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Correlation Between Frequencies and Durations of Bottle-Feeding Towards Maxillary Dental Arch Size in 7-9-Year-Old Children

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ABSTRACT

Bottle-feeding is one factor that affects the growth and development of the jaw in infants. It is a normal habit at a certain age. However, if there is prolonged bottle feeding, its frequency and duration can impact and interfere with jaw development. This study aims to establish the correlation between bottle-feeding frequencies and durations toward the maxillary dental arch size in 7-9-year-old children. This study was a cross-sectional study with 42 subjects of Javanese children aged 7 to 9 years who had a bottle-feeding habit. These subjects were taken their dental study models. The frequency and duration of bottle-feeding were obtained from the parents' questionnaire. The maxillary was measured in anterior and posterior-lateral size (inter canines and molars), anterior and posterior sagittal size (midpoint between the right and left permanent central incisors perpendicular to the inter-canines and inter-molars), by sliding calipers. The data were analyzed by Pearson's correlation. This study showed significant correlations between bottle-feeding frequencies and laterally dental arch size in the posterior direction (p=0.013; r= -0.379) and in the sagittal posterior direction (p=0.017; r=-0.366). There were significant correlations between bottle-feeding durations and laterally dental arch sizes, both in anterior (p=0.011, r=-0.387), posterior (p=0.025; r=-0.346) directions and also in the sagittally anterior dental arch size (anterior: p=0.004, r=-0.432). It can be concluded that there were correlations between frequencies and durations of bottle-feeding toward maxillary dental arch size in 7-9-year-old children.

Keywords: *Bottle-feeding, Children, Dental arch size*

1. INTRODUCTION

Dental arch size may increase according to permanent tooth eruption and be influenced by several factors such as genetics, nutrition, environment (including bad oral habits), race, gender, and age [1]. Children of 7-9 years old are in a mixed dentition phase that any permanent teeth eruptions remove any primary teeth [2]. Oral habits have been described as the masticatory system's main repetitive behaviors, mostly subconscious differing qualitatively and quantitatively from its physiological function. Abnormal oral habits run very subtly and unconsciously that even the patient is frequently unaware of their presence. At first, all such basic behaviors are practiced by conscious effort. It becomes less and less concentrated effort with each repetition and primarily applies only to the motor responses. Finally, it is entirely unconsciously pre-formed, becoming a part of the mind's routine from which the consciousness is removed [3]. Oral habits should be of crucial clinical interest since they can affect malocclusion and interfere with treatment progress [4]. The incidence of malocclusion in children with oral habits reaches 74.0 percent, while children without oral habits are only 25.1 percent [5].

Malocclusion is a major oral and dental health issue in Indonesia and is ranked third after dental caries and periodontal disease [6]. Bad oral habit is an extrinsic factor causing malocclusion [7], which may have severe effects on facial and teeth development in children [8]. Children aged 7-9 years are in a phase of mixed dentition [2]. Some bad oral habits frequently conducted in children include thumb sucking, sucking the pacifier mouth breathing, sticking out the tongue, and bottle-feeding [9]. Diagnosis of bad oral habits is essential as it can disrupt jaws' normal growth, development of occlusion, and lead to malocclusion [10]. Such habits can modify the teeth' positions, the relationship between the dental arches, and their shape [11].

Bottle feeding can have a harmonious growth effect on the teeth' jaws and arches. It is shown to occur malocclusion; thus, repeated use of bottle feeding should be avoided [12], although other studies suggest that bottle feeding has no significant correlation to jaw growth [13]. Several factors affect the impact of bad oral habits, including how much the bad habits are repeated daily (frequency), how long the bad habits are practiced (duration), how much pressure the child exerts (intensity), and the habit types [14].

2. MATERIALS AND METHODS

All procedures conducted by the researcher in this study involving human participants were approved by the Ethical Committee of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, No 5343/A.5-III/PSKG FKIK UMY/IX/2019. This study was an observational study with a cross-sectional design. It was conducted in Muhammadiyah Purwodiningratan elementary school, Yogyakarta. This study was conducted by first obtaining permission from the parents in the form of informed consent after the parents explained this research. The parents were given questionnaires contained frequency, duration of bottle-feeding, and other bad oral habits that children might have. 42 children (15 males and 27 females) were selected using a total sampling method that matched the inclusion and exclusion criteria. The inclusion criteria were Javanese children aged 7 and 9 years old who had the bottle-feeding habit, had left and right canines, and had right and left permanent first molars. Children who had caries or attrition in the right and left canine cusps and mesiobuccal cusps of the right and left permanent first molars and children who had other bad oral habits were excluded from this study.

By using alginate impressions (Aroma fine plus normal collection, GC Corporation, Tokyo, Japan), the subjects had their dental impressions taken to get dental study models grouped by age. For each dental study model, reference points were defined to measure its dimensions for both the maxillary dental arch's length and width. The midpoint between the right and left permanent central incisors, the cusp tip of the right and left canines, and the tip of the mesiobuccal cusp of the right and left permanent first molars were the reference points used in this study.

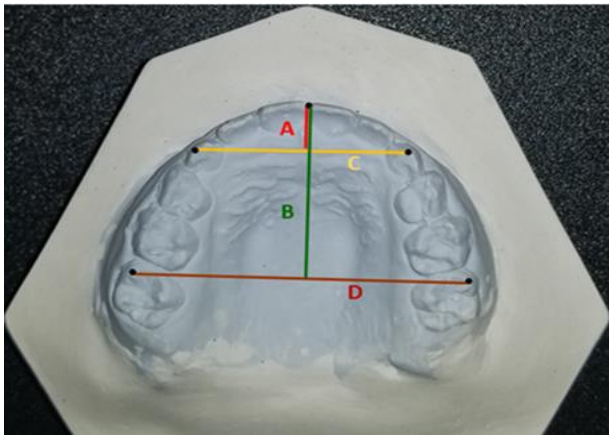

Figure 1. Maxillary Dental Arch Size. A. Anterior dental arch length; B: Posterior dental arch length; C: Anterior dental arch width; D: Posterior dental arch width. [15]

The dental arch's length was determined from the midpoint between the right and left permanent central incisors perpendicular to the midpoint of the line connecting the canine teeth' right-left cusp. This measure led to an anterior length of the dental arch. The posterior arch's length was determined from the vertical line, which was the distance between the tips of the mesiobuccal cusps of the right and left first molars from the center of the central incisors perpendicular to the line formed. The anterior dental arch width was measured from the inter-canine width, and the posterior dental arch width was measured from the inter-molar width. All of the measured parts were illustrated in Figure 1. A digital sliding caliper, Mitutoyo digimatic caliper, code number 573-721-20, model number NTD12-P6'M, serial number 0000644, Japan, was used to measure all these sizes.

Pearson's correlation was used to analyze the data to find out the correlation between frequencies and durations of bottle-feeding toward maxillary dental arch size in 7-9-year-old children.

3. RESULT

The study of the correlation between frequencies and durations of bottle-feeding toward maxillary dental arch size in 7-9-year-old children was conducted by measuring maxillary anterior and posterior dental arch length and width in children with bottle-feeding habit. This study was conducted on 42 children aged 7-9 years (male=15, female=27). The data distribution of the sample can be seen in Fig.2.

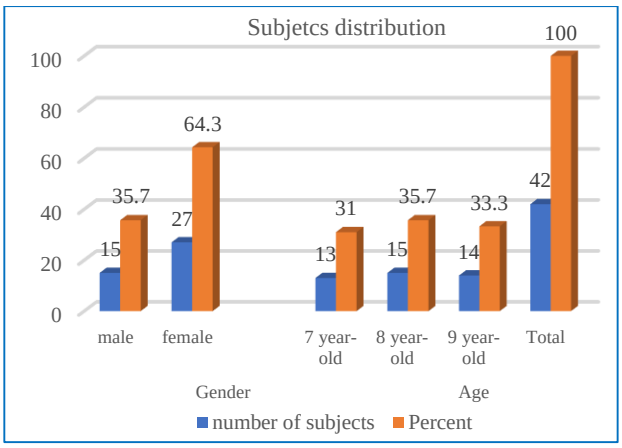

Figure 2. Distribution of the subjects based on gender and age

Based on Fig.2, the number of female respondents was more than male subjects (female=64.3%; male=35.7 and children aged 8 years old were the subjects with the highest number (35.7%).

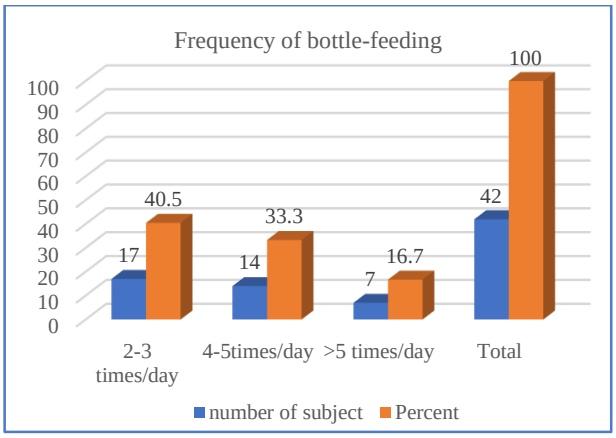

Figure 3. Bottle-feeding Frequency

Fig. 3 presents the data of bottle-feeding frequency in children aged 7, 8, and 9 years. It appears that the largest number of these children were bottle-feeding with a frequency of 2-3 times a day (17 children= 40.5%). Bottle feeding was mostly done by children with a duration of <15 minutes.

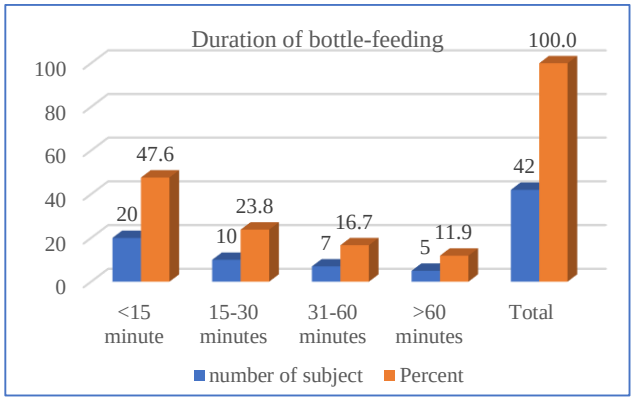

Figure 4. Bottle-feeding duration of the subjects

After measuring the dental arch's size, the average size results were obtained, as shown in Table 1. Bottle feeding was mostly carried out by children with a duration of <15 minutes per day (Fig.4).

Table 1. Mean of maxillary dental arch size in children with bottle-feeding based on age

Age (year-old)	Data	Dental arch width		Dental arch length	
		Lateral anterior (mm)	Lateral posterior (mm)	Sagittal anterior (mm)	Sagittal posterior (mm)
7	n	13	13	13	13
	Mean	31.82	52.23	8.42	28.08
	SD	1.42	1.98	1.27	1.67
8	n	15	15	15	15
	Mean	32.64	52.97	8.56	29.07
	SD	1.42	1.57	1.10	1.40
9	n	14	14	14	14
	Mean	32.16	51.76	8.73	28.48
	SD	1.83	1.78	1.36	1.95

Table 1 shows that the maxillary dental arch's widest size, both anterior and posterior, was in the 8-year-old group (32.64 mm for anterior width; 52.97 mm for posterior width), and also in the longest size of the posterior part (29.07 mm). The longest size of the anterior maxillary dental arch was in the 9-year-old group.

The data of frequencies, durations of bottle-feeding habit, and the size (width and length) of the dental arch were analyzed by Pearson's correlation, and the result was shown in Table 2.

Table 2. Correlation between frequency and duration of bottle-feeding and maxillary dental arch size

		F	D	Dental arch width		Dental arch length	
				Lateral anterior	Lateral posterior	Sagittal anterior	Sagittal posterior
F	Pearson Correlation	1	0.173	-0.289	-0.379*	-0.177	-0.366*
	Sig. (2-tailed)		0.274	0.063	0.013	0.261	0.017
	N	42	42	42	42	42	42
D	Pearson Correlation	0.173	1	-0.387*	-0.346*	-0.432**	-0.243
	Sig. (2-tailed)	0.274		0.011	0.025	0.004	0.12
	N	42	42	42	42	42	42

*Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
F: Frequency
D: Duration

This study showed that bottle-feeding frequency was significantly correlated with the maxillary posterior dental arch's size in width and length direction. It can be seen in Table 2 that the significance and correlation values were p=0.013, r= -0.379 for posterior width, and p=0.017, r= -0.366 for posterior length. The duration of bottle-feeding was also significantly correlated with the size of the maxillary anterior and posterior dental arch width (p=0.011, r= -0.387 for anterior width; p=0.025, r= -0.346 for posterior width). There was a significant correlation between bottle-feeding habit duration and maxillary anterior dental arch length (p=0.004, r=-0.432) (Table 2).

4. DISCUSSION

The dental arch development is a continuous process with some changes during the mixed developmental period [16]. The growth of dental arches is influenced by several factors, including gender, race, age, nutrition, permanent tooth eruption, genetics, and the environment, including bad oral habits [1]. Bad oral habits in children that continues at the age of over six mostly lead to malocclusion and facial deformities [16]. Some bad oral habits frequently developed in children include sticking the tongue out, mouth breathing, thumb or pacifier sucking, and bottle-feeding [9]. Bottle-feeding, allergic rhinitis, and non-nutritious sucking habits are related to primary dentition malocclusions [16].

This study showed that the 8-year-old group of bottle-feeding children had an average anterior dental arch width (32.64 ± 1.42 mm) that was wider than the 7-year age group (31.82 ± 1.42 mm). Likewise, 8 years of age was the widest (52.97 ± 1.57 mm) compared to 7 years of age (52.23 ± 1.98 mm) (Table 1). It was possibly due to the permanent lateral incisors' eruption replaced by the larger-sized than deciduous teeth. It is in line with Foster's statement that permanent teeth' mesiodistal size was larger than the mesiodistal size of primary teeth [17].

Based on the bottle feeding frequency, 17 children (40.5% of respondents) had the habit of bottle-feeding 2-4 times a day. Mostly, the children had a bottle-feeding habit duration of fewer than 15 minutes. There were 47.6% percent of respondents who had bottle-feeding habits for < 15 minutes. Children with bottle feeding duration for 15-30 minutes were 23.8%, bottle feeding duration for 31-60 minutes was 16.7%, and 11.9% of children had a bottle-feeding duration above 60 minutes. This result is in line with the research of Lubis and Tiffany stating the majority of children spent each time giving milk for about 10-15 minutes (43.1%), followed by those who spent time giving milk for about 20-30 minutes by 33.8%, and the percentage of children who spent more than 30 minutes giving milk was 23.1% [18].

Pearson's Correlation analysis regarding the relationship between the frequency and duration of bottle-feeding habits and the dental arch's size was presented in Table 2. There was a significant relationship between the frequency of bottle-feeding habits and the posterior width and length of the maxillary dental arch. It can be seen in Table 2 showing the significance value, p=0.013 and the correlation coefficient value, r=-0.379 (posterior width) and p=0.017, r=-0.366 (posterior length). Table 2 presents a correlation between bottle-feeding frequency and the posterior dental arch's width and length in a weak negative correlation, indicating that the dental arch's width and length will decrease if the frequency increases. This relationship also occurred between the duration of the bottle-feeding and the dental arch's size, both in width and length. The bottle-feeding habit duration was related to the maxillary anterior and posterior dental arches width and the maxillary anterior dental arch length. Based on Table 2, it can be seen that the significance value and the correlation coefficient value were p=0.011, r=-.387 (anterior width); p= 0.025, r=-0.346 (posterior width), and p=0.004, r=-0.432 (anterior length). Duration of bottle-feeding habit correlated with both anterior and posterior maxillary dental arch width, and both was in a weak negative correlation. It indicated that if the duration increases, the width of the maxillary dental arch will decrease. There was also a correlation between duration and the length of the anterior maxillary dental arch in a moderate negative correlation. In other words, if the duration increases, the length of the maxillary dental arch will decrease. This result is in line with the study of Aznar et al., stating that the sucking habit caused a significant reduction in the mean intermolar widths of the maxillary arch [18]. Sucking habits correlated with some upper arch constriction with any upper arch constriction [19].

The bottle-feeding habit leads to malocclusions through three mechanisms: 1. Changes in the direction of growth and facial bone development during childhood, 2. Increased tendency to atypical swallow pattern and 3. Higher prevalence rates of non - nutritive sucking (digit and pacifier-sucking) habits [20]. The buccinator muscle responsible for getting milk from the bottle becomes hypertrophied with prolonged suction, thereby disproportionately worsening maxillary growth, such as excessive maxillary narrowing [21]. This result is in line with Bowden's research revealing that due to the horizontal location of the nipple and the resulting negative intra-oral pressure, a posterior crossbite could more frequently result from active suction. This phenomenon resulted in inadequate maxillary arch width and was frequently correlated with different oral sucking and postural habits [22].

Overall, the results of the analysis showed that there was a correlation between the frequencies and duration of the bottle-feeding and the maxillary dental arch width and length

5. CONCLUSION

Based on this study's result, it can be concluded that there was a negative correlation between frequencies and duration of bottle-feeding toward maxillary dental arch size in 7-9-year-old children. Furthermore, if the frequencies and durations increase, the size of the maxillary dental arch will decrease.

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REFERENCES

[1] M.K. Alam, F. Shahid, K. Purmal, B. Ahmad, and M.F. Khamis, Bolton tooth size ratio and its relation with arch widths, arch length, and arch perimeter: a cone-beam computed tomography (CBCT) study, Acta Odontol Scand, 2014, pp. 1047-53. DOI: https://doi.org/10.3109/00016357.2014.946967

[2] J.A. Dean, J. Jones, and L.Q.A. Walker Vinson, McDonald and Avery's Dentistry for the child and adolescent, 10th ed., St. Louis: Mosby Elsevier, 2015. pp. 349–74.

[3] H. S. Al Atabi, Prevalence of Bad Oral Habits and Relationship with Prevalence of Malocclusion in Sammawa City Students Aged (6-18) Years Old, Medical Journal of Babylon, 2014, pp. 70-83.

[4] S. Goto S, BoydRL, L. Neilsen, and T. Iizuka, Long term follow up of orthodontic treatment of a patient with maxillary protrusion, severe deep overbite, and thumb-sucking, Angle Orthod, 1994, pp. 7-12. DOI: https://doi.org/10.1043/0003-3219(1994)064<0007:LFOOTO>2.0.CO;2

[5] S. Kharat, Oral Habits and its Relationship to Malocclusion: A Review, J Adv Med Dent Scie Res, 2014, pp. 123-126.

[6] Badan Penelitian dan Pengembangan Kesehatan. Departemen Kesehatan Republik Indonesia, Laporan Hasil Riset Kesehatan Dasar (Riskesdas) Nasional, Jakarta, 2013, pp. 148.

[7] V.A. Laguhi, P.S. Anindita, and P.N. Gunawan, Gambaran maloklusi dengan menggunakan HMAR pada pasien di Rumah Sakit Gigi dan Mulut Universitas Sam Ratulangi Manado, J e-GiGi (eG), 2014, pp. 1-2. DOI: https://doi.org/10.35790/eg.2.2.2014.5829

[8] V. Urzal, A.C. Braga, and A.F. Ferreira, Oral Habits as Risk Factors for Anterior Open Bite in The Deciduous and Mixed Dentition-Cross-Sectional Study, European J of Peaediatric Dentistry, 2013, pp. 298-302.

[9] L.J. Motta, T.A. Alfaya, A.F. Marangoni, and R.A. Mesquita-Ferrari, Gender as Risk Factor for Mouth Breathing and Other Harmful Oral Habits in Preschoolers, Brazilian J of Oral Sci., 2012, pp. 377-380.

[10] J. Murrieta, D. Hernández, C. Linares, M. González M, L. Juáre, and V. Montaño, Parafunctional Oral Habits and its Relationship with Family Structure in a Mexican preschoolers Group, J of Oral Research, 2014, pp. 29-36. DOI:10.17126/joralres.2014.009

[11] A. Klocke, R. Nanda, and B. Kahl-Nieke, Anterior open bite in the deciduous dentition: Longitudinal follow-up and craniofacial growth considerations, Am J Orthod Dentofacial Orthop, 2002, pp. 353-58. DOI: https://doi.org/10.1067/mod.2002.126898

[12] W. Xiao-tong and G. Li-Hong, Influence of Feeding Patterns on The Development of Teeth, Dentition, and Jaw in Children, J of Peking University, 2015.

[13] A.P. Hermont, C.C. Martins, L.G. Zina, S.M. Auad, S.M. Paiva, and I.A. Pordeus, Breastfeeding, Bottle Feeding Practices, and Malocclusion in the Primary Dentition: a Systematic Review of Cohort Studies, Int J of Environmental Research and Public Health, 2015, pp.3133-51. DOI: https://doi.org/10.1590/1807-3107BOR-2016.vol30.0022

[14] F. Varas, G. Gil, and G. Izquierdo, Prevalence of childhood oral habits and their influence in primary dentition, Rev. Pediatr Aten Primaria, 2012, pp. 13-20.

[15] A.D. Rahmawati, I.S.R. Sudarso, D. Pramono, and E. Arguni, Correlation between age and the dental arch dimension of Javanese Children, 2020 pp. 93-98. DOI: http://dx.doi.org/10.20473/j.djmkg.v53.i2.p93-98

[16] S. Melink, M.V. Vagner, I. Hocevar-Boltezar, and M. Ovsenik, Posterior crossbite in the deciduous dentition period, its relation with sucking habits, irregular orofacial functions, and otolaryngological findings, Am J Orthod Dentofacial Orthop, 2010, pp. 32-40. DOI: https://doi.org/10.1016/j.ajodo.2008.09.029

[17] T.D. Foster, Textbook of Orthodontics 3rd ed., Wiley, 1991.

[18] T. Aznar, A. Galan, I. Marin, and A. Dominguez, Dental arch diameters and relationships to oral habits, Angle Orthod, 2006, pp. 441-445. DOI: https://doi.org/10.1043/0003-3219(2006)076[0441:dadart]2.0.co;2

[19] M. Ganesh, S. Tandon, and B Sajida, Prolonged feeding practice and its effects on developing dentition, J Indian Soc Pedod Prev Dent, 2005, pp. 141-145.

[20] A. Meyers and J. Hertzberg, Bottle-feeding, and malocclusion: is there an association?, Am J Orthod Dentofacial Orthop, 1988, pp. 149-152. DOI: https://doi.org/10.1016/0889-5406(88)90293-4

[21] V.S.C. Nihi, S.M. Maciel, M.E. Jarrus, F.M. Nihi, C.L.F. Salles, R.C. Pascotto, and M. Fujimaki, Pacifier-sucking habit duration and frequency on occlusal and myofunctional alterations in preschool children, Braz Oral Res, 2015, pp.1-7. DOI: https://doi.org/10.1590/1807-3107bor-2015.vol29.0013

[22] B.D. Bowden, A longitudinal study of the effects of digital and dummy sucking, Am J Ortho Dent Fac Orthop, 1966, pp. 887-901. DOI: https://doi.org/10.1016/0002-9416(66)90192-8