ORIGINAL ARTICLE

Effect of dental care programme and fluoridation in the prevention of dental caries in asthmatic children

Gülser Kilinc,[1] Nevin Uzuner,[2] Ozkan Karaman[3]

Abstract

Objective: To investigate the effect of a regular dental care programme on the dental health of asthmatic children.

Methods: This prospective, controlled study was conducted at Dokuz Eylul University, Izmir, Turkey, between 2012 and 2014, and comprised asthmatic and non-asthmatic children between 4 and 16 years of age who used inhaler corticosteroid treatment for at least 1 year. Patients were examined for dental caries, gingival index, salivary flow rate, and salivary pH values at baseline, 6 months, and at the end of the first year. Demographic features and tooth-brushing habits of the asthmatic and non-asthmatic children were also analysed. SPSS 20 was used for data analysis.

Results: Of the 102 patients, there were 51(50%) each in asthmatic and non-asthmatic groups. Besides, 38(70.6%) participants were boys and 15(29.4%) were girls in the first group compared to 30(58.8%) boys and 21(41.2%) girls in the second group. The mean age was 11.16±3.10 years and 10.33±2.62 years, respectively, in the two groups. The number of asthmatic patients was 45(88.2%) in visit 2 and 37(72.5%) in visit 3, whereas the number of participants for the control group was 41(80.4%) in visit 2 and 36(70.4%) in visit 3. During the first visit, mean values for salivary pH and flow rate were 7.135 0.15 and 3.878 0.71 mL/min among asthma patients, and 7.158 0.14 and 4.684 0.50 among controls. In the first visit, the rate of gingivitis was 31(60.8%) in asthmatic children and 12(23.5%) in the control group. During the third visit, the rate was 4(11.1%) and 5(13.5%) among the two groups, respectively.

Conclusions: Decreased salivary flow rates associated with the drugs used by asthmatic patients caused an increase in the rate of dental caries and gingival disorders.

Keywords: Asthma, Dental Caries, Preventive Dental Treatment, Salivary pH, Salivary flow rate, Fluoride. (JPMA 66: 1378; 2016)

Introduction

Asthma is the most common chronic inflammatory disease in childhood and can be controlled by long-term inhaled corticosteroid (ICS) therapy.[1,2] The number of asthmatic patients is known to be approximately 300 million worldwide, and it is estimated that an additional 100 million people will have this disease in 2025.[1] It is thought that its prevalence will increase, particularly among children.[3]

Dental caries is a major problem affecting oral and dental health. Deterioration in oral health and an increase of dental caries are seen even in developed countries. Dental caries affects the patient's quality of life and it also causes complications. The relationship between asthma and dental caries has been known for many years. There are many retrospective studies showing the relationship between asthma and dental caries in children.[4-7] It is specified in these studies that the drugs used for asthma treatment have a negative effect on dental health. In the study of Eloot et al.[8] the rates of dental caries and gingivitis were found to be increased in 3-17-year-old children with moderate and severe asthma who used asthma medications for a long time.

In the literature, the total number of extracted and filled teeth and dental caries — decayed, missing, and filled teeth (DMFT) — for permanent teeth and for deciduous teeth, or the total number of decayed, missing, and filled surfaces tooth surfaces (DMFS) for permanent teeth and deciduous teeth), as recommended by the World Health Organisation (WHO), are generally used for the identification of dental findings in asthmatic children.[7,9] The criteria of International Caries Detection and Assessment System (ICDAS) is an evidence based system for detection and classification of caries, fillings and extracted teeth in dental research.[10]

Samec et al.[11] performed a study with the aim of determining dental caries in asthmatic children, and they used the criteria of the International Caries Detection and Assessment System (ICDAS). This technique facilitates the detection of the onset of dental caries without a cavity. Moreover, in the study of Samec et al.,[11] it was reported that asthmatic children had more caries without a cavity than caries with a cavity.

[1]Children Dental Clinic, Dokuz Eylul University, [2,3]Department of Pediatrics, Dokuz Eylul University, School of Medicine, Turkey.

Correspondence: Gülser Kilinc. Email: gulser.kilinc@deu.edu.tr

In many studies, it has been shown that the salivary flow rate, content, pH, and buffering capacity were lower in children with asthma than in children without asthma. Consequently, it was established that all of the above enumerated factors affected the oral flora that led to an increase in dental caries.[1,2,5-7] However, other publications report contrary findings.[8,12] In general, the reason for increasing dental caries in children with asthma might be related to the change in the flow, the composition of saliva, and the increase in the number of Streptococcus mutans and lactobacilli.[5,7,13]

It is generally believed that asthma itself or its medication causes an increase in dental caries by affecting the quality and quantity of saliva. The duration of treatment and the dose of medication seem to be important factors in asthma-related dental caries.[1] There are some studies showing that the long-term use of inhaled corticosteroids and β2-agonists cause a reduction in the salivary flow rate.[14,15] In the study of Kargül et al.[16] on asthmatic children, it was demonstrated that salivary and dental plaque pH fell below the critical level of 5.5 within 30 minutes after the use of the beta-2 agonist inhaler.

This study was conducted to compare the values of salivary pH, salivary flow rate, gingival index (GI), and dental caries in the 1st, 2nd, and 3rd visits of asthmatic and non-asthmatic children after providing education on oral hygiene and applying preventive measures and to investigate the effect of the education provided initially about oral and dental health on dental caries.

Patients and Methods

This prospective, controlled study was conducted at Dokuz Eylul University, Izmir, Turkey, between 2012 and 2014. Children who were admitted to our outpatient clinic with the complaints of cough and shortness of breath and diagnosed with asthma and who used ICS for the last 1 year were evaluated with respect to the severity of asthma and control levels in accordance with the recommendations of the Global Initiative for Asthma (GINA) guidelines.[17] Children with moderate-severe asthma and children without asthma, who were aged from 4 to 16 years of age, were included. All patients lived in Izmir, and the level of fluoridation in water was 0.3 parts per million (ppm). Children with immune deficiency, bleeding and clotting disorders, and significant underlying chronic disease were excluded. Some of the patients who were initially included in the study and were given asthma treatment but then had to be discontinued under the control of their physicians were also excluded. Similarly, some children in the control group who did not come to their visits although they were invited were excluded, too. Informed consent from the patients' parents and the approval of Dokuz Eylul Medical School Clinical and Laboratory Research Ethics Committee were obtained.

Patients' demographic data including their tooth-brushing habits and previous dental examinations and the duration of asthma symptoms, co-morbid diseases, the type of given ICS, and daily dose of medication were recorded at the beginning of the study. Within the scope of preventive oral-dental programme, possible harmful effects of ICS and β2-agonist on teeth and gingiva were explained to children with asthma. Rinsing the mouth with water after each use of those was recommended. Asthmatic and non-asthmatic children and their parents were informed about proper nutrition and oral care and they were recommended to brush their teeth with fluoride-containing toothpaste twice a day.

Dental examinations of both asthma patients and the control group were performed the same day in the clinical setting. Patients underwent dental examination three times: at the beginning of the study (visit 1), 6 months after being included in the study (visit 2), and at the end of the first year (visit 3). Asthmatic and control group patients underwent dental examination under a reflector lamp with the help of a probe and a mirror.

No radiographs were used for the detection of dental caries. For diagnosing interproximal caries in asthmatic and non-asthmatic children, the use of bitewing radiography was considered, but it was rejected by the ethics committee thinking that children would be exposed to radiation unnecessarily.

In addition, salivary pH, salivary flow rate, and GI were evaluated according to the criteria of Loe[18] in three visits, and the number of daily tooth-brushing was noted. Dental examinations of asthmatic and control group children were performed by the same paediatric dentist. In the first visit, the existing dental caries of children were treated after collecting saliva samples and a fluoride varnish (5% Sodium Fluoride DuraShield, Sultan) was applied. The implementation of topical fluoride varnish was repeated in visit 2 and visit 3 in the children included both in asthma and control groups.

In accordance with the GI score, the subject's gingival health was assigned as follows: no inflammation (<0.1), mild inflammation (0.1-1.0); moderate inflammation (1.1-1.9) and severe inflammation (2.0-3.0). The presence of gingivitis was evaluated according to the GI criteria. Accordingly, children were grouped considering the GI value of <0.1 as 'no bleeding' and the GI value of > 0.1 as 'bleeding available'.[18]

The dental data of the patients, the number of dental caries, and filled and extracted teeth were identified according to the criteria of International Caries Detection and Assessment System (ICDAS)[10] (Table-1).

The ICDAS scores D1-2 indicate the caries lesions without a cavity in permanent teeth and d1-2 in deciduous teeth, and D3-6 and d3-6 indicate caries with a cavity in permanent teeth and deciduous teeth, respectively. According to this scale, while D3-6MFT+d3-6mft indicates the index of total caries with a cavity in deciduous and permanent teeth and extracted and filled teeth, D1-6MFT+d1-6mft indicates the total number of caries with and without a cavity both in deciduous and permanent teeth and extracted and filled teeth.

After dental examination, non-stimulated saliva samples were collected from all children between 08.30 a.m. and 10.30 a.m. for avoiding the circadian rhythm change, and children and their parents had been warned about not eating and drinking anything for at least 2 hours before the process. They confirmed whether they took this warning into account before beginning the process. At the beginning of saliva sample collection, they were informed about the procedure, and they were made to sit on a comfortable chair. After spilling out the saliva which accumulated in the mouth in the first 10 seconds, saliva was collected into sterile plastic receptacles for 5 minutes. After spilling out the saliva which accumulated in the mouth in the first 10 seconds, saliva was collected into sterile plastic recipients for 10 minutes. The collected saliva samples were measured through a pre-calibrated pH meter device in 10 minutes, and the salivary flow rate was calculated in ml/min immediately after the measurement of salivary pH.

SPSS 20 was used for data analysis. The percentage distribution, mean (±) standard deviation and median (minimum-maximum) were used for descriptive statistics. The chi-square test was used to compare countable variables of the groups. Relative risk (RR) was calculated. Kolmogorov-Smirnov test was used for analysing the normality of distribution. In comparison to the averages of two groups, t-test was used when the distribution was normal, and Mann-Whitney U test was used when the distribution was not normal. $P<0.05$ was considered significant.

Results

Of the 102 patients, 51(50%) were asthmatic and 51(50%) were non-asthmatic. There were 38(70.6%) boys and 15(29.4%) girls in the first group compared to 30(58.8%) boys and 21(41.2%) girls in the second group. The mean age was 11.16±3.10 years and 10.33±2.62 years, respectively, in the two groups (Table-2).

Initially ICS with a dose equivalent to 400 and 200 micrograms of budesonide was used for 45(88.2%) and 6(11.8%) of the asthma-diagnosed patients, respectively. Additional montelukast tablets were administered to 9(17.6%) during the follow-up. The number of asthmatic patients dropped to 45(88.2%) on visit 2 and 37(72.5%) on visit 3, whereas the number of participants for the control group on visit 2 and visit 3 fell to 41(80.4%) and 36(70.4%), respectively.

During the first visit, the number of children aged 4-6 years who were found to have decayed teeth was 5(9.8%) in the asthma group and 7(13.7%) in the control group. In the 7-11 years' age group, the number was 21(41.18%) and 29(56.86%) , whereas in the 12-16 years' age group, the number was 25(49%) and 15(29.41%), respectively. Mean D1-6MFT+d1-6mft values among asthmatic children were 2.00 2.34, 5.10 3.56 and 3.95 2.26 in the age groups of 4-6, 7-11 and 12-16, respectively, compared to 2.29 1.89, 2.62 1.61 and 2.15 1.75 in the respective age groups among controls. Similarly, mean D3-6MFT+d3-6mft values among asthmatic patients were 2.00 2.34, 4.76 3.59 and 3.84 2.24 in the age groups of 4-6, 7-11 and 12-16, respectively, versus 1.86 1.95, 2.55 1.52 and 2.00

Table-1: The caries and restorations codes in this scale (International Caries Detection and Assessment System ICDAS).

Caries Codes	Restoration and Sealant Codes
(0) Sound tooth surface	(0) Not restored and sealant
(1) First visual change in enamel	(1) Sealant partial
(2) Distinct visual change in enamel	(2) Sealant full
(3) Enamel breakdown no dentine visible	(3) Tooth colored restored
(4) Dentinal shadow (not cavitated into dentine)	(4) Amalgam restored
(5) Distinct cavity with visible dentine	(5) Stainless steel crown
(6) Extensive distinct cavity with visible dentine	(6) Porcelain or gold or PFM or veneer
(7) Tooth extracted because of caries (tooth surfaces will be coded 97)	(7) Lost or broken restoration
(8) Tooth extracted for reasons other than caries (tooth surfaces will be coded 98)	(8) Temporary restoration

PFM: Porcelain-fused-to-metal.

Table-2: Demografic features of children with asthma and control group.

Groups	N	Gender		Median Age
		Male (%)	Female(%)	
Asthma	51	38(70.6)	15(29.4)	11.16±3.10
Control	51	30(58.8)	21(41.2)	10.33±2.62
		p=0.21	p=0.15	

1.64 among controls. (p<0.001) (Table-3).

During oral examination on the second visit, 3(5.88%) new D3-6+d3-6 and 1(1.96%) D1-2 dental caries were found among the teeth of the asthmatic children, whereas 1(1.96%) D1-2 and D3-6 caries each were observed in the control group. When the presence of dental caries was evaluated during the first visit, it was detected that the rate of decayed teeth was higher in the asthma group [RR: 1.19 (1.032-1.38) times] than in the control group. In the second examination, the rates of new dental caries were similar to each other in the asthma and control groups [(RR: 0.17 (0.021-1.50)].

As a result of dental treatments applied on the decayed

Table-5: The pH and salivary flow rate (mL/min) values of children with asthma and in the control group in visits 1, 2, and 3.

Visit	Groups	n	Mean SD
Visit 1	pH		
	Asthma	51	7.135±0.15
	Control	51	7.158±0.14
	Flow Rate (mL/min)		
	Asthma	51	3.878±0.71*
	Control	51	4.684±0.50
Visit 2	pH		
	Asthma	45	7.108±0.13
	Control	41	7.161±0.09
	Flow Rate (mL/min)		
	Asthma	45	3.784±0.60*
	Control	41	4.600±0.30
Visit 3	pH		
	Asthma	37	7.139±0.12
	Control	36	7.156±0.09
	Flow Rate (mL/min)		
	Asthma	37	3.862±0.53*
	Control	36	4.583±0.28

t -test. p<0.001*
SD: standard deviation.

Table-3: Dental caries in primary and permanent teeth of children with asthma and in the control group in visit 1.

Visit	Ages (years)	n	$D_{3\text{-}6}MFT+d_{3\text{-}6}mft$ SD	p* value	$D_{1\text{-}6}MFT+d_{16}mft$ SD	p* value
Visit 1	4–6					
	Asthma	5	2.00±2.34	1.00	2.00±2.34	0.75
	Control	7	1.86±1.95		2.29±1.89	
	7–11					
	Asthma	21	4.76±3.59	0.005	5.10±3.56	0.008
	Control	29	2.55±1.52		2.62±1.61	
	12–16					
	Asthma	25	3.84±2.24	0.008	3.95±2.26	0.008
	Control	15	2.00±1.64		2.15±1.75	

*p: Mann-Whitney U-test
DMFT: Decayed, missing, and filled teeth
SD: Standard deviation.

Table-4: Dental caries in primary and permanent teeth of children with asthma and in the control group in visits 1, 2, and 3.

		n	$D_{3\text{-}6}+d_{3\text{-}6}$ SD	$D_{1\text{-}6}+d_{1\text{-}6}$ SD	M+m SD	F+f SD	$D_{1\text{-}6}MFT+d_{1\text{-}6}mft$ SD
Visit 1	Asthma	51	3.31±2.33*	3.65±2.35*	0.33±0.90	0.33±0.90	4.27±2.96*
	Control	51	1.57±1.17	1.76±1.25	0.02±0.14	0.69±1.25	2.45±1.66
Visit 2	Asthma	45	0.64±0.95	0.80±0.91	0.04±0.20	3.40±2.48*	4.24±2.86
	Control	41	0.05±0.21	0.24±0.48	0.05±0.21	1.71±1.34	2.56±1.96
Visit 3	Asthma	37	-	0.03±0.16	0.03±0.16	0.08±0.49	4.11±2.78
	Control	36	0.05±0.32	0.03±0.16	-	0.06±0.23	2.69±2.01

DMFT: Decayed, missing, and filled teeth
D3-6+d3-6 (with cavity), D1-6+d1-6 (with+without cavity), M+m (missing), F+f (filling),
DMFt3-6 +dmft3-6(the means of with cavity and caries with cavity filled, extracted teeth with caries),
DMFt1-6 + dmft1-6 (the means of with + without cavity and caries with cavity filled, extracted teeth with caries)
SD: standard deviation, Mann-Whitney U-test, p<0.001*.

Table-6: The incidence of gingivitis (GI) in children with asthma and the control group in visits 1, 2, and 3.

Gingivitis		n	Present (%)	Absent (%)
Visit 1	Asthma	51	31 (60.8)*	20 (39.2)*
	Control	51	12 (23.5)	39 (76.5)
Visit 2	Asthma	41	5 (12.2)	36 (87.8)
	Control	45	9 (20.0)	36 (80.0)
Visit 3	Asthma	36	4 (11.1)	32 (88.9)
	Control	37	5 (13.5)	32 (86.5)

Chi-square test, p<0.001*.

teeth of the asthmatic and non-asthmatic children, the number of filled teeth, which was a few in the 1st visit, increased in the 2nd visit (Table-4). Moreover, it was found that children in both groups had an extraction due to caries during this period.

In the oral examination during the third visit, although a new D3-6 caries was not seen in any child among the asthmatic children, a D1-2 caries was observed in one tooth of a child. On the other hand, in the control group, 1(1.96%) child had D3-6 caries in one tooth.

During the first visit, mean values for salivary pH and flow rate were 7.135 0.15 and 3.878 0.71 mL/min among asthma patients, and 7.158 0.14 and 4.684 0.50 among controls. The values during the second visit were 7.108 0.13 and 3.784 0.60 among asthma patients and 7.161 0.09 and 4.600 0.30 among controls. During the third visit, the values stood at 7.139 0.12 and 3.862 0.53, and 7.156 0.09 and 4.583 0.28 among the two groups, respectively (Table-5).

The rate of gingivitis in the first visit was 31(60.8%) in asthmatic children and 12(23.5%) in the control group (p<0.001). During the second visit, the rate fell to 5(12.2%) in the asthma group and 9(20%) in the control group. During the third visit, the rate further dropped to 4(11.1%) and 5(13.5%) among the two groups, respectively (Table-6).

During the first visit, 13(19.5%) participants in the asthma group and 23(41.2%) in the control group said they brushed their teeth one time a day, 17(34.1%) and 12(23.5%) said they brushed two times, while 21(46.3%) and 16(35.3%) said they brushed at irregular intervals. During the third visit, 31(83.8%) children in the asthma group and 33(91.6%) in the control said they brushed two times daily (Table-7).

Discussion

Many studies have shown that there is a relationship between the number of teeth with caries and asthma.[5-7,12,14,16,19,20] However, most of the results mentioned were obtained from studies conducted with adults; the number of studies showing the effects of preventive dentistry on dental health in children are limited.[21]

It has been shown that the drugs used to treat asthma increase dental caries, but the issue is still controversial.[8,21,22] Although a systematic review prepared by Maupome G.[23] reported that there was no relationship between asthma and dental caries, the same researcher[24] showed in his 2010 meta-analysis that asthma increased the formation of dental caries approximately by two times. Inconsistencies in the study may have been caused by the chronic course of asthma and dental caries and the inability to evaluate the effects of complex and variable factors on the course of both diseases. In our study, the number of dental caries in children with asthma was higher than in children without asthma.

In a limited number of studies in the literature, the number of dental caries of asthmatics increased with age. Stensson et al.[9] reported that while six and more dental caries were found in 9% of 3-year-old children, 10% of 10-year-old children had nine or more dental caries. In the same study, six or more dental caries were found in 20% of children aged 3-6 years. In our study, consistent with the literature, the number of dental caries in asthmatic children also increased with age. Although 4-6-year-old children with asthma had more caries than the control group, there were no statistically significant results. D1-6MFT+d1-6mft values between 7-11 and 12-16 years' age groups were statistically much higher than the control group.

One of the possible risk factors in the formation of dental

Table-7: Frequency of tooth-brushing habits of children with asthma and the control group in visits 1, 2, and 3.

Frequency of Brushing Teeth		n	1 time (%)	2 times (%)	Irregular (%)
Visit 1	Asthma	51	13 (19.5)	17 (34.1)	21 (46.3)
	Control	51	23 (41.2)	12 (23.5)	16 (35.3)
Visit 2	Asthma	45	12 (26.7)	30 (66.6)	3 (6.7)
	Control	41	14 (34.1)	23 (56.1)	4 (9.8)
Visit 3	Asthma	37	6 (16.2)	31 (83.8)	-
	Control	36	3 (8.3)	33 (91.6)	-

caries in patients with asthma seems to be the use of inhalers. When the studies investigating the effect of asthmatic treatment on dental health were examined, it was observed that asthmatic children, adolescents, and adults who had been on long-term use of inhaled β2-agonist and ICS were predisposed to the formation of dental plaque because of reduced salivary flow rate.[7,13,15,23,25] Some researchers suggest that a decrease in salivary pH and flow rate facilitates the growth of Streptococcus mutans, thus causing the formation of dental plaque. In the study of Ryberg et al.,[26] the salivary flow rate decreased in patients using beta-2 agonist for a long time.

The use of inhaled medications for an average of 1 month might cause an increase in the dental plaque index by reducing buffering capacity and re-mineralisation.[6,25] It has also been reported that inhalers were effective in the decrease of the salivary flow rate and the formation of dental caries due to different concentrations of lactose in the medications.[11] In a study conducted by Ersin et al.,[7] asthma medications were shown to cause a decrease in salivary pH. Sag et al.[13] have compared the salivary flow rate values of 15 asthma patients using short-acting β2-agonists and ICS. After examining the patients twice within an interval of 1 month, they obtained a statistically significant decrease in the salivary flow rate. In other studies with asthmatic children, it has been shown that 30 minutes after the use of beta- 2 antagonist, salivary and plaque pH declined to a critical level (pH=5.5), causing enamel demineralisation.[13] In our study, although the salivary pH values were found to be similar in both groups in all visits, the salivary flow rate was found to be lower in children with asthma. Consistent with the literature, a lower salivary flow rate in asthmatics has suggested that long-term drug use causes dryness of the mouth. Another reason for the absence of any difference between asthmatic and non-asthmatic patients in terms of salivary pH value was attributed to the fact that the measurement of salivary pH was not performed immediately after the use of the asthma drug.

Some researchers have reported that dental caries of children with asthma using inhaler therapy are more common in permanent teeth than in deciduous teeth, and these caries are more often observed in the first permanent molars.[27-29,30] Samec et al.[11] have evaluated children treated for asthma at 2-6, 7-12, and 13-17 years of age, and the number of dental caries both in deciduous and permanent teeth at all ages has been found to be higher than in healthy children. In our study, it was found that the number of D1-6MFT+d1-6mft teeth was higher in asthmatic children at the age groups of 7-11 years and 12-16 years (except 4-6 years) than in the control group.

It has been shown that the diagnosis of asthma, the child's age, daily ICS dose, the duration of drug treatment, the habit of rinsing the mouth after drug administration, family education status, and frequent cariogenic food consumption are closely related with gingival problems as well as the number of dental caries.[11] Stensson et al.[9] found a higher incidence of gingivitis in children with asthma than that of the control group for the 3-6 age range. In our study, in a similar manner, the incidence of gingivitis in children with asthma was found to be higher than that in the control group. The asthma medications that the patients use, lack of tooth-brushing habits, and insufficient mouth rinsing after the administration of the drug increased the incidence of gingivitis. After the first visit, the patients were recommended to rinse the mouth with water after each drug administration, brush their teeth twice a day, and stay away from cariogenic food. In visits 2 and 3, a decrease in gingival problems was observed in children with asthma. The initial tooth-brushing habits of asthmatic patients were not different from the controls. In the first visit, patients with asthma and the control group were recommended to brush their teeth with fluoride-containing toothpaste twice daily. In the second and third visits, the number of brushings was found to have gradually increased. It shows that gingival problems may be reduced in asthmatic children by gaining regular tooth-brushing habits, having dental check-ups, and implementing preventive therapies.

The limitations of our study include the absence of bitewing radiography, which could not be performed for the detection of interproximal caries because approval from the ethics committee was not received, and the numbers of patients in the study and control groups decreased in follow-up visits because of the reasons mentioned above.

Conclusion

Asthmatic children had more dental caries and gingival problems than healthy children. Moreover, the salivary flow rate was found to be lower in asthmatic children depending on the drugs that are used. Further studies requiring long-term follow-up should be conducted on this issue.

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