
Yes	2029	26.68	215	10.60	1814	89.40	
No	5575	73.32	533	9.56	5042	90.44	
Diseases of the genitourinary system							0.844
Yes	86	1.13	9	10.47	77	89.53	
No	7518	98.87	739	9.83	6779	90.17	
Diseases of the musculoskeletal system and connective tissue							0.009 [*]
Yes	404	5.31	55	13.61	349	86.39	
No	7200	94.69	693	9.63	6507	90.38	
Disorders of the eye and adnexa							0.467
Yes	511	6.72	55	10.76	456	89.24	
No	7093	93.28	693	9.77	6400	90.23	
Infectious disease							0.131
Yes	68	0.89	3	4.41	65	95.59	
No	7536	99.11	745	9.89	6791	90.11	
Congenital anomalies							0.575
Yes	2898	38.11	278	9.59	2620	90.41	
No	4706	61.89	470	9.99	4236	90.01	
Diseases of skin and subcutaneous tissue							0.920
Yes	1423	18.71	141	9.91	1282	90.09	
No	6181	81.29	607	9.82	5574	90.18	
Diseases of blood and blood-forming organs							0.853
Yes	356	4.68	34	9.55	322	90.45	
No	7248	95.32	714	9.85	6534	90.15	
Diseases of the ear and mastoid process							0.008 [*]
Yes	703	9.25	89	12.66	614	87.34	
No	6901	90.75	659	9.55	6242	90.45	
Type of disability							0.046 [*]
Mental retardation	1476	19.41	140	9.49	1336	90.51	
Multiple disabilities	1458	19.17	124	8.50	1334	91.50	

Table 2 (Continued)

Variables	N = 7604	%	Used fluoride varnish		Did not use fluoride varnish		χ^2 p-Value
			$n_1 = 748$	%	$n_2 = 6856$	%	
Physical disability	1135	14.93	112	9.87	1023	90.13	
Autism	1023	13.45	122	11.93	901	88.07	
Hearing impairment	582	7.65	54	9.28	528	90.72	
Major organ malfunction	556	7.31	55	9.89	501	90.11	
Sound or speech impairment	473	6.22	60	12.68	413	87.32	
Chromosomal abnormalities	342	4.50	27	7.89	315	92.11	
Rare diseases	218	2.87	17	7.80	201	92.20	
Visual impairment	122	1.60	7	5.74	115	94.26	
Congenital defects	74	0.97	8	10.81	66	89.19	
Facial injury	52	0.68	9	17.31	43	82.69	
Refractory epilepsy	41	0.54	6	14.63	35	85.37	
Others	52	0.68	7	13.46	45	86.54	
Severity of disability							<0.001*
Mild	2740	36.03	353	12.88	2387	87.12	
Moderate	2578	33.90	248	9.62	2330	90.38	
Severe	1643	21.61	113	6.88	1530	93.12	
Very severe	643	8.46	34	5.29	609	94.71	
Utilization of children's preventive health services							0.013*
Yes	6464	85.01	659	10.19	5805	89.81	
No	1140	14.99	89	7.81	1051	92.19	
Parents' characteristics							
Sex							0.010*
Female	3022	39.74	330	10.92	2692	89.08	
Male	4582	60.26	418	9.12	4164	90.88	
Age							<0.001*
≤30 years	2059	27.08	147	7.14	1912	92.86	
31–40 years	4271	56.17	484	11.33	3787	88.67	
≥41 years	1274	16.75	117	9.18	1157	90.82	
Urbanization level							<0.001*
Level 1	995	13.09	118	11.86	877	88.14	
Level 2	1948	25.62	224	11.50	1724	88.50	
Level 3	1346	17.70	148	11.00	1198	89.00	
Level 4	706	9.28	67	9.49	639	90.51	
Level 5	1032	13.57	81	7.85	951	92.15	
Level 6	673	8.85	44	6.54	629	93.46	
Level 7	636	8.36	44	6.92	592	93.08	
Level 8	268	3.52	22	8.21	246	91.79	
Premium-based monthly salary (NT\$)							<0.001*
<15,840	1595	20.98	109	6.83	1486	93.17	
16,500–22,800	3067	40.33	300	9.78	2767	90.22	
24,000–28,800	617	8.11	58	9.40	559	90.60	
30,300–36,300	664	8.73	68	10.24	596	89.76	
38,200–45,800	734	9.65	91	12.40	643	87.60	
48,200–57,800	551	7.25	69	12.52	482	87.48	
60,800–72,800	227	2.99	28	12.33	199	87.67	
76,500–87,600	149	1.96	25	16.78	124	83.22	
Low-income household							0.062
Yes	335	4.41	23	6.87	312	93.13	
No	7269	95.59	725	9.97	6544	90.03	

* $p < 0.05$.

($p < 0.05$). The average frequency of use among those who have the premium-based monthly salary of NT\$76,500–87,600 is as high as 0.17 (Table 3).

In Table 4, logistic regression analysis reveals that usage probability increases with age that the disabled children below the age of 3 have a much reduced probability of using fluoride varnish compared to those aged 4–5 years after controlling for other variables. The probability of fluoride varnish usage among children with catastrophic illness/injury is 1.31 times more than that of those without catastrophic illness/injury (95% CI: 1.07–1.60). There is no significant difference in usage probability among the different categories of disability and relevant chronic illnesses ($p > 0.05$). However, differences are seen among the different severities, in which the 'very severe' group has the lowest usage probability (OR = 0.26; 95% CI: 0.17–0.41). The probability of usage among children of parents aged 31–40 years is 1.30 times more than that of parents aged below 30 years. Children residing in urbanization areas level 6 and 7 show a much lower usage probability compared to children residing in area level 1. Furthermore, those with premium-based monthly salary of NT\$76,500–87,600 have the

Table 3

Descriptive analysis of the use of fluoride varnish in children with disability during 2007–2008.

Variables	N	Mean	SD	p-Value (t-test or F-test)
Gender				0.961
Female	2831	0.11	0.34	
Male	4773	0.11	0.33	
Age				<0.001 [†]
<1 years	527	0.00	0.04	
1–2 years	923	0.05	0.23	
2–3 years	1487	0.09	0.31	
3–4 years	2040	0.13	0.37	
4–5 years	2627	0.14	0.38	
Aboriginal status				0.067
Aboriginal	110	0.06	0.25	
Non-aboriginal	7494	0.11	0.34	
Catastrophic illness/injury				0.001 [†]
Yes	2833	0.12	0.36	
No	4771	0.10	0.32	
Relevant chronic illnesses				
Cancer				0.083
Yes	42	0.05	0.22	
No	7562	0.11	0.34	
Endocrine and metabolic disorder				0.244
Yes	556	0.12	0.37	
No	7048	0.11	0.33	
Mental disorder				0.001 [†]
Yes	3669	0.12	0.35	
No	3935	0.09	0.31	
Diseases of the nervous system				0.315
Yes	2069	0.11	0.34	
No	5535	0.10	0.33	
Diseases of the circulatory system				0.989
Yes	486	0.11	0.34	
No	7118	0.11	0.34	
Diseases of the respiratory system				0.005 [†]
Yes	2359	0.12	0.35	
No	5245	0.10	0.33	
Diseases of the digestive system				0.381
Yes	2029	0.11	0.34	
No	5575	0.10	0.33	
Diseases of the genitourinary system				0.953
Yes	86	0.10	0.31	
No	7518	0.11	0.34	
Diseases of the musculoskeletal system and connective tissue				0.011 [†]
Yes	404	0.16	0.42	
No	7200	0.10	0.33	
Disorders of the eye and adnexa				0.639
Yes	511	0.11	0.34	
No	7093	0.11	0.33	
Infectious disease				0.236
Yes	68	0.06	0.29	
No	7536	0.11	0.34	
Congenital anomalies				0.551
Yes	2898	0.10	0.33	
No	4706	0.11	0.34	
Diseases of skin and subcutaneous tissue				0.723
Yes	1423	0.11	0.34	
No	6181	0.11	0.33	
Diseases of blood and blood-forming organs				0.596
Yes	356	0.10	0.31	
No	7248	0.11	0.34	
Diseases of the ear and mastoid process				0.037 [†]
Yes	703	0.13	0.36	
No	6901	0.10	0.33	
Type of disability				0.026 [†]
Mental retardation	1476	0.10	0.33	
Multiple disabilities	1458	0.09	0.31	
Physical disability	1135	0.11	0.34	
Autism	1023	0.13	0.36	
Hearing impairment	582	0.10	0.31	
Major organ malfunction	556	0.11	0.35	
Sound or speech impairment	473	0.14	0.39	
Chromosomal abnormalities	342	0.08	0.30	

Table 3 (Continued)

Variables	N	Mean	SD	p-Value (t-test or F-test)
Rare diseases	218	0.09	0.31	
Visual impairment	122	0.06	0.23	
Congenital defects	74	0.11	0.31	
Facial injury	52	0.21	0.50	
Refractory epilepsy	41	0.15	0.36	
Others	52	0.13	0.34	
Severity of disability				<0.001*
Mild	2740	0.14	0.39	
Moderate	2578	0.10	0.32	
Severe	1643	0.07	0.27	
Very severe	643	0.06	0.25	
Utilization of children's preventive health services				0.005*
Yes	6464	0.11	0.34	
No	1140	0.08	0.29	
Parents' characteristics				
Sex				0.007*
Female	3022	0.12	0.36	
Male	4582	0.10	0.32	
Age				<0.001*
≤30 years	2059	0.08	0.29	
31–40 years	4271	0.12	0.36	
≥41 years	1274	0.10	0.32	
Urbanization level				<0.001*
Level 1	995	0.13	0.38	
Level 2	1948	0.12	0.35	
Level 3	1346	0.12	0.37	
Level 4	706	0.10	0.30	
Level 5	1032	0.09	0.30	
Level 6	673	0.07	0.28	
Level 7	636	0.07	0.27	
Level 8	268	0.08	0.28	
Premium-based monthly salary (NT\$)				<0.001*
<15,840	1595	0.07	0.28	
16,500–22,800	3067	0.11	0.33	
24,000–28,800	617	0.10	0.34	
30,300–36,300	664	0.11	0.32	
38,200–45,800	734	0.14	0.39	
48,200–57,800	551	0.14	0.37	
60,800–72,800	227	0.14	0.40	
76,500–87,600	149	0.17	0.40	
Low-income household				0.016*
Yes	335	0.07	0.27	
No	7269	0.11	0.34	

* $p < 0.05$.

highest usage probability, with up to 2.34 fold of those with monthly salary of NT\$<15,840, proving a high degree of correlation between parental income and fluoride varnish usage in children with disability.

4. Discussion

Levy, Broffitt, Slayton, Warren, and Kanellis (2003) and Slayton, Warren, Levy, Kanellis, and Islam (2002) stated that younger children exhibit relatively lower overall fluoride applications. This study discovered that both the usage probability and frequency of fluoride varnish among the disabled children of younger age groups (<3 years) is much lower than children older than 4 years old. Likewise, Chi et al. (2010) discovered that children's preventive dental service utilization increases with age in the United States, and it is utilized by less than 10% of children below the age of 1, followed by about 10% of children aged 1–2 and up to 37.8% of those aged 3–7 years. However, this study revealed that such service is utilized by 0.19%, 4.66% and 12.79%, respectively, showing much lower usage in all 3 corresponding age groups. Despite fluoride varnish being the main preventive dental measure promoted by the Department of Health, the utilization of such services remains low among children with disability of all age groups. Furthermore, it is discovered that children with catastrophic illnesses/injuries tend to show greater usage probability. Since the utilization of fluoride varnish is ultimately dependent on the parents, this indicates that preventive oral health is greatly emphasized among parents whose children have significant illnesses.

It is established in this study that having chronic illnesses and the category of disability are not important factors influencing the use of fluoride varnish among children. Though children with disability have a greater and more diverse health care need compared to children without disability (Jeng, Wang, Cher, Lin, & Jeng, 2009), these factors do not

Table 4

Logistic regression models for the use of fluoride varnish in children with disability during 2007–2008^a.

Variables	Unadjusted OR	95% CI	p-Value	Adjusted OR	95% CI	p-Value
Gender						
Female	–	–	–	–	–	–
Male	1.00	0.86 1.17	0.969	0.95	0.80 1.12	0.502
Age						
4–5 years	–	–	–	–	–	–
3–4 years	0.91	0.76 1.09	0.291	0.92	0.77 1.11	0.402
2–3 years	0.64	0.52 0.80	<0.001 [†]	0.66	0.52 0.83	0.000 [†]
1–2 years	0.33	0.24 0.46	<0.001 [†]	0.35	0.24 0.49	<0.001 [†]
<1 years	0.01	0.00 0.09	<0.001 [†]	0.02	0.00 0.11	<0.001 [†]
Aboriginal status						
Aboriginal	–	–	–	–	–	–
Non-aboriginal	0.62	0.29 1.34	0.222	0.77	0.35 1.70	0.516
Catastrophic illness/injury						
No	–	–	–	–	–	–
Yes	1.29	1.11 1.51	0.001 [†]	1.31	1.07 1.60	0.010 [†]
Relevant chronic illnesses						
Cancer	0.46	0.11 1.89	0.280	0.39	0.09 1.69	0.210
Endocrine and metabolic disorder	1.16	0.88 1.53	0.280	1.14	0.85 1.53	0.374
Mental disorder	1.37	1.18 1.60	<0.001 [†]	1.09	0.91 1.30	0.355
Diseases of the nervous system	1.12	0.95 1.32	0.181	1.22	0.98 1.52	0.076
Diseases of the circulatory system	1.01	0.74 1.37	0.976	1.00	0.72 1.39	0.997
Diseases of the respiratory system	1.31	1.12 1.54	0.001 [†]	1.06	0.89 1.26	0.541
Diseases of the digestive system	1.12	0.95 1.33	0.180	1.03	0.86 1.24	0.729
Diseases of the genitourinary system	1.07	0.54 2.15	0.844	1.00	0.49 2.05	1.000
Diseases of the musculoskeletal system and connective tissue	1.48	1.10 1.99	0.009 [†]	1.22	0.89 1.66	0.219
Disorders of the eye and adnexa	1.11	0.83 1.49	0.467	1.05	0.77 1.44	0.747
Infectious disease	0.42	0.13 1.34	0.144	0.41	0.13 1.34	0.142
Congenital anomalies	0.96	0.82 1.12	0.575	1.00	0.82 1.21	0.963
Diseases of skin and subcutaneous tissue	1.01	0.83 1.23	0.920	0.90	0.73 1.11	0.317
Diseases of blood and blood-forming organs	0.97	0.67 1.39	0.854	1.00	0.69 1.47	0.987
Diseases of the ear and mastoid process	1.37	1.08 1.74	0.009 [†]	1.12	0.87 1.44	0.402
Type of disability						
Physical disability	–	–	–	–	–	–
Visual impairment	0.56	0.25 1.22	0.144	0.68	0.30 1.56	0.363
Hearing impairment	0.93	0.66 1.31	0.696	1.21	0.82 1.78	0.336
Sound or speech impairment	1.33	0.95 1.85	0.097	1.01	0.70 1.45	0.966
Mental retardation	0.96	0.74 1.24	0.743	0.79	0.58 1.06	0.120
Multiple disabilities	0.85	0.65 1.11	0.232	1.05	0.77 1.43	0.743
Major organ malfunction	1.00	0.71 1.41	0.988	1.13	0.76 1.70	0.550
Facial injury	1.91	0.91 4.03	0.088	1.19	0.54 2.60	0.672
Autism	1.24	0.94 1.62	0.125	0.83	0.60 1.16	0.278
Chromosomal abnormalities	0.78	0.51 1.21	0.274	1.03	0.63 1.69	0.900
Congenital defects	1.11	0.52 2.37	0.793	1.30	0.58 2.88	0.524
Refractory epilepsy	1.57	0.64 3.80	0.322	0.89	0.35 2.24	0.800
Rare diseases	0.77	0.45 1.32	0.342	0.83	0.47 1.47	0.516
Others	1.42	0.63 3.23	0.401	1.34	0.56 3.19	0.515
Severity of disability						
Mild	–	–	–	–	–	–
Moderate	0.72	0.61 0.86	0.000 [†]	0.68	0.56 0.82	<0.001 [†]
Severe	0.50	0.40 0.62	<0.001 [†]	0.44	0.34 0.58	<0.001 [†]
Very severe	0.38	0.26 0.54	<0.001 [†]	0.26	0.17 0.41	<0.001 [†]
Utilization of children's preventive health services						
No	–	–	–	–	–	–
Yes	1.34	1.06 1.69	0.013 [†]	0.97	0.76 1.24	0.815
Parents' characteristics						
Sex						
Female	–	–	–	–	–	–
Male	0.82	0.70 0.95	0.010 [†]	0.81	0.69 0.96	0.012 [†]
Age						
≤30 years	–	–	–	–	–	–
31–40 years	1.66	1.37 2.02	<0.001 [†]	1.30	1.04 1.62	0.019 [†]
≥41 years	1.32	1.02 1.70	0.034 [†]	1.02	0.77 1.35	0.919
Urbanization level						
Level 1	–	–	–	–	–	–
Level 2	0.97	0.76 1.22	0.773	1.05	0.82 1.36	0.684
Level 3	0.92	0.71 1.19	0.515	0.98	0.75 1.29	0.890
Level 4	0.78	0.57 1.07	0.123	0.89	0.64 1.24	0.489
Level 5	0.63	0.47 0.85	0.003 [†]	0.73	0.53 1.00	0.053

Table 4 (Continued)

Variables	Unadjusted OR	95% CI		p-Value	Adjusted OR	95% CI		p-Value
Level 6	0.52	0.36	0.75	0.000 [*]	0.57	0.39	0.83	0.003 [†]
Level 7	0.55	0.39	0.79	0.001 [*]	0.65	0.44	0.95	0.027 [†]
Level 8	0.67	0.41	1.07	0.093	0.85	0.52	1.41	0.534
Premium-based monthly salary (NT\$)								
<15,840	–	–	–	–	–	–	–	–
16,500–22,800	1.48	1.18	1.86	0.001 [*]	1.36	1.05	1.76	0.019 [†]
24,000–28,800	1.42	1.01	1.97	0.041 [*]	1.38	0.96	1.97	0.080
30,300–36,300	1.56	1.13	2.14	0.006 [*]	1.43	1.01	2.02	0.043 [†]
38,200–45,800	1.93	1.44	2.59	<0.001 [*]	1.75	1.26	2.42	0.001 [†]
48,200–57,800	1.95	1.42	2.68	<0.001 [*]	1.60	1.12	2.27	0.009 [†]
60,800–72,800	1.92	1.23	2.98	0.004 [*]	1.70	1.06	2.72	0.028 [†]
76,500–87,600	2.75	1.72	4.41	<0.001 [*]	2.34	1.41	3.88	0.001 [†]
Low-income household								
No	–	–	–	–	–	–	–	–
Yes	0.67	0.43	1.02	0.064	1.01	0.61	1.67	0.978

^a N = 7622.

^{*} p < 0.05.

significantly affect the use of fluoride varnish. Nevertheless, the severity of disability is an important factor; the usage of fluoride varnish tends to decrease with increasing severity. Such findings are consistent with the study by Diab and Johnston (2004) among American children with disability. This is believed to be attributable to their health status and medical needs, leading to challenges in accessing preventive health services. General health is poorer with increasing severity of disability and the need for therapeutic medical care is often prolonged and demanding. Ongoing medical care mainly revolves around the maintenance or recovery of basic daily function, thus lacking the urgency for non-emergency and preventive health services like fluoride varnish. Such phenomenon is accentuated with increasing level of severity of disability. Also, greater obstacles/challenges are faced by children with greater levels of disability (Diab & Johnston, 2004), discouraging their willingness to use fluoride varnish. Since severe disability decreases the probability of fluoride varnish usage, it would lead to further deterioration of oral health among these children, whose general health is known to be poorer to begin with. Therefore, the planning and implementation of oral health policies should be focused on the improvement of fluoride varnish usage among children with disability of higher severity. In order to increase the dentists' willingness and time spent on oral health of people with severe disability, global budgeting payment was employed to promote oral health for those with 'severe' and 'very severe' disability in Taiwan, thus increasing payments and encouraging treatment and care for the disabled people's oral health problems (Tsai, Kung, Chiang, & Chang, 2007). Hence, a similar financial incentive could be implemented to equally emphasize preventive dental health. By increasing the subsidy of care for children with disability, the utilization of preventive health services would also increase.

In terms of parental characteristics, gender differences do not seem to affect fluoride varnish usage. However, it is noted that a majority of the parents are aged between 30 and 40 years. Similar to this study, Lin, Lin, Yen, Wu, and Chwo (2004) gathered that the average age of primary carers of preschool children with disabilities is 36.3 years. Apart from seeing a significantly higher fluoride varnish usage among children with parents aged 31–40 years, children residing in less urbanized areas (levels 6–7) tend to have a lower usage. Chi et al. (2010) observed that children living in urban or rural counties were significantly less likely to have had a preventive dental visit than those living in metropolitan areas. This is likely to be associated with poorer access to preventive dental care in rural areas. The level of premium-based salary is indicative of the household income. Fluoride varnish usage is significantly higher among those having higher premium-based salary. Kenney, Kogan, and Crall (2008) confirmed that children's utilization of preventive dental care varies with household income. Household financial and socioeconomic status is closely associated with the health and development of children with disability. Families of good financial and socioeconomic status tend to place more emphasis on preventive health, showing greater ability in ensuring the health of disabled children (Inkelas, Raghavan, Kandyce, Kuo, & Ortega, 2007; Lin et al., 2004). In contrast, the usage of fluoride varnish among the children of low socioeconomic groups has much room for improvement. Time and physical constraints are commonly cited by primary carers to affect the effective usage of preventive health services. Adequate knowledge and correct concepts among primary carers are believed to have a positive impact on the children's health and development (Hudson, Matthews, Gavidia-Payne, Cameron, & Mildon, 2003). Since education often correlates with socioeconomic status, parents of lower socioeconomic groups may have inadequate knowledge on preventive health, leading to limited use of fluoride varnish. Parental characteristics play a large role in the utilization of fluoride varnish. Thus, health policy-makers should consider formulating effective parental support measures.

5. Conclusions

In order to improve the utilization of fluoride varnish, parents of children with disability aged under 3 years old should be targeted. Due to the differences in costs (in terms of time, labor and financial costs) for different levels of disability needed to help children with disability access health care and treatment, it is recommended that a differential subsidy should be set for

different levels of disability severity. This would improve the acceptance of children with disability to undergo fluoride varnish. The usage of fluoride varnish among children with disability is also lower if parents reside in less urbanized areas. Besides actively promoting the use of fluoride varnish among children specifically to less urbanized areas or rural areas, relevant incentives should be given. In addition to encouraging dentists to establish dental clinics, the dental associations should actively render coordination to regular dental care and fluoride varnish services in rural areas. Children whose parents have the highest premium-based salary show a much greater usage probability compared to those of low socioeconomic background. Though fluoride varnish services are available free of charge, there is a further need for health authorities to identify families of low socioeconomic groups to improve knowledge of fluoride varnish and to strengthen the concept of preventative oral health. In targeting families of lower socioeconomic background, having medical staff regularly visits homes and communities to provide fluoride varnish services could be considered.

With regards to funding, children with disability are often in need of pediatric care besides needing visitation by medical personnel and fluoride varnish (Lewis, Grossman, Domoto, & Deyo, 2000). Collaboration between dentists and pediatricians should be encouraged. Besides providing education pertaining to preventive oral health and explaining the importance of fluoride varnish during pediatric outpatient visits, pediatric staff should be active in requesting, reminding and arranging for fluoride varnish. Regular follow-ups to check on children's oral health status and active referrals to fluoride varnish services are also recommended. Lastly, in addition to implementing accessible space planning in clinics, other active services can be included to bring about greater convenience to parents. For instance, free transportation and consultation priority could be given to children with disability, relieving the parents of this burden and lost time.

Acknowledgements

This study was supported by Bureau of Health Promotion, Department of Health (grant No.9805006A) and Department of Health Clinical Trial and Research Center for Excellence (DOH99-TD-B-111-004) and China Medical University and Asia University (grant No.CMU97-325), based on data from the National Health Insurance Research Database provided by National Health Research Institute. The preventive health care files were provided by Bureau of Health Promotion, the disabled persons file provided by Ministry of the Interior in Taiwan. The interpretations and conclusions contained herein do not represent those of the Bureau of Health Promotion, National Health Research Institutes or Ministry of the Interior in Taiwan.

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