



Original Article

# Improvement in oral hygiene among bedridden patients following domiciliary dental care: A retrospective study



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## KEYWORDS

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**Abstract** *Background/purpose:* Domiciliary dental care (DDC) offers dental services in the comfort of a patient's home, typically for bed-bound patients. Poor oral hygiene in this group has been associated with pneumonia. Although DDC reduces the risk of pneumonia, its impact on oral hygiene has not been explored yet. Therefore, this retrospective study aimed to investigate the effectiveness of DDC in improving oral health in bedridden patients.

*Materials and methods:* We retrospectively reviewed individuals who received dental services and evaluated their oral hygiene status using the plaque index (PI). Demographic data (age, sex, cause of bedridden state) and oral findings (DMFT, number of residual roots, and remaining teeth) were also analyzed.

*Results:* In this study, a total of 61 patients were evaluated. Their mean PI improved significantly from 2.02 to 1.73 after receiving DDC. When subjects were stratified according to their baseline median PI (2.1), the high baseline PI group exhibited a greater improvement in PI, reaching levels comparable to those of the low baseline group. Multiple regression analysis identified that a higher baseline PI and a younger age (<43 years) predicted a greater improvement in PI, explaining 34.37 % of the variance. Distribution analysis revealed a higher likelihood of lower PI after intervention, with the low-to-high PI ratio improving from 1:1 to 23:4.

*Conclusion:* Overall, these findings demonstrated that patients significantly improved their PI and oral hygiene after DDC interventions. We anticipate that more dental schools, clinics, and hospitals will soon adopt DDC, increasing accessibility to dental care for bedridden patients.

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## Introduction

Taiwan officially became a super-aged society in 2025, with over 20 % of the population 65 years or above.<sup>1</sup> Along with the rapidly aging population, the number of bedridden older individuals has also increased, posing serious challenges for the healthcare system. These include the rapid demand for long-term care services for disabled people.<sup>2–5</sup> In many care-dependent elders, their oral hygiene and status have been reported to be poor, many of them suffer from gingival bleeding, root caries, and periodontitis.<sup>6–11</sup> This demographic is more prone to these oral diseases for several reasons, including having more complex health problems that predispose them to oral pathologies, a lack of access to dental clinics, and an inability to maintain proper oral hygiene.<sup>12</sup>

To address this issue, Taiwan's government incorporated domiciliary dental care (DDC) into its National Health Insurance (NHI) program in 2011.<sup>13</sup> DDC includes regular check-ups, scaling, filling, extractions, and other essential treatments administered to patients in domiciliary care. These services are generally provided by dentists trained to provide DDC. Under the NHI program, patients meeting the following three requirements can seek domiciliary healthcare services. The requirements include: (1) inability to self-care (the patient is in a chair or bed-bound more than 50 % of his waking time); (2) specific medical or nursing care needs; and (3) chronic disorders that need long-term nursing care or ongoing nursing care needs after hospital discharge.

Poor oral hygiene and oral diseases such as periodontitis have been associated with pneumonia, a highly prevalent and serious complication among bedridden patients. Pneumonia accounts for 13–48 % of infections in the nursing home setting, with a mortality rate of up to 55 %.<sup>14,15</sup> Poor oral hygiene was thought to be aspiration of oral pathogens or oropharyngeal flora, resulting in lower respiratory tract

colonization.<sup>16,17</sup> Various studies have shown DDC's role in preventing pneumonia in many nursing home settings and medical centers.<sup>15,18–23</sup> However, whether improving oral hygiene could be achieved in bedridden patients with DDC has not been studied. Therefore, we performed a retrospective analysis to assess whether DDC improved plaque index (PI) among bedridden patients.

## Materials and methods

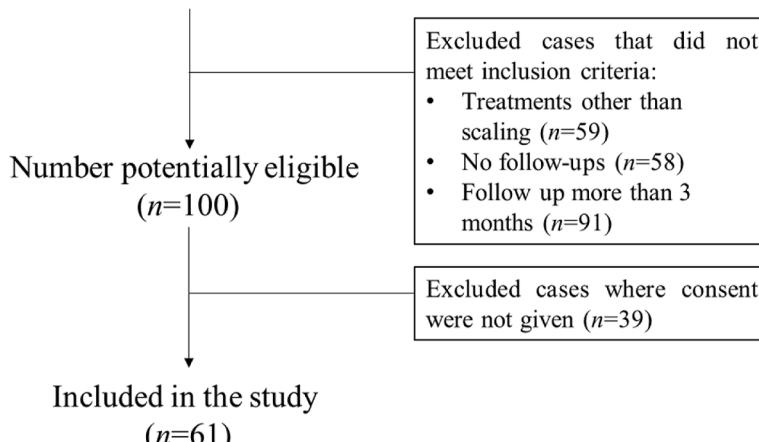
This study was approved by the Institutional Review Board of Chung Shan Medical University Hospital (approval number CS18218).

The medical records of the patients who received DDC from March 1, 2010, to November 30, 2018, were reviewed. Only patients who received scaling and had two recorded PI scores within a 3-month interval were included. Patient selection criteria encompassed nursing home residents who were primarily bedridden, spent more than 50 % of their waking time either in a chair or in bed, and had their plaque index (PI) documented in two visits. The study flow chart is shown in Fig. 1.

We adopted the PI system that was proposed by Silness and Löe in 1964 and the decayed, missing, and filled teeth (DMFT) index.<sup>24</sup> All assessments were conducted by Dr. Chuan-Hang Yu, an experienced clinician in special needs dentistry.

The study variables were tested for normal distribution using the Shapiro–Wilk test. PI, the improvements in PI, and age showed normal distribution, while others showed non-normally distributed data. Chi-square was used to determine the association between categorical variables, while Fisher's exact test was used for cells that were expected to count less than 5. Intergroup comparisons of means in each parametric and nonparametric parameter were performed using two-sample t-tests and the Wilcoxon rank sum test, respectively. Intragroup comparisons of the

From Chung Shan Medical University (CSMU) internal patient database  
between 2010 and 2018,  
number of patients receiving domiciliary dental care (DDC) from CSMU  
(n=308 patients)



**Figure 1** The diagram illustrates the retrospective cohort study design and study flow chart.

mean in PI were made using the paired t-test. The correlations between the variables at the beginning of the study were calculated using the Spearman correlation coefficient. Multiple regression analysis determined the independent variables influencing PI improvement and their coefficient. McNemar's test was used to compare the association of intervention with the state of PI among the population. Statistical significance was established at  $< 0.05$  for all tests. Data were analyzed using JMP Pro 16.

## Results

**Table 1** shows the demographic and oral findings of the study subjects. 61 patients (41 men and 20 women) were included in this retrospective study. All of them were in a bedridden state and on feeding tubes. Most of them were bedridden due to accidents (39.34 %), followed by cardiovascular disease (18.03 %) and cerebrovascular disease (13.11 %). Other reasons included congenital diseases, shock, cerebral palsy, cancer, etc. The mean age was  $43.21 \pm 13.27$  years old. Regarding their oral findings, DMFT, along with each component, the number of residual roots (RR), and the number of remaining teeth (excluding RR) had a wide range. When the samples were divided by their median baseline PI, 2.1, the difference in their DMFT was significant, while the other parameters were insignificant.

The DMFT value and the number of missing teeth were mildly inversely correlated with the PI at baseline (**Table 2**). However, other components of DMFT, such as the number of decayed and filled teeth and the number of residual roots and remaining teeth, did not have a significant correlation with the baseline PI.

The initial mean PI among subjects was 2.03, exhibiting a notable reduction to 1.73 after intervention (**Table 3**). When categorizing subjects into groups based on whether their baseline PI was below or above the median, it was observed that both groups experienced a reduction in PI after the intervention. However, statistical significance was only achieved in the group with a higher baseline PI. The intergroup analysis also revealed that the group with the highest baseline PI showed a greater improvement in their PI at the second visit, ultimately achieving PI levels comparable to those with a lower baseline PI.

**Table 4** demonstrated the independent variables of the improvements in PI after DDC. Multiple regression analysis showed that the patients' baseline PI and age are statistically significant predictors of improvement in PI after DDC, with baseline PI being a stronger predictor. The model explains 34.37 % of the variance in PI improvements.

**Fig. 2** showed that patients were more likely to improve their PI after intervention. Before the intervention, almost half of the patients had a PI greater than 2.1, but this

**Table 1** Demographic and oral findings of the study subjects.

	All (% , n = 61)	Baseline plaque index by median		P-value
		$\leq 2.1$ (% , n = 32)	$> 2.1$ (% , n = 31)	
Gender	32.79	35.48	30.00	0.65
Female	67.21	64.52	70.00	
Male				
Age (years old)	$43.21 \pm 13.27$	$42.00 \pm 13.16$	$44.47 \pm 13.49$	0.47
Cause of bedridden state	39.34	41.94	36.67	0.98
Accident	18.03	16.13	20.00	
Cardiovascular disease	13.11	12.90	13.33	
Cerebrovascular disease	8.20	9.68	6.67	
Congenital	4.92	3.23	6.67	
Shock	16.39	16.13	16.67	
Others				
Systemic disease	18.03	16.13	20.00	0.35
Cardiovascular disease only	8.20	6.45	10.00	
+ HTN/DM	4.92	9.68	0.00	
+ HTN + DM				
DMFT	$7.84 \pm 5.52$	$9.42 \pm 6.02$	$6.20 \pm 4.48$	0.035*
Decayed teeth	$2.82 \pm 3.45$	$3.42 \pm 4.32$	$2.20 \pm 2.14$	0.48
Missing teeth	$3.98 \pm 4.06$	$4.48 \pm 4.68$	$3.47 \pm 3.31$	0.63
Filled teeth	$1.03 \pm 2.52$	$1.52 \pm 3.18$	$0.53 \pm 1.46$	0.069
Number of residual root	$1.26 \pm 2.64$	$0.97 \pm 1.56$	$1.57 \pm 3.42$	0.48
Number of remaining teeth (excluding residual root)	$22.75 \pm 5.50$	$22.55 \pm 5.51$	$22.97 \pm 5.57$	0.78

\*P-value  $< 0.05$ ;  $\chi^2$  Test or Fisher's exact test.

+HTN/DM: With either hypertension or diabetes mellitus

+ HTN + DM: With both hypertension and diabetes mellitus

DMFT: Decayed, missing and filled teeth.

**Table 2** Correlation between each variable and baseline plaque index.

Spearman p	Age	PI (I)	DMFT	D	M	F	RR	RT
Age	1							
PI (I)	–0.074	1						
DMFT	0.3914	–0.2811	1					
	**	*						
D	0.0653	–0.0375	0.5856 ***	1				
M	0.5635 ***	–0.2538 *	0.6280 ***	–0.0739	1			
F	–0.1415	–0.1551	0.3749 **	0.0314	–0.1368	1		
RR	0.3825 **	0.0544	0.1759	–0.0331	0.3143 **	–0.0766	1	
RT	–0.6002 ***	0.1615	–0.5487 ***	0.0705	–0.8901 ***	0.1379	–0.7124 ***	1

\* $P < 0.05$ ; Spearman correlation coefficient.

\*\* $P < 0.005$ ; Spearman correlation coefficient.

\*\*\* $P < 0.0001$ ; Spearman correlation coefficient.

PI (I): Baseline plaque index.

RR: Residual root.

RT: Remaining teeth.

**Table 3** Inter- and intragroup comparison of mean plaque index and improvements between two groups.

	All		Baseline plaque index by median				P-value <sup>a</sup>	
	N	Mean (SD)	$\leq 2.1$		$> 2.1$			
			N	Mean (SD)	N	Mean (SD)		
PI (I)	61	2.03 (0.38)	31	1.72 (0.26)	30	2.34 (0.19)	0.0001	
PI (II)	61	1.73 (0.39)*	31	1.66 (0.37)	30	1.79 (0.41)***	0.19	
PI (I-II)	61	0.30 (0.47)	31	0.06 (0.45)	30	0.54 (0.37)	0.0001	

\* $P < 0.05$  Compared to PI (I) of respective column.

\*\*\* $P < 0.0001$  Compared to PI (I) of respective column.

PI (I): Baseline plaque index.

PI (II): Plaque index post-intervention.

PI (I-II): Improvement in plaque index.

<sup>a</sup> Comparing baseline plaque index groups ( $\leq 2.1$  vs.  $> 2.1$ ).

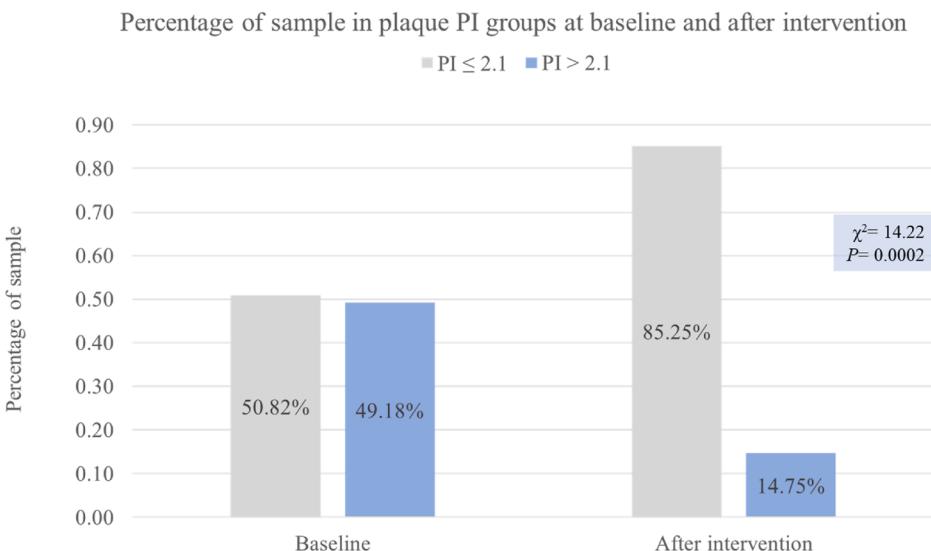
**Table 4** Independent variables of improvements in PI post-domiciliary dental care.

Independent variables	Coefficient	Standard error	P-value
Baseline plaque index more than 2.1	0.2483	0.0499	0.0001
Age below 43 years old	0.1305	0.0499	0.011
Model summary:			
Constant	0.3211		
R <sup>2</sup>	0.3437		
F-ratio (df = X, 61)	15.1901		0.0001

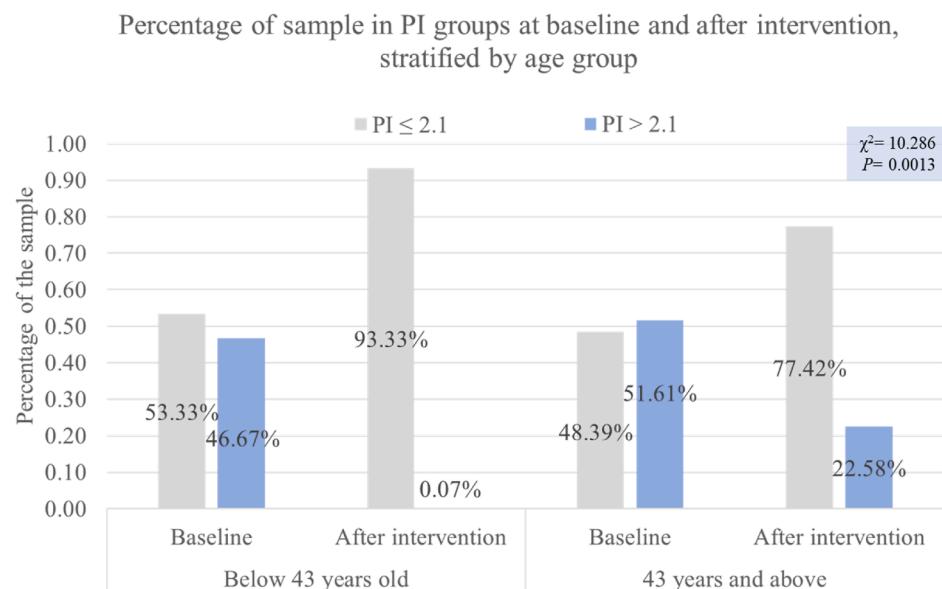
proportion dropped dramatically to 14.75 % after the intervention. Meanwhile, there was a dramatic increase in the percentage of patients with lower PI values after treatment, rising from 50.82 % to 85.25 %.

Fig. 3 revealed that among those under 43 years of age, a significant increase was observed in the proportion of

people with lower PI values after intervention, which increased from 53.33 % to 93.33 %. Simultaneously, there was a substantial reduction in the percentage of patients with a higher PI after the intervention. Similar trends were also revealed in the older age group, although with a less pronounced effect.



**Figure 2** Distribution of sample across plaque index (PI) groups at baseline and after intervention.



**Figure 3** Distribution of sample across plaque index (PI) groups at baseline and after intervention, stratified by age group.

## Discussion

In this retrospective study, demographic information demonstrated that oral hygiene and status in this population were not optimal. The findings in Table 1 showed high mean values in DMFT and its components, such as decayed and missing teeth. The average number of residual roots in the oral cavity was 1.25; however, some patients had up to 13 residual roots. Meanwhile, the median PI was 2.1, indicating a moderate accumulation of plaque in the sulcus and, as a result, a good oral hygiene status. An intriguing finding emerged after analyzing the correlations between the baseline variables: the DMFT value and the number of missing teeth exhibited a somewhat negative correlation with the baseline PI. A similar pattern was observed in a study of Lebanon's geriatric

population, which had a higher DMFT score but recorded better periodontal status.<sup>25</sup> This paradoxical relationship could be attributed to a few potential factors. Individuals with high DMFT values may have better access to dental care, allowing them to address dental issues more promptly than in the past. Alternatively, these individuals or their families might have higher education on oral hygiene, fostering greater attention to preventive measures. However, more research and exploration are needed better to understand the dynamics of these relationships in this population.

There was a significant improvement in PI among subjects, particularly those with higher baseline PI values. PI is a clinical parameter used to measure the extent of microbial plaque accumulation, thus providing a good estimation of oral hygiene status. The group with a higher

baseline PI showed a greater improvement in their PI posttreatment, ultimately achieving PI levels in line with those with a lower baseline level. This suggests that the DDC intervention particularly benefits individuals with poor oral hygiene. In Table 4, the multiple regression analysis identified both baseline PI and the age of the patients as significant predictors of improved oral hygiene after treatment, with the baseline PI being a stronger predictor. In particular, the posttreatment result showed a higher proportion of low-to-high PI in the younger age group. This model explains 34.37 % of the PI improvement variance, a moderate proportion. However, the limitation lies in the lack of a control group, hindering assessing the impact on plaque index enhancements. Despite this, our distribution analysis demonstrated a substantial increase in the low to high PI (1:1 to 23:4) post-intervention, indicating the efficacy in improving poor oral hygiene and reducing the subsequent risk of pneumonia in this frail group.<sup>16,17,26</sup>

However, this study has some limitations. As this study relied on retrospective data obtained from patient files, some important details, such as socioeconomic status and the presence of caretaker-driven oral hygiene care, were not available. Given Taiwan's aging population, demand for DDC is inevitable, and thus, integrating DDC into dental school curricula is crucial. Only Chung Shan Medical University (CSMU) has integrated the complete DDC curriculum into its undergraduate training in Taiwan since 2017, garnering positive responses to online lectures and hands-on practice from dental students.<sup>27–29</sup> Furthermore, CSMU offers continuing medical education courses on DDC for healthcare organizations and personnel, fostering awareness and encouraging more healthcare organizations to provide DDC services.<sup>30</sup> In light of this, we hoped that more dental schools in Taiwan would incorporate DDC into their undergraduate training program to better equip students for future DDC services.

This study highlights the particular benefit for individuals with poor baseline oral hygiene, indicating that targeted interventions for high-risk patients could be especially beneficial. The identified predictors of oral hygiene improvement offer valuable information for optimizing DDC programs. These results strongly support the integration of DDC into dental school curricula and continuing medical education programs. A greater implementation of DDC in healthcare settings and nursing homes could significantly improve overall health and quality of life for bedridden patients, potentially alleviating the burden on healthcare systems by preventing oral health-related complications.

## Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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