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Baseline Assessment of Dental Behavior Patterns, Associated Factors and Non-pharmacological Behavior Management Approaches among High Caries Risk 2-5-year Old Children Receiving Preventive Oral Health Care

Irosha R. Perera[1,*], K.N.N. Karunachandra[2], B. A. S. Wimalasena[3], A. M. Mustapha[4], Manosha L. Perera[5]

[1]Preventive Oral Health Unit, National Dental Hospital (Teaching) Sri Lanka, Ward Place, Colombo 7, Sri Lanka

[2]Outpatient Dental Clinic, Base Hospital, Meerigama, Sri Lanka

[3]Outpatient Dental Clinic, National Dental Hospital (Teaching) Sri Lanka, Ward Place, Colombo 7, Sri Lanka

[4]Colombo Municipal Council Dental Clinic, Colombo 15, Sri Lanka

[5]Alumnus, School of Dentistry & Oral Health, Griffith University, Gold coast, QlD, Sri Lanka

*Correspondence should be addressed to Irosha Perera, irosha_rukmali@yahoo.com

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Abstract

Background & Aim: Providing dental treatment to young children becomes challenging due to their dental fear or anxiety, which manifests in disruptive or non-compliant behavior. This study aims to collect baseline information on the behavior patterns and related factors of 2- 5-year-old children with dental caries at the first visit for basic preventive dental treatment and non-pharmacological behavioral management.

Materials and methods: A hospital-based cross-sectional study was conducted among 427, 2–5-year-old children who presented with their parents to the preventive dental clinic, community dental unit of Dental Institute, Colombo which is a premier, multispecialty, tertiary care public dental hospital in Sri Lanka. A specially designed interviewer-administered questionnaire was used to collect data on socio-demographic status, oral health behaviors, night feeding practices, dietary habits assessed by a food frequency question, dental caries status, fluoride application and child's behavior at the first and subsequent visits and non-pharmacological behavior management techniques used. The data were entered and analyzed using the SPSS-21 statistical software package using frequency distributions and chi-square test of statistical significance to compare groups.

Results: The majority of children (72.8%) were cooperative in receiving basic preventive oral health care at the first visit, which marked the first dental visit for the majority. The children carried a high burden of untreated dental caries. The mean dmft was 7.74 (95% CI: 7.39–8.10), with a mean dt of 7.61 (95% CI: 7.25-7.96). Cariogenic dietary pattern, night breastfeeding practices, and past dental care of the child were significantly associated with the observed behavior pattern of children for preventive oral health care ($p<0.05$). The preventive dental clinic had a child-friendly environment and practiced voice control with tell-show-do, rewarding, positive modeling, and distraction techniques.

Conclusions: A child-friendly environment in the dental office, simple non-pharmacological behavior management techniques, and non-invasive preventive dental treatment could be effective in managing young pediatric patients with a high burden of dental caries.

Keywords: Dental behavior, Children, Non-pharmacological behavior management, Dental caries

Introduction

Childhood dental fear or anxiety is a common barrier to providing safe and effective dental care for children and manifests itself as disruptive dental behavior [1]. A behavior management program is therefore, pivotal in providing dental care to children [2]. Behavior guidance techniques include advice, voice control by dentists, positive reinforcement, the presence or absence of parents, modeling, the show-tell-do technique, and de-sensitization [2]. The surroundings of the dental environment, age of the child and past dental experience are some other factors that influence child's dental behavior [3].

Early Childhood Dental Caries (ECC) is a common chronic childhood disease defined by the American Academy of Pediatric Dentistry as the presence of one or more primary teeth affected by caries, cavitated or non-cavitated, missing due to caries, or filled in a child aged 71 months or younger [4]. ECC affects not only the oral health but health status and quality of life of children by impairing their nutrition, sleeping, schooling, and socialization but also the well-being of their parents and primary caregivers [5]. Prevalence of dental caries among 5-year-old children is 63.1%, of which 60.7% have untreated dental caries [6]. As revealed by a research study, the prevalence of ECC among 2–5-year-old children in the Ragama MOH area increased with age to reach 68.8% at the age of 5-years [7]. Therefore, ECC and its sequalae are common reasons for children to make frequent dental visits.

Assessment of children based on their dental behavior is considered an important skill for pediatric dentists [8]. Therefore, studies are conducted to assess the behavior of children in dental settings [9-14]. One such study was conducted in India among 328 children based on their clinical records, comprising 17 children aged 2-3 years, 63 children aged 4-5 years, 191 children aged 6–10 years, and 57 children aged 11–14 years [9]. Pre-treatment, peri-treatment, and post-treatment behaviors of children were recorded using Frankl's behavior rating scale. As revealed by the results, 35.3% of 2-3-year-old children had demonstrated definitely negative behavior at the first visit, which was declined to 11.8% at the second visit [9]. Among the 4-5-year-old group, 4.8% were definitely negative, while 20.6% were categorized as negative at the first visit. Another study conducted among 3–12-year-old Brazilian children revealed a 9.3% prevalence of negative dental behavior, with a greater frequency among younger children, those with no previous dental experience, and those whose mothers exhibited a moderate to severe level of anxiety [10].

Supported by research evidence, dental fear and anxiety manifested as disruptive dental behavior is a major hindrance to the practice of efficient and effective pediatric dentistry in low-income countries (LIC) and Lower-Middle-Income countries (LMIC) with resource constraints. Many of those countries, like Sri Lanka, are currently suffering economic crises [15]. Consequently, there are shortages in dental material, equipment, and workforce for providing public dental care services. Adding to the burden, problem-based dental visits are common in LIC and LMIC, and the treatment of choice for symptomatic pulp-exposed deciduous teeth with dento-alveolar infections is extraction under general anesthesia [16]. Pharmacological behavior management techniques such as inhalation sedation for children are hardly available in LICs and LMICs. Despite its importance and practical implications in pediatric dentistry, there were no published studies on disruptive dental behavior of children and the effectiveness of non-pharmacological behavior management techniques from Sri Lanka. In addition, preventive oral health care is deemed essential to manage ECC, in light of ample evidence of its effectiveness. Professional fluoride application provides a simple, non-invasive treatment option to gain the cooperation of children with high burden of ECC.

Against this backdrop, this study aims to collect baseline information on the behavior patterns and related factors of 2- 5-year-old children with dental caries at the first visit for basic preventive dental treatment and non-pharmacological behavioral management.

Materials and Methods

A Hospital-based cross-sectional study was conducted at the preventive dental clinic, Community Unit, Dental Institute, Colombo later upgraded as National Dental Hospital (Teaching) Sri Lanka which is multispecialty, premier, public dental hospital in Sri Lanka. Ethics approval for the present study was obtained from the Ethics Review Committee of Sri Lanka Medical Association (ERC/13/051). Written informed consent was obtained from all participating parents. Administrative approval was obtained from the Director, Dental Institute. Study participants included preschool children aged 2–5-years, attending the preventive dental clinic with their parental care givers. Those children excluded were: parents who did not consent, children lesser than 2-years and 6 years and above on the date of data collection and those who presented with other care givers without father or mother.

According to the formula of Lwanga K. and Lemeshow the sample size was calculated (Lwanga and Lemishow, 1991) [17].

Sample size $n = z^2 \times p\ (1-p) / d^2$.

(z= critical value of confidence interval, p =estimate of the proportion - considered as 50 % (eg. considering 50% of children as cooperative), d = precision level.

$n = 1.96 \times 1.96 \times 0.50\ (1-0.50) / 0.05 \times 0.05 = 384$

10% added for non-respondents

Minimum total sample size =427

Therefore, consecutive 2-5-year old children and their consenting parents (fulfilling the inclusion criteria) were included in the study, until the required sample size was accomplished. Non probability, consecutive sampling method representing all working hours of the preventive dental clinic was used to recruit the sample.

A specially designed data collection form was used to collect data for the study. It included socio-demographic status, oral health behaviors: brushing habits and dental visits, night feeding practices, dietary habits assessed by a food frequency question, dental caries status, fluoride application and child's dental behavior at the first and subsequent visit and non-pharmacological behavior management technique used.

Our previous research findings reported high cariogenic dietary patterns and revealed cariogenic food items consumed by children with a high burden of untreated decayed teeth who attended the preventive dental clinic [18-21]. Those food items were included in the food frequency questionnaire (FFQ) item with healthy food items in the data collection form used for the present study [18-21]. Therefore, based on our previous research findings, an 'operational classification' was derived to categorize children into mutually exclusive dietary patterns. If a child consumed cariogenic food (*biscuits, buns, pastries, toffees/chocolates, bubble gum/chewing gum, lollypop, milk/tea with sugar, fizzy drinks, sweetened milk packets*) ≥ 4 times per week, irrespective of frequency of consumption of 'healthy food' (*fruits, vegetables including green leafy vegetables, pulses yoghurt/curd/cheese, nuts*), he/she was categorized in "cariogenic dietary pattern". If a child consumed 'healthy food items' ≥ 4 times a week with <4 times consumption of 'cariogenic food items', he/she was categorized into "less cariogenic dietary pattern". A child with weekly frequency of consumption of 'cariogenic food' <4 times with similar frequency of consumption of 'healthy food items', was categorized into "mixed dietary pattern". The existing dental behavior of the child was assessed based on observation of the child during the first visit (and the subsequent visit for uncooperative children) as the level of cooperativeness of the child for fluoride gel/varnish application. Mother or father was allowed to be present with the child while the treatment was provided. The effectiveness of the behavior management technique/techniques used for an uncooperative child was assessed by the level of cooperation for the second fluoride gel/varnish application treatment compared to the baseline level of cooperation.

Data were entered analyzed using SPSS-21 statistical software package. Frequency distributions and descriptive statistics are presented. The composite scores of dmft were computed and assessed for distributions by using Kolmogorov-Smirnov and Shapiro-Wilk tests of normality. As both tests were highly significant p=0.00001 the median score was used to dichotomize the dmft and dt as ≤ median score and > median score [18]. Of socio-economic status variables such as parental education groups were re-categorized as G.C.E (Ordinary Level) and below vs above G.C.E. (Ordinary Level). Fathers' occupation categories were dichotomized as 'Skilled/Unskilled workers/Business' and Clerical/technical/professional'. For mothers' occupation in addition to those two categories, the "Housewife" category was included [18]. Past history of dental visits of the child was dichotomized as "never" and "ever". Types of toothpaste used by children were dichotomized as "fluoridated toothpaste" and "Non-fluoridated toothpaste'. Groups were compared using chi-square test of statistical significance with the level of significance at $p<0.05$.

Results

Table 1 illustrates the socio-demographic profile of children. Boys slightly dominated (52.9%), and nearly half of the children were Sinhalese. The majority of fathers were skilled/unskilled workers (41.9%) followed by clerical/technical categories (25.1%). The overwhelming majority of mothers (80.6%) were housewives. Mothers were more educated than fathers as the majority of mothers had G.C.E. A/L while fathers had G.C.E.O/L qualifications.

Table 1. Socio-demographic profile of 2-5-year-old-children.

Variable	Number	%
Gender		
Male	226	52.9
Female	201	47.1
Total	427	100.0
Ethnicity		
Sinhalese	213	49.9
Tamil	83	19.7
Sri Lankan Moors	130	30.4
Total	427	100.0
Father's occupation		
Skilled/unskilled worker	179	41.9
Self-employed/business	115	20.9
Clerical/Technical	107	25.1
Professional	26	0.1
Total	427	100.0
Mother's occupation		
Housewife	344	80.6
Skilled/unskilled worker	16	3.7
Self-employed/business	13	3.0

Clerical/Technical	30	7.0
Professional	24	5.7
Total	427	100.0
Father's Education		
No schooling	2	0.4
Grade 1-5	14	3.3
Grade 6-10	67	15.7
G.C.E.(O/L)*	168	39.3
G.C.E.(A/L)**	142	33.3
Degree/Diploma	34	8.0
Total	427	100.0
Mother's education		
No schooling	11	2.6
Grade 1-5	11	2.6
Grade 6-10	85	19.9
G.C.E. (O/L)*	142	33.2
G.C.E.(A/L)**	150	35.1
Degree/Diploma	26	6.6
Total	427	100.0
*General Certificate of Examination-Ordinary Level		
**General Certificate of Examination-Advanced Level		

As shown in **Table 2**, the majority of children (80.8%) reported to be using fluoridated adult toothpaste, practicing assisted tooth brushing (74.7%) and brushing teeth twice daily (69.6)%. The majority of children (78.5%) were on cariogenic dietary patterns and some practiced night feeding. Further, the majority of children, (73.8%) did not visit a dentist previously.

Table 2. Oral-health-related behaviors of 2-5-year-old children.

Variable	**Number**	**%**
Brushing Habits		
Type of toothpaste		
Fluoridated adult	345	80.8
Fluoridated children	59	13.8
Non fluoridated adult	32	7.5
Non-fluoridated children	21	4.9
Total	427	100.0
Frequency of brushing		
Once daily	116	27.2
Twice daily	297	69.6
More than twice daily	14	3.3
Total	427	100.0
Type of brushing		
Self	55	12.9
Assisted	319	74.7
Both	53	12.4
Total	427	100.0
Feeding habits		
Night feeding with formula milk		
No	305	71.4
Yes	122	28.6
Total	427	100.0
On demand night breast feeding		
No	245	57.4
Yes	182	42.6
Total	427	100.0
Dietary pattern		
Cariogenic	335	78.4
Less cariogenic	23	5.4
Mixed	69	18.2
Total	427	100.0
Dental Visits		
Never	315	73.8
LRH	52	12.2
Any public/private dental clinic	58	13.6
School Dental Clinic	1	0.2
MOH Dental Clinic	1	0.2
Total	427	100.0

Figure 1 shows the dental behavior of children at the first visit for basic preventive oral health care and the majority (72.8%) were identified as cooperative.

Table 3 depicts the dental caries burden of children and on average the children had 7 decayed teeth.

Figure 2 illustrates the distribution of children by type of non-pharmacological behavior management techniques.

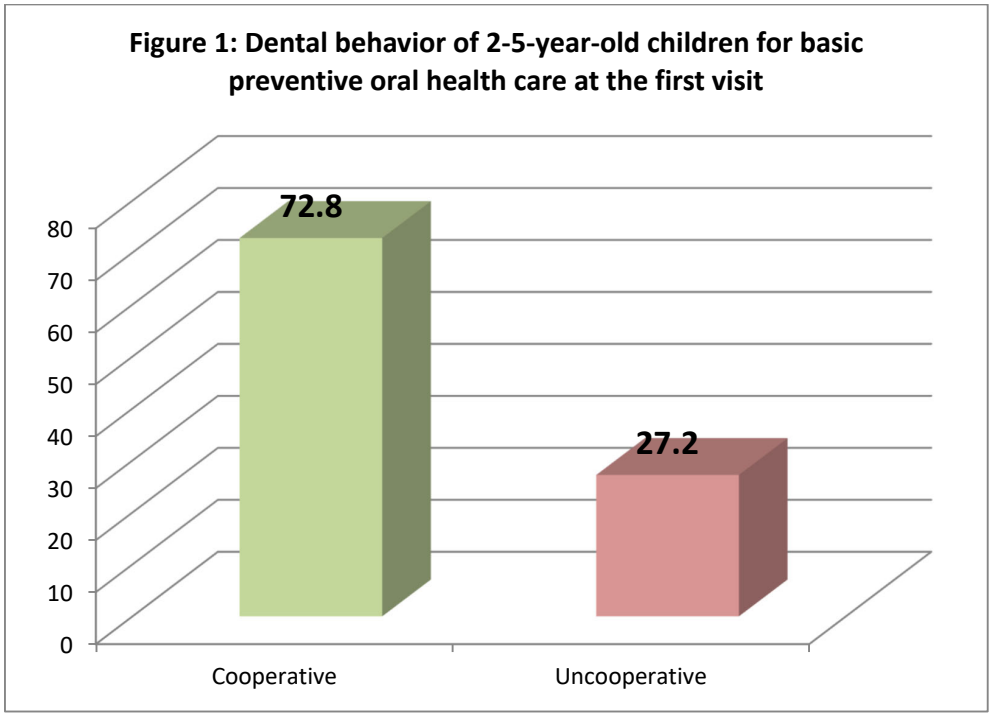

Figure 1. Dental behavior of children on the first visit.

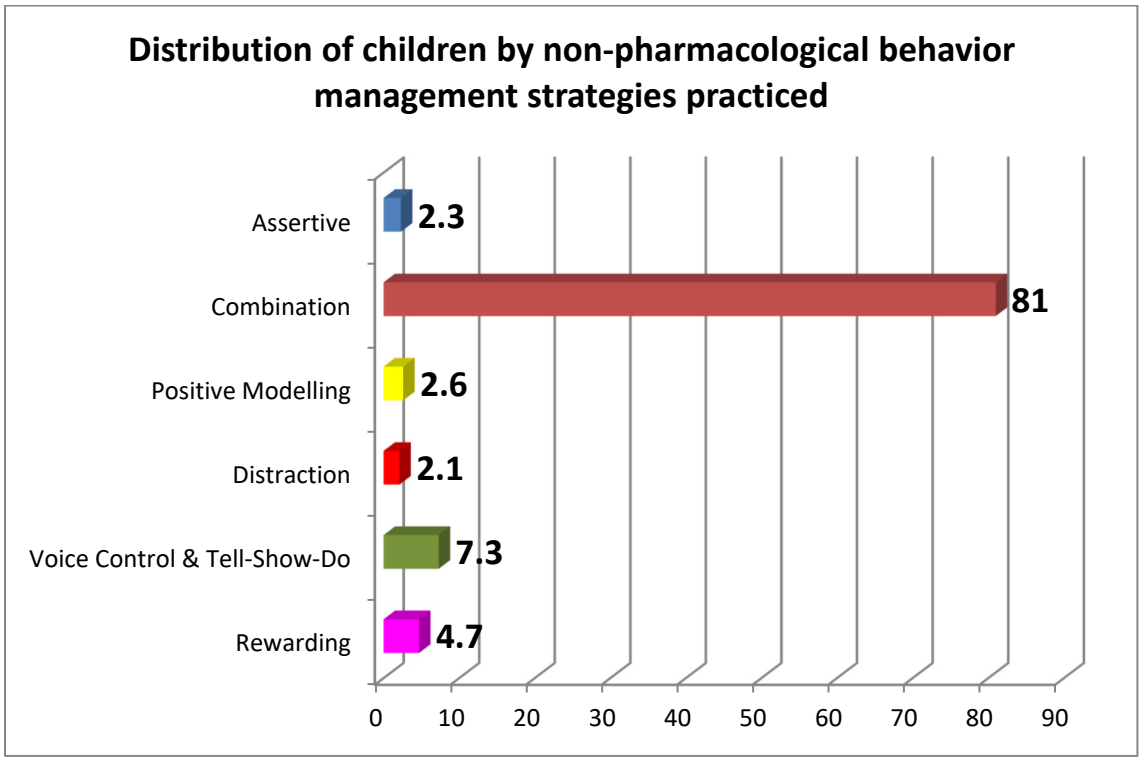

Figure 2. Distribution of children by type of non-pharmacological behavior management strategy practiced.

Accordingly, 81% of children were managed by a combination of voice control with tell-show-do, rewarding, positive modelling and distraction techniques.

Table 3. Prevalence and severity of dental caries among 2-5-year old children attended the preventive dental clinic.

Attribute	**Prevalence**
Prevalence of dental caries*	N %
≤7 dmft	226 (52.9)
>7 dmft	201 (47.1)
Total	427 (100.0)
Prevalence of untreated dental caries (dt)**	
≤7	233 (54.6)
>7	194 (45.4)
Total	427 (100.0)
Mean dmft ± SD (95% CI)	7.74 ± 3.724 (7.39-8.10)
Mean dt ± SD (95% CI)	7.61 ± 3.767 (7.25-7.96)
Mean mt ± SD (95% CI)	0.11 ± 0.688(0.04-0.18)
Mean ft ± SD (95% CI)	0.03 ± 0.305 (0.00-0.06)
Significance caries index (SiC dmft) ± SD (95% CI)	12.08 ± 2.282 (11.70-12.46)

Table 4.1 compares the dental behavior of children at the first visit for basic preventive oral health care by their gender, socioeconomic status, and dental caries burden. There were no significant associations.

As shown in **Table 4.2**, children who practiced on demand night breast feeding were more uncooperative than those who were not for basic preventive dental care at the first dental visit. Moreover, children with cariogenic dietary patterns and made their first dental visit behaved more cooperatively than those who with other dietary patterns and had previous dental visits Those differences were statistically significant ($p<0.05$).

Table 4.1. Comparing behavior of 2-5-year-old children at the first visit for basic preventive oral health care by their gender, socioeconomic status, dental caries burden.

Variable	**Uncooperative Behavior**	**Cooperative Behavior**	**Chi-square value**	**p-value**
Gender	N %	N %		
Male	56 (48.3)	170 (54.7)	1.383	0.240
Female	60 (51.7)	141 (45.3)		
Total	116 (100.0)	311 (100.0)		
Ethnicity	N %	N %		
Sinhalese	61 (52.6)	152 (48.9)	1.741	0.419
Tamil	18 (15.5)	66 (21.2)		
Muslim	37 (31.9)	93 (29.9)		
Total	116 (100.0)	311 (100.0)		
Father's education	N %	N %		
G.C.E.(O/L) and below	63 (50.0)	188 (60.5)	1.315	0.252
Above G.C.E.(O/L)	63 (50.0)	123 (39.5)		
Total	116 (100.0)	311 (100.0)		
Mother's education	N %	N %		
G.C.E.(O/L) and below	62 (53.4)	187 (60.1)	1.551	0.213
Above G.C.E.(O/L)	54 (46.6)	124 (39.9)		
Total	116 (100.0)	311 (100.0)		
Father's occupation	N %	N %		
Skilled/unskilled workers & business	75 (64.7)	219 (70.4)	1.308	0.253
Clerical/technical/professional	41 (35.3)	92 (29.6)		

Total	116 (100.0)	311 (100.0)		
Mother's occupation	N %	N %		
Housewife	88 (75.8)	256 (82.3)	3.563	0.168
Skilled/unskilled workers & business	12 (10.4)	17 (5.5)		
Clerical/technical/professional	16 (13.8)	38 (12.2)		
Total	116 (100.0)	311 (100.0)		
Untreated dental caries*	N %	N %	1.893	0.169
≤7	57	176 (56.6)		
>7	69	135 (43.4)		
Total	116 (110.0)	311 (100.0)		
*dichotomized by the median value of 7				

Table 4.2. Comparing behavior of 2-5-year-old children at the first visit for basic preventive oral health care by their oral-health-related-behaviors.

Variable	**Uncooperative Behavior**	**Cooperative Behavior**	**Chi-square value**	**p-value**
Type of toothpaste	N %	N %		
Fluoridate toothpaste	95 (81.9)	258 (83.0)	0.066	0.797
Non-fluoridated toothpaste	21 (18.1)	53 (17.0)		
Total	116 (100.0)	311 (100.0)		
Frequency of brushing				
Once daily	35 (30.2)	81 (26.0)	1.420	0.492
Twice daily	76 (65.5)	221 (71.1)		
More than twice daily	5 (4.3)	9 (2.9)		
Total	116 (100.0)	311 (100.0)		
Type of brushing				
Self	18 (15.5)	37 (11.9)	2.800	0.247
Assisted	80 (69.0)	239 (76.8)		
Both	18 (15.5)	35 (11.3)		
Total	116 (100.0)	311 (100.0)		
On-demand night breastfeeding				
No	55 (47.4)	190 (61.1)	6.465	**0.011***
Yes	61 (52.6)	121 (38.9)		
Total	116 (100.0)	311 (100.0)		
Night formula milk feeding				
No	87 (75.0)	218 (70.1)	0.995	0.318
Yes	29 (25.0)	93 (29.9)		
Total	116 (100.0)	311 (100.0)		
Dietary pattern				
Cariogenic	73 (62.9)	262 (84.2)	23.163	**0.0001***

Healthy	12 (10.4)	11 (3.5)		
Mix	31 (26.7)	38 (12.3)		
Total	116 (100.0)	311 (100.0)		
Past dental care				
Never	77 (66.4)	238 (76.5)	4.497	**0.034***
Ever	39 (33.6)	73 (23.5)		
Total	116 (100.0)	311 (100.0)		
p<0.05				

Discussion

Behavior management of children becomes pivotal in dental setting as dental treatment altogether with its characteristics evoke dental fear/anxiety among children [22]. There is an array of well-known, non-pharmacological behavior management techniques reported in literature that have been used successfully to manage disruptive or uncooperative behaviors of children at dental settings [23-26]. Supporting the findings of our study, the behavior management packages comprising of simple voice control combined with tell-show-do, positive modelling, distraction techniques had shown promising results [23-26]. These findings were in line with our previous work on behavior management strategies employed to gain cooperation and to educate preschool children on oral health promotion [21]. Live modelling using mother or father based on the age of the child was highly recommended by one previous study]26] whilst other studies recommended virtual reality of distraction [27].

According to our study, only 27.2% of 2-5-year-old children were uncooperative at the first visit to receive basic preventive oral health care. Further, all of them become cooperative at the subsequent visit. However, a study conducted in India revealed, a higher percentage (35.29%) of 2-3 year-old children had demonstrated definitely negative behavior at the first visit [9]. The Brazilian study revealed a lower prevalence (9.3%) of negative behavior among children, with a greater frequency among younger children, those with no previous use of dental services and those whose mothers exhibited a moderate to severe level of anxiety [10]. Another study reported 60% of prevalence of negative behavior among 7-17-year-old Indian children undergoing invasive dental treatment such as dental extractions and 45% prevalence of negative behavior among children undergoing pulpectomy [11]. More comparable findings were reported by a study conducted among 2-8-year-old, Chinese children, as 29.7% of children demonstrated behavioral management problems [12]. Similar findings were reported by a study conducted in the Western Washington state, USA employing a sample of 421 children from 21 pediatric dental practices [13]. The average age of the children was 6.8 ± 2.8 years and the proportion of children who displayed negative behavior during treatment was 21% (95% CI=17.5, 24%) [13]. However, comparison of study findings should be done cautiously, due to methodological differences in studies such as ages of children, scales used to rate behavior of children, and differences in dental treatment procedures, dental clinic settings and socio-cultural contexts.

The child-friendly-environment, trained staff, and non-invasive preventive oral health care provision could be the most plausible explanations for differences in findings of above studies with our study. The study conducted among the 3-5-year-old Kindergarten children in Hong Kong [28]. Only 4% of the children scored negatively for dental fear and anxiety (95% CI 2.3%-5.7%) as assessed by Frankl behavior rating scale, at oral examination with dental instruments at outreach kindergarten setting. The majority (85%) of children had not visited a dental clinic [28]. As concluded by the authors, in general, children displayed low fear or anxiety levels in a dental outreach consisting of a non-invasive oral examination and preventive treatment in a familiar kindergarten setting [28]. Child-friendly dental settings thus simulating a kindergarten to some extent, may help to reduce dental anxiety of children to a greater extent than a routine dental setting.

Our findings demonstrated significant associations of child's dental behavior at the first visit for preventive oral health care with cariogenic dietary pattern, night on-demand breast feeding practices and past history of dental visits ($p<0.05$). However, gender, caries burden predominantly manifested as untreated dental caries and socio-economic factors and brushing habits were not associated with child's dental behavior. Those findings were supported and contrasted by the findings of other studies. A Brazilian birth-cohort study on factors associated with dental fear revealed that lower the family income at birth and the higher the severity of dental caries, the higher the prevalence of dental fear [29]. Further, children who never visited the dentist and those who frequently experienced dental pain: a proxy indicator of high burden of dental caries experienced more dental fear [29]. An Indian study conducted among children revealed, gender differences in dental anxiety as female children were more dentally anxious than their male counterpart however, the number of visits to the dental clinic, socioeconomic status, cariogenic dietary pattern, and type of treatment being done

did not contribute to a child's anxiety level [30]. Supporting our findings, a study revealed that there could be associations of duration of breast feeding and bottle feeding with child anxiety disorders [31]. As the cooperative behavior of children at the first visit to preventive dental clinic, was significantly associated with not having past dental experience it could be rationally argued that those children were not conditioned to negative dental experience previously. However, as the majority of children practiced cariogenic dietary patterns and were cooperative for preventive dental care at the visit there could be a significant association in those.

To the best of our knowledge this was the first study that assessed dental behavior patterns of children, related factors, and non-pharmacological behavior management. However, it is a baseline study which used less vigorous statistical models. Therefore, further research is warranted with methodological refinements. Assessing the dental behavior of children by objective methods such as Frankl's behavior rating scale, dietary patterns by quantitative food frequency questionnaires and the use of rigorous multivariate statistical modelling would enable detailed assessments of factors associated with dental behavior of children.

Conclusion

Our findings clearly indicated the effectiveness of simple non-pharmacological behavior management techniques in managing disruptive dental behavior in 2- to 5-year-old children with dental caries. A first dental visit to a child-friendly dental setting for non-invasive preventive dental treatment would be a promising approach to gain cooperation of children with dental caries. Our findings will be useful for other LICs and LMICs.

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