Relationship between Gingivitis and Autism in Children: A Matched Case-control Study

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Authors' contributions

This work was carried out in collaboration between all authors. Author ASS designed the study and wrote the protocol and first draft of the manuscript. Author AP contributed to collect samples, author FARR managed literature searches and analyses of the study. Author AB contributed for statistical analysis. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Autism is a neurodevelopmental disorder diagnosed in early childhood. Studies have shown that autistic children have poorer gingival health and hence chances of higher incidence of gingivitis may occur in autistic than non-autistic children. Gingivitis is characterized by gingival inflammation without loss of attachment due to continuous exposure to dental plaque. Studies on the gingival health of autistic children in Malaysia are lacking. Hence, this study aims to evaluate and compare the gingival health status of autistic and non-autistic children.
Materials and Methods: A total of 86 children were recruited and an oral assessment was performed on each child to assess the degree of calculus, plaque accumulation and gingival

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inflammation using the calculus, plaque and gingival indices respectively. Pooled dental plaque (supragingival margins and gingival crevices of the buccal surface of the anterior maxillary molar and lingual of mandibular molar teeth) samples were collected and transferred to Stuart transport media. Samples were diluted and 100 µl aliquots were cultured on Columbia agar with 5% sheep blood. Plates were incubated in an anaerobic environment at 37ºC for 7 days. Colonies were Gram stained and examined for cellular morphology followed by indole and catalase test. Bacterial identification was done using the Rapid ID 32 A kit. Kolmogorov-Smirnov, Chi-square, Mann-Whitney U, Odds ratio and Spearman's correlation analyses were used to analyze the data.
Results: The prevalence of dental calculus was significantly elevated in the autistic group with 43 sample size in each group (p = 0.001). However, the prevalence of gingivitis and plaque were not significantly different between the two groups. The presence of plaque (p = 0.001) and calculus (p = 0.004) were significantly associated with the development of gingivitis.
Conclusion: While the autistic children had significantly more calculus, the occurrence of gingivitis and plaque were similar between autistic and control groups. Measures to control dental plaque and calculus among the autistic children should be improved to prevent gingivitis.

1. INTRODUCTION

Autism was first described by Leo Kanner in 1943, symptoms usually appear in early childhood and they differ in severity from mild to severe [1]. The prevalence of autism is rising and studies conducted in the United Kingdom, United States of America, Japan and South Korea report prevalence estimates of 157, 113, 181 and 264 per 10,000 individuals respectively [2]. In Malaysia, the prevalence is approximately 1.6 per 1000 among children aged 1.5 to 3 years old [3].

Gingivitis is a reversible type of periodontal disease which is distinguished by inflammation of the gingival tissue without loss of periodontal attachment due to prolonged exposure of the gingiva to dental plaque. It can develop into periodontitis in susceptible individuals causing permanent destruction of periodontal tissue [4].

Studies have shown that autistic children have poor oral hygiene and gingival health along with a higher incidence of periodontal disease than non-autistic children [1,5,6,7,8,9,10]. They have higher plaque and gingival index scores with increased need for periodontal treatments such as scaling and root planning [5,6]. Generalized gingivitis seen in autistic children was attributed to several reasons such as irregular brushing habits, lack in manual dexterity, poor hand coordination, poor dental awareness, lack of dental education and adverse effects of certain medications used to manage some manifestations of autism [5,8,9]. Study reported a higher occurrence of gingivitis in those with mixed and permanent dentition whereas another researcher reported significantly more gingivitis among elder autistic children. Gingivitis was attributed to hormonal factors and excessive plaque accumulation due to insufficient oral hygiene practices in both studies [1,10].

2. MATERIALS AND METHODS

A case-control study was conducted for six months (1st July to 31st Dec 2013) at three different centers of one of the autism society in Malaysia in Klang Valley. The children who were diagnosed by a psychiatrist as autistic were considered as cases. Children who were residing in three orphanage homes located at the same areas as the respective centres of the autism society, but not suffering from autism were considered as controls. Stratified Random Sampling matched with age groups was used to select the study sample.

The sample size was calculated for matched case-control study by using the following parameters: Confidence interval = 95%, power=80%, ratio of case against control was 1:1, proportion of dental plaques and calculus in control group = 5%, the difference between the proportion of dental plaques and calculus among autistic and non-autistic children =30%, the expected odds ratio or design effect was 8.14. due to feasibility constraints in statistical analysis, the researchers decided to replace any drop-outs or lost to follow up cases with a randomly selected new one according to the respective groups.

Forty-three autistic children were selected from three centres of an autism society in Malaysia located at the Klang Valley. The cases belonged

to (4–16) years of age group and suffering from mild to moderate autism with no comorbidities. Matched with age-groups 43 healthy children without autism (control) were randomly selected from 3 differnt children homes in the Klang Valley. A study info sheet was distributed and informed written consent was obtained from every participants before proceeding with this research.

Considering a proportion of 10% oral bacterial assessment with a precision of 9% and a confidence coefficient of 95%, 43 subjects were required for this study. A convenience sample of 43 autistic individuals aged 4 to 16 years old were obtained from three branches of one of the autism societies.

The inclusion criteria were mild to moderate cases of autism between the ages of 4 to 16 years old for the test group and non-autistic individuals of similar age group as controls. The exclusion criteria were severe cases of autism with co-morbidities and uncooperative subjects

2.1 Ethical Consideration

The present study was independently reviewed and approved by the Research Ethics Committee of the internal university and board members of one of the autism society in Malaysia where study had been conducted. The children's parents provided informed written consent after receiving information about the objectives and procedures of this study. The control group consisted of 43 non-autistic individuals of the same age group solicited from children homes. Informed written consents were provided by highest management authorities of these establishments as well as parents of the participants.

2.2 Dental Assessment and Sample Collection

The dental assessment for all subjects was performed by the registered dentist using a sterile dental mirror and probe. The children were assessed for the presence and degree of calculus, plaque and gingivitis using the calculus, plaque and gingival indices in Table 1 [5,11,12]. To check the gingival status, all the sites of Ramford;s teeth (#16,#21,#24,#36,#41,and #44) were taken into consideration. These findings along with subject demographics (age, gender and ethnicity) were recorded in a dental form.

Pooled plaque samples were collected using a sterile probe swab from the supragingival margins and gingival crevices of the buccal surface of the anterior maxillary molar and lingual of mandibular molar teeth and were immediately placed into Stuart transport medium (Improswab™, Guangzhou Improve Medical Instruments Co. Ltd., Guangzhou, China).

2.3 Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 17.0 (IBM SPSS Inc., Chicago, Illinois, USA). Chi-square was done to study the association between a factor and the outcome while odds ratio and Spearman's correlation coefficient were computed to find the direction and strength of association. Level of significance was set at $p < 0.05$.

3. RESULTS

In this study, majority of the participants were male 62 (72%). Among the autistic children, Majority of the participants 68 (79.1%) belonged to the age group of (4-12) years. The distribution of ethnicity revealed that majority of them were Malay 58 (67.4%). Oral characteristics of participants in Table 2 revealed that majority had gingivitis 63 (73.3%) and plaques 78 (90.7%). However, majority of participants were without dental calculus 45 (52.3%). There were no significant associations between gingivitis and gender or ethnicity or age of the participants.

Table 3 revealed that the autistic group had a lower incidence of gingivitis (46%), but a higher incidence of plaque (51.3%) than the non-autistic group (54% and 48.7% respectively). However, difference in the prevalence of gingivitis and plaque between the two groups was found to be statistically insignificant (p=0.001).The calculus index was positively and significantly correlated with autism (Spearman's ρ=+0.389; p-Value=0.001*).

Table 4 revealed that there was a significant association between the presence of plaque and gingivitis (p = 0.001). The OR and 95% CI for the OR could not be computed because one cell had a frequency of 0. The plaque index was positively and significantly correlated with the prevalence of gingivitis (Spearman's ρ = +0.601).

Table 1. Description of indices used [11,12]

	Description
Calculus index	
Score	
0	No calculus present.
1	Supragingival calculus covering not more than one third of the exposed tooth surface.
2	Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.
3	Supragingival calculus covering more than two thirds of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both.
Plaque index	
Score	
0	No plaque in the gingival area.
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be recognized only by running a probe across the tooth surface.
2	Moderate accumulation of soft deposits within the gingival pocket and on the gingival margin and/or adjacent tooth surface, which can be seen by the naked eye.
3	Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface.
Gingival index	
Score	
0	No inflammation. Gingival tissue is normal.
1	Mild inflammation. There is a slight change in colour and slight oedema of the gingival tissue but there is no bleeding on probing.
2	Moderate inflammation. There is some redness, oedema and glazing of the gingival tissue which bleeds on probing.
3	Severe inflammation. There is marked redness, oedema and ulceration of the gingival tissue which tends to bleed spontaneously.

Table 2. Oral characteristics of the participants

Demographic and oral characteristics	Autistic (N_1 = 43) n_1 (%)	Non-autistic (N_2 = 43) n_2 (%)	Total (N = 86) n (%)
Gingival index			
0 (None)	14 (32.5)	9 (20.9)	23 (26.7)
1 (Mild)	15 (34.9)	19 (44.2)	34 (39.6)
2 (Moderate)	11 (25.6)	13 (30.2)	24 (27.9)
3 (Severe)	3 (7.0)	2 (4.7)	5 (5.8)
Plaque index			
0 (None)	3 (7.0)	5 (11.6)	8 (9.3)
1 (Mild)	10 (23.3)	8 (18.6)	18 (20.9)
2 (Moderate)	21 (48.8)	15 (34.9)	36 (41.9)
3 (Severe)	9 (20.9)	15 (34.9)	24 (27.9)
Calculus index			
0 (None)	14 (32.5)	31 (72.1)	45 (52.3)
1 (Mild)	18 (41.9)	8 (18.6)	26 (30.2)
2 (Moderate)	6 (14.0)	3 (7.0)	9 (10.5)
3 (Severe)	5 (11.6)	1 (2.3)	6 (7.0)

Table 3. Comparison between gingivitis status / dental plaques/dental calculus and autism

	Autistic ($N_1 = 43$) n_1 (%)	Non-autistic ($N_2 = 43$) n_2 (%)	Total (N = 86) n (%)	χ^2 value	OR	95% CI	p-value
Gingivitis status							
Present	29 (46.0)	34 (54.0)	63 (73.3)	1.484	0.548	0.207 – 1.451	0.223
Absent	14 (60.9)	9 (39.1)	23 (26.7)				
Plaque status							
Present	40 (51.3)	38 (48.7)	78 (90.7)	0.551	1.754	0.392 – 7.852	0.713
Absent	3 (37.5)	5 (62.5)	8 (9.3)				
Calculus status							
Present	29 (70.7)	12 (29.3)	41 (47.7)	13.471	5.351	2.127 – 13.460	0.001[*]
Absent	14 (31.1)	31 (68.9)	45 (52.3)				

[*]*Here, p-value<0.05 was considered as significant*

Table 4. Comparison between dental plaques or dental calculus and gingivitis status

	Gingivitis status			χ^2 value	OR	95% CI	p-value
	Present ($N_1 = 63$) n_1 (%)	Absent ($N_2 = 23$) n_2 (%)	Total (N = 86) n (%)				
Plaque status							
Present	63 (80.8)	15 (19.2)	78 (90.7)	24.161	–	–	0.001[*]
Absent	0 (0)	8 (100)	8 (9.3)				
Calculus status							
Present	36 (87.8)	5 (12.2)	41 (47.7)	8.466	4.80	1.583 – 14.556	0.004[*]
Absent	27 (60.0)	18 (40.0)	45 (52.3)				

[*]*Here, p-value<0.05 was considered as significant*

There was a significant association between the presence of calculus and gingivitis (p = 0.004). Individuals with calculus were 4.8 times more likely to develop gingivitis than individuals without calculus (OR = 4.80). The calculus index was positively correlated with the presence of gingivitis by 34.2% (Spearman's ρ = 0.342; p-value=0.002).

4. DISCUSSION

The median plaque index and gingival index scores show that in general, the children experienced moderate accumulation of plaque and mild gingivitis. The autistic children had a higher incidence of calculus (calcified plaque deposits) than the control group. However, the prevalence of plaque and gingivitis were comparable between the two groups. The latter was due to good oral hygiene care given to the children by their parents and caregivers at the respective centres. A Swedish study involving 20 autistic and 20 non-autistic children reported similar findings in which there was no significant difference in the occurrence of gingivitis between the two groups [13].

The presence of plaque and calculus were positively correlated with gingivitis, indicating that they pose as risk factors for the development of gingivitis. Similar findings had been reported in other studies [14,15]. In two separate studies in which one involved 1362 Jordanian children with mean plaque and gingival scores of 1.46 and 1.56 respectively while another involved 86 Serbian children with median plaque and gingival scores of 1.757 and 1.894 respectively, researchers reported that dental plaque accumulation was associated with gingival inflammation [14,15]. Calculus had been implicated as a risk factor for the development of periodontal disease in children and adults in other studies [16].

5. CONCLUSION

The autistic group had significantly more calculus than control but the prevalence of plaque and gingivitis were similar between the two groups. As dental plaques and calculus are considered as risk factors for the development of gingivitis, good personal oral hygiene habits along with professional treatments are important measures to prevent gingivitis. A limitation of this study is the small sample size as it was aimed as a pilot study. Larger multi-centric studies are needed to validate the findings from this study.

CONSENT

Consent of each parent has been taken.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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