ORIGINAL ARTICLE

Facilitating Factors, Barriers and the Associated Factors Towards Toothbrushing Among Primary Caregivers of Children With Cerebral Palsy in Kelantan

Noorul Afiqah Kamarul Zaman, Normastura Abd Rahman, Munirah Mohd Adnan, Muhammad Nazmi bin Abdul Majid

Dental Public Health Unit, School of Dental Sciences, Universiti Sains Malaysia, Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia.

ABSTRACT

Introduction: Primary caregivers of children with cerebral palsy (CP) face challenges in maintaining their children's oral hygiene. This study aims to identify the facilitating factors, barriers, and associated factors influencing toothbrushing practices among primary caregivers of children with CP. **Methods:** A cross-sectional study was conducted among 81 primary caregivers aged 18 years and above. Sociodemographic data and oral health knowledge, attitude, and practices (OHKAP) scores were collected. Facilitating factors and barriers were assessed using environmental context and behavior regulation domains. Data were analyzed using IBM SPSS version 27.0. **Results:** Most caregivers were female, with a mean (SD) age of 43.6 (9.34) years, while their children were predominantly male, aged 10.3 (3.93) years, and commonly diagnosed with diplegia (44.4%). The mean (SD) OHKAP score was 18.75 (2.91), and 91.4% reported regularly brushing their child's teeth. The most common facilitating factor was fear of poor oral health, while the main barrier was the child's bad mood. Higher OHKAP scores were significantly associated with better toothbrushing skills and toothbrush preferences. Caregiver's sex, relationship with the child, and education level were linked to various barriers, including lack of access to oral health information and children's reluctance to brush. **Conclusion:** Various factors influence toothbrushing practices among caregivers of children with CP. Since higher OHKAP scores correlate with better toothbrushing skills, targeted caregiver training may improve oral hygiene outcomes.
Malaysian Journal of Medicine and Health Sciences (2025) 21(6): 1-18. doi:10.47836/mjmhs.v21.i6.1410

Keywords: Cerebral palsy, oral health, toothbrushing, caregivers, education

Corresponding Author:
Prof Dr Normastura Binti Abd Rahman, M.Comm.
Medicine (Oral Health)
Email: normastura@usm.my
Tel: +609-7675822

INTRODUCTION

Children with Cerebral Palsy (CP) are classified as having a physical disability that poses considerable challenges that can be classified based on the number and location of affected limbs with hemiplegia, diplegia, or quadriplegia in severe cases. Monoplegia and triplegia are less common than other classifications (1,2). The global incidence of CP is estimated to range from 1.5 to over 4 per 1,000 live births (3). In Malaysia, as of 2022, the Department of Social Welfare (JKM) reported 674,548 registered Persons with Disabilities (PWD), accounting for 2.0% of the country's total population (4). Among these, the physical disability category which includes CP had the highest number of registrations, totaling 245,015 (4). In 2017, the Department of Statistics Malaysia recorded 5,840 CP cases (5), while the Ministry of Health (MOH) Malaysia reported 2,766 children with special needs (CSNs) in 2012, of whom 215 were diagnosed with CP (6). However, there remains a lack of comprehensive epidemiological data on children with CP in Malaysia, which poses challenges in advancing research and oral healthcare service planning.

Children with CP are at significantly higher risk of poor oral health outcomes due to a combination of motor impairments, reliance on caregivers for oral hygiene, and associated medical conditions (7). Globally,

previous studies show that children with CP have a higher prevalence of dental caries, periodontal disease, malocclusion, and gingival overgrowth compared to typically developing children (7–9). In the case of severe neurological impairment, children with CP increase their risk of dental disease due to motor challenges and limited oral care (10). Those with epilepsy and on anticonvulsant medication are reported to have gingival hyperplasia, a known side effect of anticonvulsant medication (11). This condition further increases their risk of dental disease in addition to undernutrition from pseudo-bulbar palsy, dental erosion from gastroesophageal reflux disease, and their reliance on caregivers for oral hygiene (8,10,11).

These children with CP often partially or fully depend on caregivers to perform daily tasks (12). Therefore, effective oral hygiene practices such as tooth brushing are crucial for caregivers (13). However, most of the previous studies have explored general health challenges faced by children with CP (7–9), and there is a significant gap in understanding the specific factors that facilitate or hinder oral hygiene maintenance and the role of caregivers in overcoming these challenges. Existing research on oral health barriers primarily reflects findings from parents of typically developing children (14), overlooking the unique difficulties faced by caregivers of children with CP. Therefore, research on oral health disparities among children with CP remains limited, particularly in Malaysia and the broader Southeast Asian region.

A systematic review of normal children identified common barriers to toothbrushing, such as difficulty managing children's behaviour, uncertainty about supervised toothbrushing practices, and lack of appropriate resources, like adapted toothbrushes (14). However, studies examining these challenges in the context of CP are scarce. A study done by Campanaro et al. (15) reported that caregivers of CSNs often face multiple constraints, including time limitations, behavioural difficulties, and inadequate oral health knowledge, all of which hinder effective oral care.

Moreover, limited research explored the impact of caregivers' oral health knowledge, attitudes, and practices (OHKAP) on children's oral hygiene outcomes. A study found that caregivers with lower OHKAP scores struggled to maintain consistent toothbrushing routines (13), and those with lower educational levels were less likely to ensure their children brushed twice daily (16). These findings highlight the critical need for targeted interventions to enhance caregivers' knowledge and equip them with practical strategies for overcoming daily challenges in maintaining their child's oral hygiene. Despite evidence that increased caregiver awareness can improve oral health outcomes, research addressing the practical barriers they face such as time constraints, behavioral challenges, and the additional medical needs of children with CP remains insufficient.

While previous studies have explored general oral health challenges among children with CP, no known research has specifically examined the facilitating factors and barriers to toothbrushing and the association with OHKAP and caregivers' profiles. Thus, this study aims to determine the factors that facilitate and hinder toothbrushing practices among caregivers of children with CP, and to examine their association with OHKAP as well as caregiver profiles in Kelantan. By identifying these key factors, this research intend to fill the gaps in the existing literature and inform targeted interventions to improve oral health outcomes for children with CP in Malaysia.

MATERIALS AND METHODS

A cross-sectional study was conducted at Community Rehabilitation Centers (CBR) in Kelantan from April to May 2024. The total number of children with CP registered in CBR centres during this period served as the basis for the sampling frame. The source population consisted of primary caregivers (aged 18 years and above) of children with CP (aged 17 years and younger) who were attending the CBR centres in Kelantan. The sampling frame was based on the inclusion criteria and exclusion criteria. This study included primary caregivers of children with CP of all types based on physiological, topographical, and functional capacity. They are also able to understand Bahasa Malaysia (BM) as well as able to read and write. However, the primary caregivers with physical and mental disabilities were excluded from this study as these conditions affected their OHKAP as well as their children with CP. The sample size was determined based on the study by Campanaro et al (2014), who reported that 38% of the facilitating factors were related to child cooperation among caregivers (15). To achieve 80% power at a 0.05 significance level, a total of 91 caregivers are required in this study. With the anticipation of 20% would be uncooperative, a total of 109 primary caregivers were required in this study. Thus, the universal sampling method was applied since only a total of 81 children with CP and their primary caregivers were eligible to be selected to participate in this study during the data collection period.

A self-administered questionnaire in BM comprised four sections: Section 1 on sociodemographic profiles of primary caregivers and children with CP, Section 2 on primary caregivers' OHKAP, Section 3 on the facilitating factors and Section 4 on the barriers towards toothbrushing for children with CP.

Section 1(a) consists of the sociodemographic profile of the primary caregivers with CP. This includes the following: age, sex, ethnicity, relationship with the children with CP, caregiver's education level, occupation, household income per month (MYR), and source of oral health information. The household income was further categorised into B40 (less than

MYR4,849), M40 (between MYR4850 and MYR10,959), and T20 (more than MYR10,960) (17). Meanwhile, Section 1(b) consists of the sociodemographic profile of children with CP, including the following: age (in years), sex (male and female), ethnicity (including Malay, Chinese, Indian, and others), presence of other medical problems (with 'yes' or 'no' answers, and specifying the type if applicable), and classification of CP by body part (Monoplegia, Hemiplegia, Diplegia, Triplegia, and Quadriplegia).

Section 2 includes the OHKAP questionnaire which was adapted from a validated, self-administered version in Bahasa Malaysia (BM) developed by Misran et al. (14). Additional questions specific to caregivers of children with CP were developed based on the study by Dougherty et al. (2). The adapted questionnaire underwent content and response process validation to ensure its relevance and clarity for the target population.

The BM OHKAP questionnaire consists of a total of 29 items which divided into three main components which are Section 2(a) on oral health knowledge (OHK), Section 2(b) on oral health attitude (OHA), and Section 2(c) on oral health practices (OHP). The OHK section comprised eight questions assessing caregivers' understanding of oral health. The OHA section included four questions measuring caregivers' perceptions and beliefs about oral health. The OHP section was divided into two subsections: evaluating caregivers' oral hygiene (eight questions), and assessing their toothbrushing practices for their children with CP (nine questions).

As for the scoring system, responses to the OHK section were recorded as "Yes," "No," or "Do not know." Correct answers were assigned a score of 1, while incorrect and "Do not know" responses were scored 0, given the total OHK score ranged from 0 to 8. The OHA section required participants to respond with either "Agree" or "Disagree." Positive attitudes were scored as 1, whereas negative attitudes were scored as 0. The total attitude score ranged from 0 to 4. For the OHP section, six multiple-choice questions regarding caregivers' oral health practices were scored on a scale of 0 to 1 each, while two yes/no questions were scored as 1 or 0, respectively. This resulted in a total possible score ranging from 0 to 7, as one question serves only as a guiding question and is not scored. The subsection on caregivers' oral health practices toward their children with CP consists of nine questions, with a total score range of 0 to 7, as two questions serve only as guiding questions and are not scored. The total OHKAP score was calculated by summing the scores from all three components, giving a total score range of 0 to 26. A higher score indicates better OHKAP.

Sections 3 and 4 on facilitating factors and barriers towards toothbrushing are divided into Domain 1 (D1): environmental context and Domain 2 (D2): behavior regulation. For the facilitating factors, the subdomain for D1 is the factors that make it easy for parents to brush their child at home, which consists of ten items. The subdomain for D2, which is the factors that encourage the children to brush at home, consists of seven items. Meanwhile, for barriers towards toothbrushing, the subdomain for D1 is the difficulty during brushing a child's teeth, consisting of four items, and the subdomain for D2, which is the child's reason for not brushing their teeth, consists of eight items. The questionnaires for facilitating factors and barriers towards toothbrushing were developed based on literature reviews (14,15,18). These sections underwent content validation and response process validation based on Yusof (2019) (19,20). The content validation score was S-CVI/Ave = 0.99, S-CVI/UA = 0.94, and the face validation score was S-FVI/Ave = 0.97, S-FVI/UA = 0.85, which both were indicated as good (21). The items with unclear terms were clarified by reconciliation with two dental public health specialists.

Permission was obtained from the Department of Social Welfare (JKM) (Reference letter: JKMM 100/12/5/2:2024 / 006) and ethical approval from the Human Research and Ethics Committee of Universiti Sains Malaysia (JEPeM Code: USM/JEPeM/KK/24010075) to conduct a study at the CBR Center. An informed letter was sent to CBR centers in Kelantan with registered children with CP. Consequently, meetings were arranged with the CBR coordinator and primary caregivers of children with CP. During the sessions, the researcher introduced the study, emphasizing its goals and the data collection process. Primary caregivers were assured that their participation was voluntary and confidential, and they could withdraw anytime. Furthermore, informed consent forms were provided prior to distributing the questionnaires, ensuring each participating caregiver consented. The researcher assisted participants in completing the questionnaires, which took 15-20 minutes. For caregivers unable to attend in person due to transportation or family care responsibilities, permission was obtained to conduct the study at their homes. Meanwhile, new appointments were scheduled for data collection at their home for those unavailable due to work commitments. An honorarium was provided to each caregiver as recognition for their contribution.
Data analysis was performed using IBM SPSS version 27.0. Data was explored using descriptive statistics for each variable. Categorical variables were summarized in frequency and percentage (%), and the continuous variables were summarised in mean and Standard Deviation (SD) or median and Interquartile Range (IQR). The total OHKAP score was treated as a continuous variable rather than being categorized into discrete groups.

The statistical analyses used were independent t-test (OHKAP score and age) and chi-square test (primary caregivers' profiles: sex, age, relation to children

with CP, education level, and household income) to determine the factors associated with the facilitating factors and barriers towards toothbrushing. The level of significance was set at 0.05 (two-tailed).

RESULT

The study included 81 primary caregivers of children with CP, as provided in Table I. Most of the primary caregivers were female (85.2%), with a mean (SD) age of 43.6 (9.34) years. Most were Malay (98.8%), with mothers comprising the majority of primary caregivers who participated in this study. The median (IQR) monthly household income was 2000.00 (3739.50) MYR, with 75.3% representing the B40 income earners. Meanwhile, sociodemographic profiles of children with CP presented that most of them were male (63.0%), with a mean age of 10.3 (SD = 3.93) years. In addition, the majority of the children were Malay (98.8%), and 32.1% of the caregivers reported that their children had additional problems such as epilepsy and asthma. The classification based on affected body parts varied, with diplegia being the most common (44.4%) and quadriplegia (29.6%). Challenges encountered during toothbrushing included biting the toothbrush (23.9%) and difficulty closing their mouth and opening it (21.2% each). However, none reported running away, reflecting their lower limb disabilities.

Table I: Sociodemographic profiles of the caregivers and children with CP (n=81)

Profile		n (%)
Caregiver's profile		
Sex		
	Male	12 (14.8)
	Female	69 (85.2)
Age (years)[a]		43.6 (9.34)
Ethnicity		
	Malay	80 (98.8)
	Others	1 (1.2)
Relation with children with CP		
	Mother	61 (75.3)
	Father	12 (14.8)
	Grandmother	5 (7.4)
	Sister	2 (2.5)
Caregiver's education level		
	Tertiary	22 (39.5)
	Upper secondary	36 (44.0)
	Lower secondary	6 (7.4)
	Primary	7 (8.6)
	Not formal education	0 (0.0)
Occupation		
	Government sector	22 (27.2)
	Private sector	6 (7.4)
	Housewife	34 (42.0)
	Self- employed	13 (16.0)
	Unemployed	6 (7.4)
Household income per month (MYR)[b]		2000.00 (3739.50)
Category of Household income[c]		
	Category B40	61 (75.3)
	Category M40	18 (22.2)
	Category T20	2 (2.5)
Source of information		
	Doctor / Nurse / Healthcare worker	62 (76.5)
	Television / Radio	10 (12.3)
	Newspaper / reading materials	10 (12.3)
	Internet	36 (44.4)
	Family / Friends	16 (19.8)
	Others	6 (7.4)
Children with CP		
Sex		
	Male	51 (63.0)
	Female	30 (37.0)
Age (years)[a]		10.3 (3.93)
Ethnicity		
	Malay	80 (98.8)
	Others	1 (1.2)
Other medical problem		
	No	55 (67.9)
	Yes	26 (32.1)
Classification based on body part		
	Monoplegia	3 (3.7)
	Hemiplegia	4 (4.9)
	Diplegia	36 (44.4)
	Triplegia	14 (17.2)
	Quadriplegia	24 (29.6)
Problems encountered during toothbrushing by children with CP:		
	Close mouth	24 (21.2)
	Turn head away	20 (17.7)
	Run away	0 (0.0)
	Cry loudly	5 (4.4)
	Tongue push toothbrush	15 (13.3)
	Bite toothbrush	27 (23.9)
	Chew toothbrush	6 (5.3)
	Difficulty to open mouth	24 (21.2)
	Gag	14 (12.4)

[a]mean (SD)
[b]median (IQR)
[c]category B40 (<RM4,849), M40 (between RM 4850 and RM 10,959), T20 (> RM 10,960)

CONTINUE

Table II indicates the OHK and OHA of primary caregivers of children with CP, with a knowledge score of 6.38 (SD = 1.54) and an attitude score of 3.73 (SD = 0.47). Meanwhile, Table III portrayed the OHP score of the primary caregivers and the OHP score of primary caregivers toward their children with CP, with a mean score of 4.40 (SD = 1.29) and 3.95 (SD = 1.36), respectively. The total mean score of OH practice was 8.36 (SD = 2.11), which resulted in the total mean score for oral health KAP score of 18.75 (SD = 2.91) of 26. The

Table II: Oral Health Knowledge and Attitude of Caregivers of Children with CP (n=81)

Oral Health Knowledge	n (%)
Dental plaque is formed by colonization of bacteria trying to attach themselves to the tooth's smooth surface	
Yes	62 (76.5)
No	3 (3.7)
Do not know	16 (19.8)
Dental caries mainly caused by the bacteria	
Yes	71 (87.7)
No	0 (0.0)
Do not know	10 (12.3)
Having sugars can lead to the dental caries	
Yes	79 (97.5)
No	0 (0.0)
Do not know	2(2.5)
The fluoride toothpaste is good for preventing dental caries	
Yes	67 (82.7)
No	5 (6.2)
Do not know	9 (11.1)
Bacteria was one of the reasons causing the gingivitis	
Yes	72 (88.9)
No	2 (2.5)
Do not know	7 (8.6)
Gingival bleeding is normal when tooth is brushed	
Yes	33 (40.7)
No	36 (44.4)
Do not know	12 (14.8)
Toothbrushing is an important way to prevent gingival bleeding	
Yes	59 (72.8)
No	9 (11.1)
Do not know	13 (16.0)
Hand dexterity relates to the effectiveness of toothbrushing	
Yes	71 (87.7)
No	2 (2.5)
Do not know	8 (9.9)
Total knowledge score[a]	6.38 (1.54)
Oral Health Attitude	n (%)
Regular dental check-ups prevent dental problems	
Agree	79 (97.5)
Disagree	2 (2.5)
The condition of my teeth is greatly important to me	
Agree	80 (98.8)
Disagree	1(1.2)
The condition of my teeth has been decided since birth and has no relation to self-care	
Disagree	64 (79.0)
Agree	17 (21.0)
Self-care is important for preventing dental problems	
Agree	79 (97.5)
Disagree	2 (2.5)
Total Attitude score[a]	3.73 (0.47)

[a]mean (SD)
Knowledge score: Min = 0, Max = 8
Attitude score: min=0, max= 4

CONTINUE

Table III Oral Health Practice of Caregivers of Children With CP(n=81)

Oral Health Practice of Caregivers of Children with CP	
Variables	n (%)
Frequency of toothbrushing	
More than once a day	72 (88.9)
Once a day	7 (8.6)
Seldom or do not brush	2 (2.5)
Type of toothpaste	
Fluoridated toothpaste	70 (86.4)
Unfluoridated toothpaste	4 (4.9)
Have no idea	7 (8.6)
Frequency of using dental floss at least once a day	
Yes	16 (19.8)
No	65 (80.2)
Frequency of sugar consumption	
More than once a day	47 (58.0)
Less than once a day	1 (1.2)
Once a day	33 (40.7)
Experience of toothache in the previous 12 months	
No	39 (48.1)
Often	42 (50.6)
Always	-
Action taken if there is toothache	
Nothing	4 (4.9)
Took medication	30 (37.0)
Went to the dentist for treatment	46 (56.8)
Others	1 (1.2)

CONTINUE

Oral Health Practice of Caregivers of Children with CP	
Variables	n (%)
Ever seen a dentist or dental nurse	
No	-
Yes	81 (100.0)
Last dental visit	
Less than a year ago	42 (51.9)
1 to 2 years ago	14 (17.3)
More than 2 years ago	25 (30.8)
[1]Practice score[a]	4.40 (1.29)
Oral health practice of caregivers towards their children with CP	
Toothbrushing practice among children with CP (with or without assistance)	
Yes	74 (91.4)
No	7 (8.6)
Amongst caregivers that practice toothbrushing on their children with CP (n=74)	
Assistance during toothbrushing with children with CP	
Yes	66 (89.2)
No	8 (10.8)
Type of toothbrush used on their children with CP	
Manual toothbrush	70 (94.6)
Modified	4 (5.4)
Electric	-
Type of bristle used on their children with CP	
Soft bristle	57 (77.0)
Medium	17 (23.0)
Hard	-
Frequency of toothbrushing on children with CP in a day	
Once	22 (29.7)
2 times	43 (58.1)
≥ 3 times	9 (12.2)
Frequency of toothbrushing on children with CP at night in a week	
Everyday	28 (37.8)
6 times / week	-
5 times / week	1 (1.4)
4 times / week	1 (1.4)
3 times / week	7 (9.5)
2 times / week	5 (6.8)
1 time / week	6 (8.1)
Never	26 (35.1)

CONTINUE

Oral Health Practice of Caregivers of Children with CP	
Replacement of toothbrush	
When the bristles become frayed with use	43 (58.1)
>3 months	31 (41.9)
Children with CP's last dental visit	
Within 6 months	28 (37.8)
6 months to 1 year	11 (14.9)
1 – 2 years	6 (8.1)
More than 2 years	13 (17.6)
Never	16 (21.6)
Reason for the last dental visit (n=58)	
Toothache	8 (13.8)
Dental trauma	0 (0.0)
Went for dental visit due to other oral health problem	14 (24.1)
Referral	36 (62.1)
Regular dentals check up	0 (0.0)
[2]Practice score[a]	3.95 (1.36)
Total Practice score[a]	8.36 (2.11)
Total KAP Mean Score	18.75 (2.91)

[a]mean(SD)
[1]Practice score: min=0, max=7
[2]Practice score: min=0, max=7
Total Practice score : min =0, max 14
Total KAP Mean score: min=0, max=26

high mean score indicates a better OHKAP.

Fig. 1 illustrates factors that facilitate toothbrushing practices among primary caregivers of children with CP, which contain two domains: environmental context (D1) and behavior regulation (D2). The most common facilitating factors towards toothbrushing identified in D1, which focuses on factors that ease parents to brush their child, are fear of poor oral health (97.6%) and family support (92.6%). In D2, which concerns factors encouraging children to brush at home, advice from dental professionals (67.9%) and preferring specific toothbrush types (66.6%) were mostly reported.

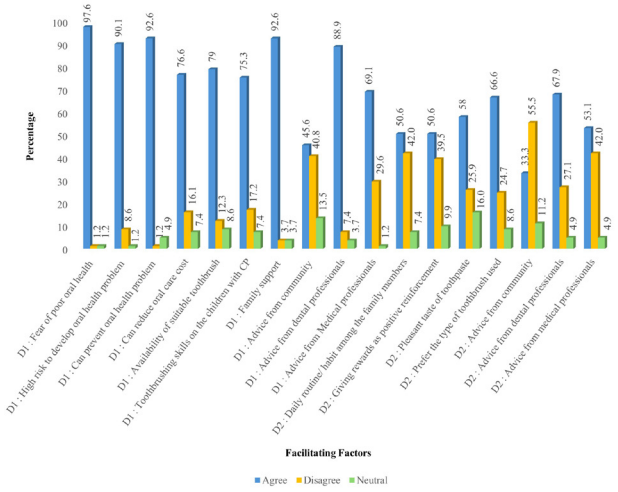

Fig. 1: Facilitating factors towards toothbrushing practices among primary caregivers of children with CP

Fig. 2 portrays the barriers to toothbrushing among caregivers of children with CP. The first domain (D1), which focuses on difficulty during brushing children, lack of access to oral health information (24.7%), and lack of time (21.0%), were identified as the most common barrier towards toothbrushing. Meanwhile, the D2 focuses on the child's reason for not brushing their teeth. Notably, the most reported barriers were the child's bad mood (56.8%), forceful brushing by parents (38.3%), and the child is not liking to put anything in their mouth (32.1%).

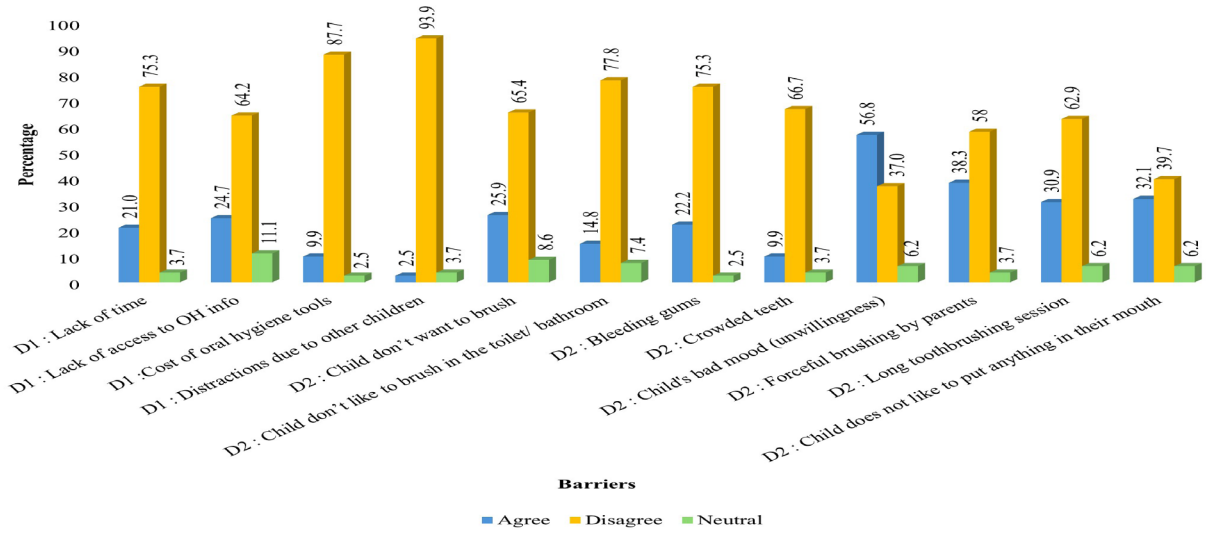

Fig. 2: Barriers towards toothbrushing practices among primary caregivers of children with CP

Table IV presents the association between various factors (OHKAP, primary caregivers' profiles including sex, age, relation to child, education level, and household income) and the facilitating factors of toothbrushing. Among primary caregivers who agreed that their skills in toothbrushing facilitate the practice, the mean (SD) OHKAP score was significantly higher [19.31 (2.79)] compared to those who did not agree [17.05 (2.66), p-value = 0.002]. Similarly, caregivers who agreed that their children preferred the type of toothbrush had a significantly higher mean (SD) OHKAP score [19.39 (2.58)] compared to those who disagreed [17.85 (3.22), p-value = 0.037]. For other factors within this domain, there were no significant differences in OHKAP scores ($p > 0.05$).

Table IV: The factors (OHKAP, primary caregivers profiles: sex, age, relation to children with CP, education level and household income) associated with the facilitating factors towards toothbrushing (n=81)

Variables	n	OHKAP Mean (SD)	p-value	Sex n(%)		p-value	Age Mean (SD)	p-value	Relation to children with CP n(%)			p-value	Education level n(%)		p-value	Household Income n(%)		p-value
				M	F				FA	MO	O		F5 and below	F6 and above		B40	M40 & T20	
Facilitating factors to toothbrushing																		
1. The factors that ease parents to brush their child at home (Environmental context)																		
Fear of poor oral health																		
Agree	79	18.71 (2.91)		12 (15.2)	67(84.8)		43.66(9.35)		12(15.2)	59(74.7)	8(10.1)		48(60.8)	31(39.2)		59(74.7)	20(25.3)	
Disagree	2	20.51 (3.53)	0.394[a]	0(0)	2(100)	0.724[c]	41.50(12.02)	0.749[a]	0(0)	2(100)	0(0)	0.715[b]	1(50.0)	1(50.0)	0.637[c]	2(100)	0(0)	0.565[c]
Child's high risk to develop oral health problem																		
Agree	73	18.64 (2.94)		12(16.4)	61(83.6)		43.99(9.50)		12(16.4)	54(74.0)	7(9.6)		44(60.3)	29(39.7)		55(75.3)	18(24.7)	
Disagree	8	19.75 (2.60)	0.245[a]	0(0)	8(100)	0.260[c]	40.13(7.36)	0.311[a]	0(0)	7(87.5)	1(12.5)	0.460[b]	5(62.5)	3(37.5)	0.609[c]	6(75.0)	2(25.0)	0.637[c]
Can prevent oral health problem																		
Agree	75	18.80 (2.92)		11(14.7)	64(85.3)		43.61(9.53)		11(14.7)	56(74.7)	8(10.7)		45(60.0)	30(40.0)		57(76.0)	18(24.0)	
Disagree	6	18.17 (2.99)	0.611[a]	1(16.7)	5(83.3)	0.611[b]	43.50(7.26)	0.430[a]	1(16.7)	5(83.3)	0(0)	0.701[b]	4(66.7)	2 (33.3)	0.555[c]	4 (66.7)	2 (33.3)	0.462[c]
Can reduce oral care cost																		
Agree	62	18.98 (3.10)		12(19.4)	50(80.6)		43.18(9.17)		12(19.4)	45(72.6)	5(8.1)		36(58.1)	26(41.9)		47(75.8)	15(24.2)	
Disagree	19	18.00 (2.11)	0.200[a]	0(0.0)	19(100)	0.083[c]	45.00(10.02)	0.460[a]	0(0.0)	16(84.2)	3(15.8)	0.090[b]	13(68.4)	6(31.6)	0.298[c]	14(73.7)	5(26.3)	0.535[c]
Availability of suitable toothbrush																		
Agree	64	19.09 (2.71)		9(14.1)	55(85.9)		42.70(8.89)		9(14.1)	50(78.1)	5(7.8)		35(54.7)	29(45.3)		47(73.4)	17(26.6)	
Disagree	17	17.47 (3.37)	0.054[a]	3(17.6)	14(82.4)	0.484[c]	47.00(10.46)	0.092[a]	3 (17.6)	9 (64.7)	3 (17.6)	0.416[b]	14 (82.4)	3(17.6)	0.303[c]	14 (82.4)	13 (17.6)	0.340[c]
Skills to toothbrush children with CP																		
Agree	61	19.31 (2.79)		9(14.8)	52(85.2)		43.97(9.62)		9(14.8)	46(75.4)	6(9.8)		35(57.4)	26(42.6)		45(73.8)	16(26.2)	
Disagree	20	17.05 (2.66)	0.002[a]	3 (15.0)	17 (85.0)	0.615[c]	43.50(8.56)	0.545[a]	3 (15.0)	15 (75.0)	2 (10.0)	0.999[b]	14 (70.0)	6 (30.0)	0.232[c]	16 (80.0)	4 (20.0)	0.407[c]
Family support																		
Agree	75	18.87 (2.94)		10(13.3)	65(86.7)		43.72(9.48)		10(13.3)	57(76.0)	8(10.7)		43(57.3)	32(42.7)		55(73.3)	20(26.7)	
Disagree	63	17.33 (2.34)	0.217[a]	2 (33.3)	4 (66.7)	0.215[c]	42.17(7.94)	0.698[a]	2 (33.3)	4 (66.7)	0(0.0)	0.332[b]	6(100)	0(0.0)	0.153[c]	6(100)	0(0.0)	0.171[c]
Advice from community (neighbours, head village, NGO)																		
Agree	37	18.86 (3.29)		5(13.5)	32(86.5)		42.68(10.67)		5(13.5)	28(75.7)	4(10.8)		21(56.8)	16(43.2)		27(73.0)	10(27.0)	
Disagree	44	18.65 (2.58)	0.754[a]	5(15.9)	37(84.1)	0.507[c]	44.39(8.90)	0.193[a]	7 (15.9)	33 (75.0)	4(9.1)	0.933[b]	28 (63.6)	16 (36.4)	0.343[c]	34 (77.3)	10 (22.7)	0.424[c]

CONTINUE

Table IV: The factors (OHKAP, primary caregivers profiles: sex, age, relation to children with CP, education level and household income) associated with the facilitating factors towards toothbrushing (n=81) (CONT.)

Variables	n	OHKAP Mean (SD)	p-value	Sex n (%)		p-value	Age Mean (SD)	p-value	Relation to children with CP n (%)			p-value	Education level n (%)		p-value	Household Income n (%)		p-value
				M	F				FA	MO	O		F5 and below	F6 and above		B40	M40 & T20	
Facilitating factors to toothbrushing																		
1. The factors that ease parents to brush their child at home (Environmental context)																		
Fear of poor oral health																		
Advice from dental professionals																		
Agree	72	18.99 (2.88)		11(15.3)	61(84.7)		43.49(9.69)		11(15.3)	54(75.0)	7(9.7)		42(58.3)	30(41.7)		53(73.6)	19(26.4)	
Disagree	9	17.83 (2.23)	0.343[a]	1(11.1)	8(88.9)	0.662[c]	44.56(6.23)	0.748[a]	1 (11.1)	7 (77.8)	1 (11.1)	0.443[b]	7 (77.8)	2 (22.2)	0.227[c]	8 (88.9)	1(11.1)	0.292[c]
Advice from medical professionals																		
Agree	56	19.09 (3.14)		11(19.6)	45(80.4)		42.80(9.65)		11(19.6)	40(71.4)	5(8.9)		34(60.7)	22(39.3)		42(75.0)	14(25.0)	
Disagree	25	18.00 (2.27)	0.128[a]	1(4.0)	24(96.0)	0.061[c]	45.40(8.51)	0.250[a]	1(4.0)	21(84.0)	3(12.0)	0.184[b]	15(60.0)	10 (31.3)	0.571[b]	19(76.0)	5(24.0)	0.579[b]
2. The factors that encourage the children to brush at home (Behaviour regulation)																		
Daily routine/ habit among the family members																		
Agree	41	19.32 (2.85)		5(12.2)	36(87.8)		43.90(10.60)		5(12.2)	30(73.2)	6(14.6)		25(61.0)	16(39.0)		30(73.2)	11(26.8)	
Disagree	40	18.18 (2.89)	0.078[a]	7 (17.5)	33 (82.5)	0.360[c]	43.24(8.06)	0.764[a]	7 (17.5)	31 (77.5)	2 (5.0)	0.311[b]	24 (60.0)	16(50.0)	0.553[c]	31(77.5)	9(22.5)	0.423[c]
Giving rewards as positive reinforcement																		
Agree	41	19.02 (3.09)		4(9.8)	37(90.2)		45.22(11.12)		4(9.8)	30(73.2)	7(17.1)		25(61.0)	16(39.0)		31(75.6)	10(24.4)	
Disagree	40	18.75 (2.49)	0.684[a]	8 (20.0)	32 (80.0)	0.163[c]	42.47(6.79)	0.111[a]	8 (20.0)	31 (77.5)	1 (2.5)	0.054[b]	24 (60.0)	12(40.0)	0.555[c]	30 (75.0)	10 (25.0)	0.577[c]

CONTINUE

Table IV: The factors (OHKAP, primary caregivers profiles: sex, age, relation to children with CP, education level and household income) associated with the facilitating factors towards toothbrushing (n=81) (CONT.)

Variables	n	OHKAP Mean (SD)	p-value	Sex n (%)		p-value	Age Mean (SD)	p-value	Relation to children with CP n (%)			p-value	Education level n (%)		p-value	Household Income n (%)		p-value
				M	F				FA	MO	O		F5 and below	F6 and above		B40	M40 & T20	
Facilitating factors to toothbrushing																		
2. The factors that encourage the children to brush at home (Behaviour regulation)																		
Pleasant taste of toothpaste																		
Agree	47	19.36 (2.56)		5(10.6)	42(89.4)		44.06(10.01)		5(10.6)	37(78.7)	5(10.6)		28(59.6)	19(40.4)		36(76.6)	11(23.4)	
Disagree	34	18.67 (2.76)	0.316[a]	7 (20.6)	27 (79.4)	0.177[c]	45.19(8.08)	0.652[a]	7 (20.6)	24 (70.6)	3 (8.8)	0.459[b]	21 (61.8)	13 (38.2)	0.514[c]	25 (73.5)	9 (26.5)	0.475[c]
Prefer the type of toothbrush used																		
Agree	54	19.39 (2.58)		5(9.3)	49(90.7)		43.89 (9.63)		5(9.3)	44(81.5)	5(93)		32(59.3)	22(40.7)		41(75.9)	13(24.1)	
Disagree	27	17.85 (3.22)	0.037[a]	7 (25.9)	20 (74.1)	0.051[c]	43.80(9.09)	0.972[a]	7 (25.9)	17 (63.0)	3(11.1)	0.119[b]	17 (63.0)	10 (37.6)	0.470[c]	20 (74.1)	7(25.9)	0.530[c]
Advice from community (neighbours, head village, NGO)																		
Agree	27	19.48 (2.99)		5(18.5)	22(81.5)		44.48(10.71)		5(18.5)	19(70.4)	3(11.1)		14(51.9)	13(48.1)		18(66.7)	9(33.3)	
Disagree	54	18.51 (2.77)	0.167[a]	7 (13.0)	47 (87.0)	0.362[c]	43.80(8.95)	0.772[a]	7 (13.0)	42 (77.8)	5 (9.3)	0.753[b]	35 (64.8)	19 (35.2)	0.188[c]	43 (79.6)	11(20.4)	0.158[c]
Advice from dental professionals																		
Agree	55	19.02 (2.72)		7(12.7)	48(87.3)		44.09(9.22)		7(12.7)	43(78.2)	5(9.1)		35(63.6)	20(36.4)		44(80.0)	11(20.0)	
Disagree	26	18.73 (3.04)	0.683[a]	5 (19.2)	21(80.8)	0.324[c]	43.36(9.69)	0.759[a]	5 (19.2)	8 (69.2)	3(11.5)	0.671[b]	14 (53.8)	12 (46.2)	0.274[c]	17 (65.4)	9 (34.6)	0.126[c]
Advice from medical professionals																		
Agree	43	19.40 (2.90)		8(18.6)	35(81.4)		43.79(9.68)		8(18.6)	31(72.1)	4(9.3)		26(60.5)	17(39.5)		33(76.7)	10(23.3)	
Disagree	38	18.35 (2.58)	0.105[a]	4 (10.5)	34 (91.2)	0.241[c]	44.00(8.94)	0.923[a]	4 (10.5)	30 (78.9)	4 (10.5)	0.593[b]	23 (60.5)	15 (39.5)	0.588[c]	28 (73.7)	10 (26.3)	0.475[c]

The p-value is set as significant at $p<0.05$.
[a]independent t-test : equal variance assumed
[b]Pearson Chi-square test
[c]Fisher's Exact test / Fisher-Freeman-Halton exact test
M = Male, F = Female, FA = Father, MO = Mother, 0 = Other, F5 = Form 5, F6 = Form 6

Table V explores factors (OHKAP, primary caregiver profiles: sex, age, relation to children with CP, education level, and household income) associated with barriers to toothbrushing. There was a statistically significant difference between OHKAP mean scores and the barrier of children not wanting to brush their teeth. Caregivers with higher mean (SD) OHKAP scores [19.38 (2.88)] disagreed that children do not want to brush compared to those who agreed [17.52 (2.64)], (p-value = 0.013). Other than that, there was a significant association between the sex of primary caregivers and several barriers, whereby more females disagreed that lack of access to oral health information was one of the barriers (p=0.025). Meanwhile, more females agreed with the barrier of the child's bad mood (p=0.041) and forceful brushing by parents (p=0.006). Regarding the relationship to children with CP, there were significant associations between mothers who agreed that lack of access to OH information (p=0.039), the child's bad mood (p=0.007), and forceful brushing by parents (p=0.006) were the barriers compared to fathers. Additionally, primary caregivers with higher education levels demonstrated a significant association with the barrier of children's reluctance to brush in the bathroom (p=0.033).

Table V: The factors (OHKAP, primary caregivers profiles : sex, age, relation to children with CP, education level and household income) associated with the barriers towards toothbrushing (n=81)

Variables	n	OHKAP Mean (SD)	p-value	Sex n (%)		p-value	Age Mean (SD)	p-value	Relation to children with CP n (%)			p-value	Education level n (%)		p-value	Household Income n (%)		p-value
				M	F				FA	MO	O		F5 and below	F6 and above		B40	M40 & T20	
Barriers to toothbrushing																		
1.Difficulty during brushing child's teeth (Environmental context)																		
Lack of time																		
Agree	17	18.35 (3.10)		3(17.6)	14(82.4)		47.24(10.12)		3(17.6)	12(70.6)	2(11.8)		10(58.8)	7(41.2)		13(76.5)	4(23.5)	
Disagree	64	18.85 (2.93)	0.541[a]	9(14.1)	55(79.7)	0.484[c]	42.66 (9.08)	0.077[a]	9(14.1)	49(76.4)	12(9.4)	0.879[c]	39(62.3)	25(37.7)	0.795[b]	48(75.0)	16(25.0)	0.588[c]
Lack of access to oral health information																		
Agree	20	18.15 (3.41)		0(0.0)	20(100)		43.05(11.08)		0(0.0)	17(85.0)	3(15.0)		12(60.0)	8(40.0)		15(75.0)	5(25.0)	
Disagree	61	19.19 (2.69)	0.177[a]	12(19.7)	49(71.0)	0.025[c]	43.50 (8.68)	0.858[a]	12(19.7)	44(72.1)	5(8.2)	0.039[c]	36(59.6)	25(40.4)	0.597[c]	46(75.4)	15(24.6)	0.593[b]
Cost of oral hygiene tools																		
Agree	8	17.88 (2.36)		2(25.0)	6(75.0)		44.13 (7.22)		2(25.0)	6(75.0)	0(0.0)		5(62.5)	3(37.5)		7(87.5)	1(12.5)	
Disagree	73	17.88 (2.97)	0.403[a]	10 (13.7)	63 (86.3)	0.338[c]	43.56 (9.57)	0.873[a]	10 (13.7)	55 (75.3)	8(11.0)	0.473[c]	43(60.6)	28(39.4)	0.616[c]	4(74.0)	19(26.0)	0.363[c]
Distractions due to other children																		
Agree	2	15.00 (1.41)		1(50.0)	1(50.0)		46.50 (0.72)		1(50.0)	1(50.0)	0(0.0)		2(100)	0(0.0)		2(100)	0(0.0)	
Disagree	79	18.78 (2.89)	0.070[a]	11(13.9)	68 (86.1)	0.276[c]	43.63 (9.52)	0.673	11(13.9)	60(75.4)	8(10.1)	0.352[c]	47(60.5)	32(39.5)	0.376[c]	59(74.7)	20(25.3)	0.565[c]
2. Child's reason for not brushing their teeth (Behaviour regulation)																		
Child don't want to brush																		
Agree	21	17.52 (2.64)		4(19.0)	17(81.0)		41.43 (8.46)		4(19.0)	17(81.0)	0(0.0)		11(52.4)	10(47.6)		16(76.2)	5(23.8)	
Disagree	60	19.38 (2.88)	0.013[a]	8 (13.3)	52(86.7)	0.377[c]	44.04 (8.89)	0.252[a]	8(13.3)	44(73.3)	8(13.3)	0.196[c]	39(67.9)	21(32.1)	0.210[b]	45 (75.0)	15(25.0)	0.882[b]
Child don't like to brush in the toilet/ bathroom																		
Agree	12	18.33 (1.50)		2(16.7)	10(83.3)		43.00 (8.78)		2 (16.7)	9 (75.0)	1 (1.3)		4 (33.3)	8 (66.7)		9 (75.0)	3 (25.0)	
Disagree	69	19.08 (2.67)	0.477[a]	10 (14.5)	59 (85.5)	0.566[c]	45.20 (9.46)	0.725[a]	10 (14.5)	52 (75.4)	7 (10.1)	0.967[c]	45 (66.7)	24 (33.3)	0.033[b]	52 (75.0)	17(246)	0.615[c]

CONTINUE

Table V: The factors (OHKAP, primary caregivers profiles : sex, age, relation to children with CP, education level and household income) associated with the barriers towards toothbrushing (n=81) (CONT.)

Variables	n	OHKAP Mean (SD)	p-value	Sex n (%)		p-value	Age Mean (SD)	p-value	Relation to children with CP n (%)			p-value	Education level n (%)		p-value	Household Income n (%)		p-value
				M	F				FA	MO	O		F5 and below	F6 and above		B40	M40 & T20	
Barriers to toothbrushing																		
2. Child's reason for not brushing their teeth (Behaviour regulation)																		
Bleeding gums																		
Agree	18	18.22 (2.67)	0.284[a]	3 (16.7)	15 (83.3)	0.550[c]	41.72 (7.20)	0.356[a]	3 (16.7)	15 (83.3)	0 (0.0)	0.384[c]	9 (50.0)	9 (50.0)	0.287[b]	15 (83.3)	3 (16.7)	0.287[c]
Disagree	63	19.05 (2.91)		9 (14.3)	54 (85.7)		43.89 (4.06)		9 (14.3)	46(73.0)	8 (12.7)		40 (63.9)	23(36.1)		46 (73.0)	17 (27.0)	
Crowded teeth																		
Agree	8	19.13 (2.10)	0.860[a]	1 (12.5)	7 (87.5)	0.662[c]	43.00 (7.41)	0.826[a]	1 (12.5)	7 (87.5)	0 (0.0)	0.582[c]	3 (37.5)	5 (62.5)	0.157[c]	7 (87.5)	1 (12.5)	0.363[c]
Disagree	73	18.94 (2.81)		11 (15.1)	62(84.9)		43.70 (8.63)		11 (15.1)	54 (74.0)	8 (11.0)		47 (62.9)	26 (37.1)		54(74.0)	19 (26.0)	
Child's bad mood (unwillingness)																		
Agree	46	18.50 (2.92)	0.157[a]	10 (21.7)	36 (78.3)	0.041[c]	42.30 (8.20)	0.087[a]	10 (21.7)	35 (76.1)	1(2.2)	0.007[c]	26 (56.5)	20 (43.5)	0.174[c]	32(69.6)	14 (30.4)	0.132[c]
Disagree	35	19.47 (2.83)		2 (5.7)	33 (94.3)		46.10 (10.88)		2 (5.7)	26 (74.3)	7 (20.0)		21 (70.0)	9 (30.0)		29(82.9)	.16 (17)	
Forceful brushing by parents																		
Agree	31	18.13 (3.17)	0.058[a]	9 (29.0)	22 (71.0)	0.006[c]	41.26 (8.19)	0.080[a]	9 (29.0)	21 (67.7)	1(3.2)	0.006[c]	16 (51.6)	15 (48.4)	0.143[b]	22 (71.0)	9 (29.0)	0.324[b]
Disagree	50	19.38 (2.57)		3(6.0)	47 (94.0)		45.00 (9.67)		3(6.0)	40 (80.0)	7 (14.0)		32 (68.1)	15 (31.9)		39 (78)	11(22.0)	
Long toothbrushing session																		
Agree	25	18.40 (3.40)	0.387[a]	6 (24.0)	19 (76.0)	0.114[c]	43.16 (8.55)	0.652[a]	6 (24.0)	18 (72.0)	1 (4.0)	0.185[c]	14 (56.0)	11 (44.0)	0.280[b]	20 (80.0)	5 (20.0)	0.360[b]
Disagree	56	19.02 (2.65)		6 (10.7)	50 (89.3)		44.22 (9.99)		6 (10.7)	43 (76.8)	7 (12.7)		35 (68.6)	16 (31.4)		41 (73.2)	15 (26.8)	
Child does not like to put anything in their mouth																		
Agree	26	18.35 (3.30)	0.298[a]	7 (26.9)	19 (73.1)	0.094[c]	41.77 (8.58)	0.126[a]	7 (26.9)	18 (69.2)	1 (3.8)	0.104[c]	12 (46.2)	14 (53.8)	0.095[b]	18 (69.2)	8 (30.8)	0.271[b]
Disagree	55	19.08 (2.67)		5 (9.9)	50(90.9)		45.20 (9.46)		5 (9.1)	43(78.2)	7 (12.7)		33 (66.0)	17 (34.0)		43(78.2)	12 (21.8)	

The p-value is set as significant at $p<0.05$.
[a]independent t-test : equal variance was assumed
[b]Pearson Chi-square test
[c]Fisher's Exact test / Fisher-Freeman-Halton exact test
M = Male, F = Female, FA = Father, MO = Mother, 0 = Other, F5 = Form 5, F6 = Form 6

DISCUSSION

A cross-sectional study was conducted in Kelantan from April to May 2024 at CBR under the Disabled Development Department (JPPWD), JKM. The study focused on children with CP who had been enrolled in CBR since their early age for rehabilitation and training in motor skills, cognitive development, and activities of daily living. These children typically begin attending CBR shortly after diagnosis, often around the age of diagnosis, to receive multidisciplinary therapies tailored to their specific needs.

Sociodemographic profiles of the caregivers of children with CP

Most of the 81 primary caregivers were female, and their mean age was 43.60 years, similar to the study reported by Bizarra et al. (2022). This indicates a consistent demographic trend across diverse study populations (22–24). In particular, most primary caregivers of children with CP were mothers (75.3%), consistent with studies revealing mothers as the predominant caregivers, followed by fathers (15,22). Additionally, most primary caregivers in this study had achieved upper secondary education (44.0%) and belonged to the B40 income group (75.3%). While this finding reflects the socioeconomic profile of caregivers in our sample, studies conducted in Kelantan and Negeri Sembilan have similarly reported that caregivers of children with CP often come from lower socioeconomic backgrounds (25,26). Moreover, most caregivers (76.5%) received oral health information from healthcare workers, consistent with previous studies (27). This effective communication by healthcare workers builds trust and act as a source of reliable information, essential for better healthcare outcomes (28).

Sociodemographic profiles of the children with CP

This study included 81 children with CP with a mean age of 10.3 years and mostly male (63%), consistent with the higher male prevalence in other studies (23,25,29,30). Diplegia and quadriplegia were the most common classifications, aligning with previous research (22). While 32.1% had other medical issues like epilepsy and asthma, most of the children did not. Furthermore, epilepsy, a common comorbidity, affects up to 49% of children with CP in some studies (22). Children with CP commonly face challenges during toothbrushing, such as biting the toothbrush, closing their mouth, or difficulty opening it, consistent with a study in Lisbon reporting closed mouth as the most frequent issue (24). Unlike children with Down Syndrome, who often turn their heads away, these behaviors in CP likely stem from motor control and coordination difficulties, affecting lip and jaw movement necessary for effective toothbrushing. However, none of the caregivers reported children running away during toothbrushing, possibly due to mobility limitations from quadriplegia or diplegia types of CP.

Oral Health Knowledge, Attitude, and Practices (OHKAP)

Regarding the OHK, most of the caregivers were aware of the link between sugars and dental caries. This awareness may be attributed to ongoing public health campaigns and dental health education provided by healthcare workers, as noted in previous studies (29). Additionally, there were mixed opinions on the normalcy of gingival bleeding during toothbrushing, highlighting the need for more education on periodontal health (32). While caregivers generally exhibited positive oral health attitudes, their knowledge did not always translate into practice, as many failed to implement recommended habits such as regular dental visits and sugar intake reduction (16). In terms of OHP, caregivers' actual oral health habits and their care for children with CP varied. While most assisted their children with toothbrushing, adherence to recommended practices like brushing twice daily and regular dental visits was inconsistent. Some caregivers cited difficulties in night-time toothbrushing, indicating the need for support in overcoming obstacles to oral health care (29).

Facilitating factors towards toothbrushing

Our study discovered that caregivers primarily brush their children's teeth out of fear of poor oral health, aligning with research emphasizing the role of understanding risks in promoting oral hygiene (14,33). However, studies on CSNs suggest that caregivers prioritise other factors over oral health concerns (15). Family support emerged as a crucial facilitator, echoing research demonstrating that positive reinforcement encourages healthy hygiene habits (14,34). Additionally, many caregivers also thought that brushing teeth was a good way to prevent oral health issues, as reported in our study. Some parents of typically developing children occasionally blame tooth decay were due to genetic factors rather than oral hygiene alone (34).

Other than that, most primary caregivers believe their children are likely to have oral health issues, suggesting a significant concern about their children's oral health. This is consistent with a review indicating that parents who understand and know about oral health are more likely to brush their children's teeth (14). These caregivers also recognized the difficulties faced by children with CP, such as developmental enamel deficiencies resulting from prenatal infections, which increase the likelihood of oral health issues (8). Furthermore, primary caregivers asserted that as their confidence and skills grew over time, they discovered that brushing got simpler and easier with practice and became a natural part of their daily routine (15).

Barriers towards toothbrushing

In this study, most primary caregivers of children presented a lower level of agreement with a barrier to toothbrushing, likely because they felt capable of handling the task. Despite improving toothbrushing rates

among children with CP which are in agreement among those in Japan and Sudan, oral health issues like dental caries and gingivitis remain higher than those without CP (29,35). Possible reasons for this trend include caregivers' ineffective toothbrushing practice and other factors like diet and medication (36). In addition, the caregivers often prioritise the general health of children with CP over their oral health (37). Even though our study reported that 91.4% of children with CP brushed their teeth, additional investigation is required to understand the underlying reasons for this problem.

Primary caregivers mostly identified their child's mood as the main barrier to toothbrushing, echoing findings from previous research (14,15). Some children resist brushing, either actively refusing or being uncooperative. However, those studies suggest that children respond more positively when toothbrushing is presented as a task they can control. Due to impaired motor skills, children with CP may rely heavily on caregivers, making caregiver involvement are vital for their rehabilitation.

Interestingly, lack of time was not a significant concern for most of the caregivers. This contrasts with previous studies where lack of time was a top barrier, possibly due to different caregiver demographics (15). Additionally, caregivers did not find oral hygiene tool costs prohibitive, prioritizing other expenses like diapers and nutritional needs. Nonetheless, CP's chronic nature poses financial challenges, potentially limiting access to necessary services (38).

The factors (OHKAP, primary caregivers' profiles: sex, age, relation to children with CP, education level, and household income) associated with the facilitating factors towards toothbrushing.

Primary caregivers with higher OHKAP scores were more likely to agree that skills and toothbrush preference facilitated toothbrushing. This aligns with research showing that informed parents support supervised toothbrushing due to their understanding of proper technique and tools for effective oral care (14). However, other studies found that self-efficacy does not always translate to consistent brushing, highlighting a gap between intention and practice (28). Additionally, more females viewed toothbrushing as cost-effective than males, likely due to their role in managing household finances and education level influences willingness to pay for oral healthcare, with higher-educated caregivers recognizing the cost-saving benefits of toothbrushing. Neglecting oral hygiene can lead to costly treatments, adding financial strain (40). Other than that,, caregivers must bear expenses for nutritious diets and medical needs, with many reporting hospitalizations or additional treatments (41). Younger caregivers agreed that suitable toothbrushes facilitate brushing for children with CP which support generational attitudes influence shopping habits, guiding targeted product and advertising strategies (42). Our study also underscores the role of primary caregivers in children's oral health. Regardless of their relationship with the child, providing caregivers with education and practical skills can enhance children's oral health and foster collaboration with healthcare professionals (38).

The factors (OHKAP, primary caregivers' profiles: sex, age, relation to the child, education level, and household income) associated with the barriers towards toothbrushing.

Caregivers with higher OHKAP scores disagreed with barriers such as children refusing to brush. Positive oral health knowledge and experiences foster appropriate behavior, with caregivers serving as role models (16). Their positive influence also reduces challenges like distractions and forceful brushing (15). However, caregivers with higher OHKAP scores acknowledged that a child's bad mood can be a barrier. Studies show that children with CP often resist brushing, necessitating constructive parenting techniques such as explaining oral health in simple terms which requires caregivers to have sufficient knowledge to communicate effectively (43). Most female caregivers did not perceive lack of access to oral health information as a barrier, as younger caregivers frequently seek online resources, improving their awareness and navigation of oral hygiene practices (44). Additionally, the strong association between caregiver sex and a child's mood highlights the emotional labour mothers invest in managing brushing-related challenges (14,43). Many female caregivers also rejected forceful brushing, recognizing its potential to worsen resistance (14).

This study found that caregiver-child relationships influence perceived barriers, with many mothers citing children's poor behavior as a key challenge. However, they did not see access to oral health information or forceful brushing as major barriers, likely due to available digital resources and local clinics (14,44). Addressing these emotional aspects is crucial for families of children with CP. Across all education levels, caregivers reported brushing their children's teeth primarily in the bathroom, aligning with studies showing that while many parents prefer this setting, others choose alternative spaces like bedrooms or living rooms to enhance comfort and engagement (45). Our analysis found no significant association between household income and perceived barriers. However, most caregivers, regardless of income, identified a child's bad mood as a barrier. Thus, caregivers can better manage their child's mood by using techniques that enhance communication, offer positive reinforcement, and create a supportive environment (34). Effective communication strategies, including the Communication Function Classification System (CFCS), can help caregivers manage their child's mood. For children with higher communication abilities (Levels I–II), verbal praise and active listening are effective, while those with lower abilities (Levels III–V) benefit from visual aids and alternative communication methods (46). Creating a supportive environment with

positive reinforcement fosters effective communication and emotional well-being across all CFCS levels.

Practical Implications, Recommendations and Limitation

There is “no one size fits all" approach to patient education as each patient has various learning demands (47). Therefore, oral health education materials and interventional activities should be customised and written at a reading level appropriate for most caregivers' educational backgrounds (47). Our study found that caregivers with higher OHKAP scores were more confident in managing their child's brushing and choosing suitable toothbrushes, underscoring the need for structured interventions. Implementing interactive brushing workshops and regular healthcare follow-ups at CBRs can enhance adherence to oral hygiene routines. Research by Angarita et al. (48) and Aliakbari et al. (14) supports this, showing that interactive workshop and home-based training significantly improve caregivers' knowledge and supervised brushing practices, leading to better oral health outcomes.

These programs should also address gender-specific needs, as more female caregivers in our study viewed toothbrushing as cost-effective way to reduce oral care expanses. Since female caregivers often bear greater emotional and household responsibilities, structured workshops and follow-ups can boost their confidence and lessen their caregiving burden (49). Similar to interprofessional skills workshops for dementia caregivers by Prado et al. (50), which have been shown to enhance caregiver confidence and preparedness in managing complex care tasks, hands-on brushing workshops can equip caregivers with practical skills to improve their child’s oral health management. To enhance program effectiveness, educational materials should be accessible, using simple language and infographics to aid comprehension, especially for caregivers with lower literacy levels (47). Providing patient education packets before clinic visits can further support learning, as illustrated materials significantly improve understanding, particularly for individuals with limited reading skills. Combining interactive training with visual resources can strengthen caregivers' oral health management skills, benefiting children with CP.

However, there are some limitations in this study. First, due to the low prevalence of CP , potential selection bias may have occurred because the caregivers attending CBRs may have greater healthcare access, which may limit the study’s generalizability. Future studies should include diverse settings to improve representativeness. Second, caregiver recall bias could affect the accuracy of reported experiences and challenges, making the findings less applicable to broader populations. Future research could use objective measures like direct observation to improve accuracy. Third, social desirability bias may have led caregivers to report more favourable oral health practices. Anonymous surveys and validated assessment tools could help minimize this bias.

Additionally, there was a discrepancy between the estimated sample size and the final sample, as only 81 eligible primary caregivers were available. Although the sample was obtained from a single institution, which is CBR, it encompassed all CBR centres in Kelantan to ensure comprehensive coverage of this population. However, the inherent limitation in sample availability may have slightly reduced statistical power, potentially affecting the detection of smaller effect sizes. Despite this, universal sampling minimized selection bias, and the findings remain representative within the Kelantan CBR context. Future studies with a larger sample, possibly including caregivers from other settings to enhance generalizability

CONCLUSION

Most of the primary caregivers of children with CP were reported to have a common facilitating factor and barrier, which was fear of poor OH and the child's bad mood, respectively. In particular, toothbrushing skills and preferences for toothbrushes were associated with higher OHKAP scores. Furthermore, caregivers' sex and relationship with the child were associated with several barriers, such as lack of access to oral health information, the child's bad mood, and forceful brushing. Additionally, education level was linked to children disliking brushing in the bathroom.

ACKNOWLEDGEMENT

We are thankful to the dedicated officers overseeing each CBR in Kelantan for their assistance throughout the process. We also express profound appreciation to all primary caregivers of children with CP for generously sharing their insights and experiences during this study.

REFERENCES

1. Pakula AT, Van Naarden Braun K, Yeargin-Allsopp M. Cerebral Palsy: Classification and Epidemiology. Phys Med Rehabil Clin N Am. 2009;20:425–452. doi: 10.1016/j.pmr.2009.06.001.
2. Dougherty NJ. A Review of Cerebral Palsy for the Oral Health Professional. Dent Clin North Am. 2009;53:329–338. doi: 10.1016/j.cden.2008.12.001.
3. Stavsky M, Mor O, Mastrolia SA, Greenbaum S, Than NG, Erez O. Cerebral palsy-trends in epidemiology and recent development in prenatal mechanisms of disease, treatment, and prevention. Front Pediatr. 2017.
4. Department of Statistics Malaysia. Person With Disability Statistics, Malaysia, 2022 [Internet]. 2024 [cited 2024 May 3]. Available from: https://www.dosm.gov.my/portal-main/release-content/person-with-disability-2022-.
5. Bakar MAA, Samat N, Yaacob NS. Spatial

accessibility to health care services among children with cerebral palsy in Johor, Peninsular Malaysia. Geospat Health. 2021;16. doi: https://doi.org/10.4081/gh.2021.987.
6. UNICEF. UNICEF Children with disability in Malaysia 2014. 2014.
7. Cui S, Akhter R, Yao D, Peng XY, Feghali MA, Chen W, Blackburn E, Martin EF, Khandaker G. Risk Factors for Dental Caries Experience in Children and Adolescents with Cerebral Palsy—A Scoping Review. Int J Environ Res Public Health. 2022;19. doi: 10.3390/ijerph19138024a.
8. Karaseridis K, Dermata A. Cerebral palsy: Oral manifestations and dental management. Balkan Journal of Dental Medicine. 2023;27:1–7. doi: 10.5937/bjdm2301001k.
9. Moreira RN, Alcântara CEP, Mota-Veloso I, Marinho SA, Ramos-Jorge ML, Oliveira-Ferreira F. Does intellectual disability affect the development of dental caries in patients with cerebral palsy? Res Dev Disabil. 2012;33:1503–1507. doi: 10.1016/j.ridd.2012.03.026. Cited: in: : PMID: 22522208.
10. Jan BM. Dental health of children with cerebral palsy. Neurosciences Journal. 2016;21. doi: 10.17712/nsj.2016.4.20150729.
11. Clбudio MM, Rodrigues JVS, Garcia VG, Theodoro LH. Prevalence of gingival hyperplasia induced by anticonvulsants: A systematic review. Braz Dent Sci. 2021;24. doi: 10.14295/bds.2021.v24i1.2112.
12. Amitha MH, Aiswarya AB, Anshad M, Anu J, Kanwardeep S, Preethi V, Swathi S. Special Needs of Special Children-Parental View. Journal of Health and Allied Sciences NU. 2015;5:038–044. doi: 10.1055/s-0040-1703887.
13. Prabhu A, Rao AP, Reddy V, Ahamed SS, Muhammad S, Thayumanavan S. Parental knowledge of pre-school child oral health. J Community Health. 2013;38:880–884. doi: 10.1007/s10900-013-9693-x.
14. Aliakbari E, Gray-Burrows KA, Vinall-Collier KA, Edwebi S, Salaudeen A, Marshman Z, Mceachan RRC, Day PF. Facilitators and barriers to home-based toothbrushing practices by parents of young children to reduce tooth decay: a systematic review. Clin Oral Investig. 2021;25:3384–3393. doi: 10.1007/s00784-021-03890-z.
15. Campanaro M, Huebner CE, Davis BE. Facilitators and barriers to twice daily tooth brushing among children with special health care needs. Special Care in Dentistry. 2014;34:185–192. doi: 10.1111/scd.12057.
16. Liu HY, Chen JR, Hsiao SY, Huang S Te. Caregivers' oral health knowledge, attitude and behavior toward their children with disabilities. J Dent Sci. 2017;12:388–395. doi: 10.1016/j.jds.2017.05.003.
17. Lim JL. T20, M40, B40 Household Income Update 2023 [Internet]. Malaysian Employer Federation (MEF). 2023 [cited 2024 May 20]. Available from: https://www.mef.org.my/news/general_article.aspx?%40ID=59.
18. Poornima U, Luke AM, Mathew S. Parents' attitude toward assisted oral hygiene care for their children. Journal of Global Oral Health. 2022;5:69–74. doi: 10.25259/jgoh_40_2020.
19. Yusoff MSB. ABC of Content Validation and Content Validity Index Calculation. Education in Medicine Journal. 2019;11:49–54. doi: 10.21315/eimj2019.11.2.6.
20. Yusoff MSB. ABC of Response Process Validation and Face Validity Index Calculation. Education in Medicine Journal. 2019;11:55–61. doi: 10.21315/eimj2019.11.3.6.
21. Polit DF, Beck CT, Owen S V. Focus on research methods: Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Res Nurs Health. 2007;30:459–467. doi: 10.1002/nur.20199.
22. Inbasekaran D, Malaiappan S, Nambi G. The knowledge attitude and practices of oral hygiene practices among caregivers of children with cerebral palsy. Drug Invention Today. 2020;13:1263–1266.
23. Daraniyagala TR, Herath CK, Gunasinghe MS, Ranasinghe N, Herath MB, Jayasooriya PR. Oral Health Status of Children with Cerebral Palsy and its Relationship with Caregivers Knowledge Related to Oral Health. Journal of South Asian Association of Pediatric Dentistry. 2019;2:37–42. doi: 10.5005/jp-journals-10077-3031.
24. Bizarra de FM, Luнs H, Bernardo M. Institutional caregivers' predictors of oral hygiene frequency in adults with cerebral palsy. Revista Portuguesa de Estomatologia, Medicina Dentaria e Cirurgia Maxilofacial. 2022;63:20–26. doi: 10.24873/J.RPEMD.2022.03.864.
25. Abduludin DMA, Rahman NA, Adnan MM, Yusuf A. Experience of caregivers caring for children with cerebral palsy in accessing oral health care services: A qualitative study. Archives of Orofacial Sciences. 2019;14:133–146. doi: 10.21315/aos2019.14.2.381.
26. Mokhtar S, Abd Jalil L, Muhd Noor N, Tan B, Shamdol Z, Ali Hanafiah H. Dental Status and Treatment Needs of Special Needs Children in Negeri Sembilan, Malaysia. World J Res Rev. 2016;2:64–70.
27. Misran AA, Mohd Adnan M, Abd Rahman N. Association between Oral Health Knowledge, Attitude and Practice with Dental Plaque Maturity Status among Adolescents in Kota Bharu, Kelantan. Malaysian Journal of Medicine and Health Sciences. 2022;18:29–35.
28. Asan O, Yu Z, Crotty BH. How clinician-patient communication affects trust in health information sources: Temporal trends from a national cross-sectional survey. PLoS One. 2021;16. doi: 10.1371/journal.pone.0247583.
29. Hadeya MH, Amal HA. Parental Oral Health

Knowledge, Attitude, Practice and Caries Status of Sudanese Cerebral Palsy Children. Ped Health Res. 2017;2. doi: 10.2176/2574-2817-2-11.
30. Ahmad R, Rahman NA, Hasan R, Yaacob NS, Ali SH. Oral health and nutritional status of children with cerebral palsy in northeastern peninsular Malaysia. Special Care in Dentistry. 2020;40:62–70. doi: 10.1111/scd.12436.
31. Pavone P, Gulizia C, Le Pira A, Greco F, Parisi P, Di Cara G, Falsaperla R, Lubrano R, Minardi C, Spalice A, et al. Cerebral Palsy and Epilepsy in Children: Clinical Perspectives on a Common Comorbidity. Children. 2021;8. doi: 10.3390/children8010016.
32. Baudet A, Veynachter T, Rousseau H, Anagnostou F, Jeanne S, Orti V, Thilly N, Clйment C, Bisson C. Perception of gingival bleeding by people and healthcare professionals: A multicentre study in an adult French population. Int J Environ Res Public Health. 2020;17:1–12. doi: 10.3390/ijerph17165982.
33. Huebner CE, Riedy CA. Behavioral Determinants of Brushing Young Children's Teeth: Implications for Anticipatory Guidance. National Institute of Health. 2010;32:48. Cited: in: : PMID: 20298653.
34. Duijster D, Verrips GHW, Van Loveren C. The role of family functioning in childhood dental caries. Community Dent Oral Epidemiol. 2014;42:193–205. doi: 10.1111/cdoe.12079. Cited: in: : PMID: 24117838.
35. Subasi F, Mumcu G, Koksal L, Cimilli H, Bitlis D. Factors affecting oral health habits among children with cerebral palsy: Pilot study. Pediatrics International. 2007;49:853–857. doi: 10.1111/j.1442-200X.2007.02445.x.
36. Bensi C, Costacurta M, Docimo R. Oral health in children with cerebral palsy: A systematic review and meta-analysis. Special Care in Dentistry. 2020;40:401–411. doi: 10.1111/scd.12506.
37. Weckwerth SAM, Weckwerth GM, Ferrairo BM, Chicrala GM, Ambrosio AMN, Toyoshima GHL, Bastos JRM, Pinto EC, Velasco SRM, Bastos RS. Parents' perception of dental caries in intellectually disabled children. Special Care in Dentistry. 2016;36:300–306. doi: 10.1111/scd.12191.
38. Abdullahi A, Isah A. Caregiver's perspectives on facilitators and barriers of active participation in cerebral palsy rehabilitation in North West Nigeria: A qualitative study. BMC Health Serv Res. 2020;20. doi: 10.1186/s12913-020-05487-w.
39. Berzinski M, Morawska A, Mitchell AE, Baker S. Parenting and child behaviour as predictors of toothbrushing difficulties in young children. Int J Paediatr Dent. 2020;30:75–84. doi: 10.1111/ipd.12570.
40. Wagner J, Walstad WB. Gender Differences in Financial Decision-Making and Behaviors in Single and Joint Households. American Economist. 2023;68:5–23.doi:10.1177/05694345221076004.
41. Shahat ARS, Greco G. The economic costs of childhood disability: A literature review. Int J Environ Res Public Health. 2021;18. doi: 10.3390/ijerph18073531.
42. Jones JS, Murray SR, Tapp SR. Generational Differences in the Workplace. Journal of Business Diversity. 2018;18. doi: 10.33423/jbd.v18i2.528.
43. Pinho M, Gaunt R. Doing and undoing gender in male carer/female breadwinner families. Community Work Fam. 2021;24:315–330. doi: 10.1080/13668803.2019.1681940.
44. Wang X, Shi J, Kong H. Online Health Information Seeking: A Review and Meta-Analysis. Health Commun. 2021;36:1163–1175. doi: 10.1080/10410236.2020.1748829. Cited: in: : PMID: 32290679.
45. Martin M, Rosales G, Sandoval A, Lee H, Pugach O, Avenetti D, Alvarez G, Diaz A. What really happens in the home: A comparison of parent-reported and observed tooth brushing behaviors for young children. BMC Oral Health. 2019;19. doi: 10.1186/s12903-019-0725-5.
46. Westby C. The Communication Function Classification System. Word of Mouth. 2020;32:11–13. doi: 10.1177/1048395020949087.
47. Friedman AJ, Cosby R, Boyko S, Hatton-Bauer J, Turnbull G. Effective teaching strategies and methods of delivery for patient education: A systematic review and practice guideline recommendations. Journal of Cancer Education. 2011;26:12–21. doi: 10.1007/s13187-010-0183-x.
48. Angarita-Díaz M del P, Durán-Arismendy E, Cabrera-Arango C, Vásquez-Aldana D, Bautista-Parra V, Laguna-Moreno J, Mondragyn-Lypez W. Enhancing knowledge, attitudes, and practices related to dental caries in mothers and caregivers of children through a neuroeducational strategy. BMC Oral Health. 2024;24. doi: 10.1186/s12903-023-03734-0.
49. Kim Y, Mitchell HR, Ting A. Application of psychological theories on the role of gender in caregiving to psycho-oncology research. Psychooncology. 2019;28:228–254. doi: 10.1002/pon.4953.
50. Prado P, Norman RS, Vasquez L, Glassner A, Osuoha P, Meyer K, Brackett JR, White CL. An interprofessional skills workshop to teach family caregivers of people living with dementia to provide complex care. J Interprof Educ Pract. 2022;26. doi: 10.1016/j.xjep.2021.100481.