

# Impact of Functional Disability on Self-Perceived Oral Problems and Oral Care Behaviors among Stroke Survivors: A Cross-Sectional Study

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## Research article

**Keywords:** functional disability, oral care behaviors, self-perceived oral problems, stroke survivors

**Posted Date:** May 13th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-28099/v1>

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# Abstract

**Background:** Stroke is a major cause of functional disability, which is in turn correlated with poor oral health. There is a dearth of studies that have investigated self-reported oral health, a measure of how individuals perceive their oral health and unmet treatment needs, in elders after stroke. Therefore, the purpose of this study was to compare self-perceived oral problems and oral care behaviors between stroke survivors with and without functional disability.

**Methods:** Two-hundred and seven stroke survivors were recruited, comprised of 104 participants without functional disability, and 103 with functional disability, based on the modified Rankin Scale. Interviews were conducted to collect data regarding self-perceived oral problems, oral care behaviors, and dental attendance behaviors. Multivariate logistic regression analysis was performed to compare the data between the two groups.

**Results:** After adjusting for sociodemographic variables, the functional disability group was significantly less likely to brush their teeth twice a day (odds ratio [OR], 0.388; 95% confidence interval [CI], 0.200-0.751), and both more likely to have a change in teeth cleaning after stroke (OR, 0.155; 95% CI, 0.030-0.804), and to need help when cleaning their teeth (OR, 2.701; 95% CI, 1.018-7.163). There were no significant differences in self-perceived oral problems or dental attendance behaviors between the two groups.

**Conclusion:** Stroke survivors with functional disability had worse oral care behaviors compared with those without functional disability.

## Background

Stroke is an acute cerebrovascular disease with a high incidence of disability among elders.[1] The prevalence of stroke among individuals aged > 60 years has been reported as high as 4825/10 million in China in 2013, and, with the rapid aging of the population, this prevalence could increase in the near future.[2] After the recovery phase, nearly half of stroke survivors retain some degree of dysfunction, and approximately 20% are partially or completely in need of care.[3, 4] The World Health Organization indicated that oral health plays an important role in quality of life.[5] In 2016, the World Dental Federation reported a new definition of oral health and emphasized its importance in general health and quality of life.[6] Therefore, oral health needs attention, particularly in stroke survivors.

Previous studies have indicated that functional disability, which can cause inconvenience in oral care, is correlated with poor oral health.[7, 8] However, there is limited data on self-reported oral health among stroke survivors with and without functional disability. Self-reported oral health is a widely used measure of oral health in population studies.[9] This simple assessment provides information on how individuals perceive their oral health and unmet treatment needs,[10] and is closely related to clinical examination results.[11] Therefore, the aim of this study was to investigate and compare self-perceived oral problems and oral care behaviors among stroke survivors with and without functional disability.

## Methods

### Study population

Based on the modified Rankin Scale, 207 stroke survivors, 104 without functional disability (score, 0–1) and 103 with functional disability (score, 2–5), were recruited using a convenience sampling method. Participants were recruited from Xuanwu Hospital, Tiantan Hospital, and Xihongmen Hospital in Beijing, China, from September 2016 to October 2017. The inclusion criteria were age  $\geq$  60 years, history of stroke for  $\geq$  6 months, number of teeth  $\geq$  16, ability to communicate in Mandarin, provision of written informed consent, and assistance of a relative if the participant had cognitive impairment. The exclusion criteria were oral tumor or acute oral infection, severe systemic disease (such as heart, lung, liver, or kidney dysfunction), and inability to undergo oral examinations or functional tests.

### Outcome Variables

In this study, there were 3 main outcome variables: self-perceived oral problems, oral care behaviors, and dental attendance behaviors. Self-perceived oral problems included bad breath, dry mouth, tooth sensitivity, tooth cavity, tooth pain, residual tooth root, chewing difficulty, missing teeth without replacement, impact of missing teeth on appearance and speaking, bleeding and swelling gums, discomfort or pain in oral soft tissue, food impaction, and tooth mobility. Oral care behaviors included teeth brushing, teeth flossing, changes in teeth cleaning after stroke, assistance needed when cleaning teeth, and using toothpaste with fluoride. Dental attendance behaviors included frequency of visiting a dentist, changes in dental attendance after stroke, last time of dental attendance, reason for last dental visit, visiting a dentist because of tooth or gum pain within 6 months, and frequency of mouth cleaning. Sociodemographic information was also collected, including age, sex, education, retirement pension, marriage status, residence, and stroke history. Oral health interviews were conducted by trained dentists.

### Statistical analysis

Measurement data were tested using the Kolmogorov-Smirnov test. If the distribution was normal, data were expressed as mean (SD); if the distribution was not normal, data were expressed as median (quartile). Count data were expressed as constituent ratio (%). Study variables were divided into two groups according to mean or median. The Chi-square test was used for single-factor analysis. Interference factors were screened according to single-factor analysis and references, and then a multivariate logistic regression model was used for multivariate analysis. Statistical analyses were performed using SPSS version 22.0 (IBM Corporation) with  $P < .05$  considered statistically significant.

## Results

### Participant characteristics

Compared with the non-functional disability group, the functional disability group was more likely to be older ( $P < .001$ ), without a retirement pension ( $P = .014$ ), unmarried ( $P < .001$ ), and with a history of hemorrhagic stroke ( $P = .001$ ). There were no statistically significant differences in sex, education, residence, or time and frequency of stroke between the two groups. (Table 1)

Table 1  
Characteristics of the study participants

Characteristics	Non-functional disability group n = 104	Functional disability group n = 103	P value
Age (years)	66.9 ± 7.1	72.2 ± 9.9	0.000
Men	60 (57.7)	59 (57.3)	0.952
Education ≥ 7 years	48 (46.2)	36 (35.0)	0.101
With a retirement pension	82 (80.4)	95 (92.2)	0.014
Married	97 (93.3)	59 (57.3)	0.000
Urban residence	83 (79.8)	95 (92.2)	0.220
Time of stroke (months)	54 (18, 125)	59 (24, 161)	0.263
Ischemic stroke	88 (95.7)	72 (79.1)	0.001
Stroke ≥ 2 times	23 (22.1)	16 (15.5)	0.226
Values are presented as n (%), mean ± standard deviation or median (25%, 75%).			

## Self-perceived Oral Problems

Over half of the stroke survivors, regardless of functional disability, reported problems with food impaction, missing teeth without replacement, and dry mouth (76.7%, 60.6%, and 54.8% in participants without functional disability; 68%, 59.8% and 53.1% in participants with functional disability, respectively). Up to a half of the stroke survivors had self-perceived oral problems, including tooth cavities, tooth sensitivity, tooth mobility, residual tooth roots, and chewing difficulty (50.0%, 47.1%, 45.6%, 37.9%, and 37.9% in participants without functional disability; 47.3%, 40.2%, 40.0%, 48.4%, and 47.4% in participants with functional disability, respectively).

After adjusting for age, sex, education, retirement pension, marriage status, and type of stroke, the functional disability group was more likely to have chewing difficulty (odds ratio [OR], 1.761; 95% confidence interval [CI], 0.930–3.334), residual tooth roots (OR, 1.706; 95% CI, 0.903–3.225), tooth pain (OR, 1.502; 95% CI, 0.783–2.882), bad breath (OR, 1.246; 95% CI, 0.614–2.527), tooth cavities (OR, 1.239; 95% CI, 0.645–2.382), and discomfort or pain in the oral soft tissues (OR, 1.014; 95% CI, 0.455–2.260). However, these differences were not significant. (Table 2)

Table 2  
Self-perceived oral problems

Oral problems	Non-functional disability group n = 104	Functional disability group n = 103	Crude model†		Adjusted model†‡	
			OR	95% CI	OR	95% CI
Bad breath	32 (31.1)	28 (29.5)	0.927	0.505–1.702	1.246	0.614–2.527
Dry mouth	57 (54.8)	51 (53.1)	0.935	0.536–1.630	0.865	0.460–1.628
Tooth sensitivity	49 (47.1)	39 (40.2)	0.755	0.431–1.321	0.979	0.517–1.852
Tooth cavity	51 (50.0)	43 (47.3)	0.896	0.509–1.577	1.239	0.645–2.382
Tooth pain	37 (35.6)	39 (40.2)	1.218	0.688–2.155	1.502	0.783–2.882
Residual tooth root	39 (37.9)	46 (48.4)	1.541	0.875–2.713	1.706	0.903–3.225
Chewing difficulty	39 (37.9)	46 (47.4)	1.480	0.843–2.600	1.761	0.930–3.334
Missing teeth without replacement	63 (60.6)	58 (59.8)	0.968	0.550–1.703	0.912	0.474–1.754
Impact of missing teeth on appearance or speaking	30 (29.4)	26 (27.1)	0.891	0.480–1.657	0.848	0.421–1.708
Bleeding and swelling gum	42 (40.4)	28 (28.9)	0.599	0.333–1.079	0.815	0.423–1.569
Discomfort or pain in oral soft tissue	20 (19.4)	18 (18.8)	0.958	0.472–1.944	1.014	0.455–2.260
Food impaction	79 (76.7)	66 (68.0)	0.647	0.346–1.209	0.689	0.332–1.429
Tooth mobility	47 (45.6)	38 (40.0)	0.794	0.452–1.397	0.825	0.440–1.545

Values are presented as n (%); †based on functional disability group versus non-functional disability group; ‡adjusted for age, sex, education, retirement pension, marriage status, and type of stroke. OR, odds ratio; CI, confidence interval.

## Oral Care Behaviors

A low percentage of participants brushed their teeth twice daily, regardless of whether they had (40.8%), or did not have functional disability (58.7%). Furthermore, the large majority of participants (> 90%) maintained the same tooth cleaning habits that they had prior to their stroke. Few participants had a tooth flossing habit, or used fluoridated toothpaste. A larger percentage of participants with functional disability reported that they needed assistance with tooth cleaning (17.3%) compared to participants without functional disability (7.8%).

After adjusting for age, sex, education, retirement pension, marriage status, and type of stroke, the functional disability group, who were significantly less likely to brush their teeth twice a day (OR, 0.388; 95% CI, 0.200-0.751), also tended to experience a change in tooth cleaning habits after stroke (OR, 0.155; 95% CI, 0.030-0.804), and were more likely to need help when cleaning their teeth (OR, 2.701; 95% CI, 1.018-7.163). There were no significant differences in flossing habits, or the use of fluoridated toothpaste between the two groups. (Table 3)

Table 3  
Oral care behaviors

Oral-care behaviors	Non-functional disability group n = 104	Functional disability group n = 103	Crude model†		Adjusted model†‡	
			OR	95% CI	OR	95% CI
Brushing teeth twice a day	61 (58.7)	42 (40.8)	0.485	0.279–0.844	0.388	0.200–0.751
Having teeth flossing habit	4 (3.8)	3 (2.9)	0.750	0.164–3.437	1.450	0.282–7.447
No change in teeth cleaning after stroke	100 (98.0)	84 (90.3)	0.187	0.039–0.888	0.155	0.030–0.804
Needing help when cleaning teeth	8 (7.8)	17 (17.3)	1.478	1.081–2.020	2.701	1.018–7.163
Using fluoridated toothpaste	19 (18.3)	13 (12.6)	0.646	0.301–1.389	0.784	0.332–1.849
Values are presented as n (%); †based on functional disability group versus non-functional disability group; ‡adjusted for age, sex, education, retirement pension, marriage status, and type of stroke. OR, odds ratio; CI, confidence interval.						

## Dental Attendance Behaviors

While most participants had at least one dental visit experience in their lifetime (66.7% and 82.7% of participants with, and without functional disability, respectively), few were regular attendees (1.0% and 8.7% of participants with, and without functional disability, respectively), or had increased their frequency

of attendance after stroke (5.8% and 10.6% in participants with, and without functional disability, respectively). Approximately one third (32.7%) of participants without functional disability had visited a dentist within the past year, compared to a quarter (25.2%) of participants with functional disability. Under a fifth of all participants had visited a dentist because of tooth or gum pain within the past 6 months, while mouth cleaning within the past year was slightly more prevalent among participants without functional disability (12.5%) compared to participants with functional disability (3.9%).

After adjusting for age, sex, education, retirement pension, marriage status, and type of stroke, the functional disability group was significantly less likely to have had at least one dental visit experience in their lifetime (OR, 0.463; 95% CI, 0.200-1.072), and more likely to have visited a dentist because of tooth or gum pain within the past 6 months (OR, 1.128; 95% CI, 0.481-2.646). This group was also less likely to have undergone regular dental examinations (OR, 0.094; 95% CI, 0.009-1.035), visited a dentist within the past year (OR, 0.847; 95% CI, 0.428-1.676), have increased dental attendance after stroke (OR, 0.773; 95% CI, 0.259-2.310), and recent mouth cleaning (OR, 0.518; 95% CI, 0.153-1.753). However, these differences were not significant. (Table 4)

Table 4  
Dental attendance behaviors

Dental attendance behaviors	Non-functional disability group n = 104	Functional disability group n = 103	Crude model†		Adjusted model†‡	
			OR	95% CI	OR	95% CI
At least one dental visit experience	86 (82.7)	68 (66.7)	0.419	0.218–0.805	0.412	0.175–0.969
Regular dental examinations	9 (8.7)	1 (1.0)	0.103	0.013–0.832	0.094	0.009–1.035
More dental attendances after stroke	11 (10.6)	6 (5.8)	0.523	0.186–1.472	0.773	0.259–2.310
Dental visit within a year	34 (32.7)	26 (25.2)	0.695	0.380–1.273	0.847	0.428–1.676
Dental visit because of tooth or gum pain within 6 months	16 (15.4)	16 (15.5)	1.011	0.476–2.149	1.128	0.481–2.646
Mouth cleaning within a year	13 (12.5)	4 (3.9)	0.283	0.089–0.899	0.518	0.153–1.753

Values are presented as n (%); †based on functional disability group versus non-functional disability group; ‡adjusted for age, sex, education, retirement pension, marriage status, and type of stroke. OR, odds ratio; CI, confidence interval.

## Discussion

To our knowledge, this is the first report on self-perceived oral problems, oral care behaviors, and dental attendance behaviors among stroke survivors with and without functional disability in China. Our results showed that stroke survivors with functional disability were more likely to have worse oral care behaviors than those without. However, there were no significant differences in self-perceived oral problems or dental attendance behaviors between the two groups. This study provides valuable information to better understand the self-perceived oral problems and dental-related behaviors among these vulnerable individuals.

As expected, oral care behaviors declined as functional ability worsened. Stroke survivors with functional disability were less likely to brush their teeth twice a day and more likely to need help when cleaning their teeth. Previous reports have suggested that oral care behaviors are correlated with functional ability and cognitive function.[12–16] Komulainen et al. reported that brushing teeth twice a day was closely related to better instrumental activities of daily living and cognitive function.[13] As is well known, stroke, as a cerebrovascular disease, can cause physical and cognitive disability.[17, 18] Our study demonstrated the impact of subsequent functional disability on oral care behaviors.

Our study found no significant differences in dental attendance behaviors between stroke survivors with and without functional disability. This might have been attributed to the large proportion of participants who did not undergo regular dental examinations. In other words, the elderly population in our nation does not seem to have a dental visit habit. A previous study in 2011 in America, including 706 stroke survivors, reported that 46% had a dental visit in the previous year.[19] Another study in 2014 in Switzerland showed that 64.2% of elders had a dental visit in the previous year.[20] Our nation should therefore, make a greater effort to promote dental attendance.

To our surprise, our study found no significant difference in self-perceived oral problems between stroke survivors with and without functional disability. One reason might be that our participants did not pay much attention to their oral condition. Another reason might be that stroke caused a decline of sensation and cognition, which concealed the self-perceived oral problems. This suggests that a clinical examination should be added in a future study to better understand the oral condition of these individuals. Another limitation is that our study was based on a limited sample size and convenience sampling method. Therefore, studies with a larger sample size and a random sampling method are needed.

## **Conclusions**

Stroke survivors with functional disability had worse oral care behaviors than those without. However, no significant differences in self-perceived oral problems or dental attendance behaviors were observed in our study. Therefore, special attention should be paid to improve oral care behaviors of stroke survivors with functional disability.

## **List Of Abbreviations**

OR, odds ratio; CI, confidence interval.

## **Declarations**

## **Acknowledgements**

The authors would like to acknowledge the support of Xuanwu Hospital, Tiantan Hospital, and Xihongmen Hospital in Beijing, China, for the recruitment of participants.

## **Consent for publication**

Written informed consent for publication was obtained from all participants.

## **Competing interests**

The authors declare that they have no competing interests.

## **Ethics approval and consent to participate**

Prior to patient recruitment the study was approved by the Ethics Committee of Beijing Stomatological Hospital. All participants gave their written consent.

## **Funding**

This study was supported by the Beijing Science and Technology Committee (Z151100004015041) and Beijing Stomatological Hospital Subject Construction Fund (16-09-20).

## **Authors' contributions**

DY and SZ had this conception and designed this study. WY, CX, GC, ZQQ and SDD collected and analyzed the data. This paper was written by WY, revised and approved by all authors.

## **Availability of data and materials**

Supporting data can be accessed by contacting the correspondence author.

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