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ORIGINAL PAPER

Oral Health Behaviours of Preschool Children with Autism Spectrum Disorders and Their Barriers to Dental Care

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Abstract

This study compared oral health behaviours and barriers to dental care among preschool children with and without ASD, and evaluated dental knowledge and attitudes of their parents. 257 preschoolers with ASD and an age- and gender-matched control sample were recruited. Children with ASD had less frequently performed tooth-brushing and used toothpaste, but more often required parental assistance in tooth-brushing ($p < .05$). Barriers to dental care were more frequently reported among children with ASD ($p < .001$). Parents of children with ASD had higher scores in dental knowledge and attitudes than those without ASD. Differences in oral health behaviours and barriers to dental care existed between preschool children with and without ASD. Parents of children with ASD had better dental knowledge and attitudes.

Keywords Autism spectrum disorders · Preschool children · Oral health behaviours · Oral health knowledge · Oral health attitudes · Barriers to dental care

Introduction

Autism spectrum disorders (ASD) is a spectrum of developmental disorders, which is characterized by pervasive impairments in social interaction and qualitative impairments in verbal communication, along with repetitive, stereotyped patterns of behaviours, interests, or activities (APA 2013). The latest US CDC (2016) reported that an estimated 1 in 68 (14.6 per 1000) school-aged children have been identified with ASD. In Hong Kong, the average incidence of ASD among children aged 0–4, is reported to be 5.49 per 10,000; and the incidence of ASD is 16.1 per 10,000 in children less than 15-year-old over the period 1986–2005 (Wong and Hui 2008).

A meta-analyses of anxiety deriders among children and adolescents with ASD reported that among the 31 studies involving 2121 individuals (aged < 18 years); almost 40% had at least one comorbid anxiety—the most frequent being specific phobia (at ~ 30%), but also obsessive compulsive disorders (~ 17%) and social anxiety (~ 17%) were common (van Steensel et al. 2011).

Anxiety along with impaired communication and oral sensitivity of children with ASD could lead to a series of oral health challenges. The importance of oral health challenges in preventing oral disease and providing oral health care for individuals with ASD has long been recognized (Swallow 1969; Kopel 1977). Understanding their oral health needs can be difficult owing to a lack of cooperation with clinical oral examinations (Lowe and Lindemann 1985). All too often the first encounter of individuals with ASD with oral health services is because of dental emergencies and there is a reliance on provision of dental treatment under general anesthesia for children with ASD (Klein and Nowak 1999).

Given challenges associated with food selectivity, oral defensiveness to tooth brushing and infrequent use of preventive and oral health care services, individuals with autism should have a greater caries risk. However, the evidence of increased caries risk is conflicting, with some studies reporting a higher dental caries experience (DeMattei et al. 2007; Marshall et al. 2010; Altun et al. 2010; Jaber 2011) and others suggesting a similar or even lower dental caries experience (Shapira et al. 1989; Fahlvik-Planefeldt and Herrstrom

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2001; Namal et al. 2007; Loo et al. 2008; Slayton 2010; Du et al. 2015; Vellappally et al. 2014; Fakroon et al. 2015).

It would appear plausible that individuals with ASD are at a greater risk of periodontal disease, owing to problems in plaque control and oral defensiveness to oral hygiene devices in the mouth, including tooth brushing. Most studies in the literature reported poorer dental hygiene or poorer periodontal health outcomes (Lowe and Lindemann 1985; Shapira et al. 1989; Pilebro and Backman 2005; DeMattei et al. 2007; Altun et al. 2010; Luppanapornlarp et al. 2010; Jaber 2011; Subramaniam and Gupta 2011; Mohinderpal-Chadha et al. 2012; Vajawat and Deepika 2012; El Khatib et al. 2014; Yashoda and Puranik 2014).

Both parents and general dentists are the primary oral health caregivers of the children with ASD. It is essential to understand the challenges in oral self-care and barriers to dental services among children with ASD. This could help improve the quality of care and set up a series of tailored oral health promotion programmes for these individuals. Therefore, the aims of the study were (1) to compare the oral health behaviours and barriers to oral health care among preschool children with and without ASD in Hong Kong, and (2) to evaluate the oral health knowledge and oral health attitudes among parents of preschool children with and without ASD.

Materials and Methods

Sample

The sampling frame for this study was the complete list of Special Child Care Centers (SCCC), as identified from the Government Social Welfare Department in Hong Kong Special Administrative Region (HKSAR), China. Nineteen SCCCs of the identified 34 centres were selected according to random numbers generated from a computer package. Letters were sent to the school principals to explain the purpose of the study and to invite the SCCCs to participate. In total, 515 children with ASD were identified from the 19 SCCCs and their parents were invited to participate in the study. An age (±3 months) and gender-matched sample of preschool children was recruited from mainstream preschools to act as the control group. Approval to conduct the study was obtained from the local Institutional Review Board (IRB HKU: UW 11-184).

Data Collection

The socio-demographic profiles of parents were obtained, which include the highest level of formal education and family income level. The child's date of birth and gender were obtained from the family information form.

For the oral health behaviors of children with and without ASD, the emphasis of assessment was on dental care utilization and oral habits of the child. The assessment of child's oral habits focused on the frequency of tooth brushing, parental assistance with tooth brushing, usage of toothpaste and frequency of snacking between meals. For the barriers to oral self-care, difficulties of tooth bushing and reasons for the difficulties experienced were explored. For the barriers to dental services, the assessment was performed using 15 items as described by Nelson et al. (2011). Parents were asked whether they had experienced any of a list of potential barriers to dental care. The list contained both "environmental" barriers, which originate in the dental care system, and "non-environmental" barriers, which originate with the child and family.

The oral health knowledge of parents was assessed using a standardized measure to elicit their knowledge on the causes of dental caries and periodontal disease and ways to prevent them (Schwarz and Lo 1994; Lin et al. 2001). This oral health knowledge measures consists of four open-ended questions: Questions 1–2: what do you think are the three most important factors leading to tooth decay/gum disease? Questions 3–4: what do you think could be the three most important methods to prevent tooth decay/gum disease? For each question, up to three answers were recorded. An overall oral health knowledge score was constructed by counting the number of acceptable answers given to the four questions (each scoring 1). Thus, an oral health knowledge score can range from 0 to 12 and a higher score indicates better oral health knowledge.

The oral health attitudes of parents were assessed using a standardized measure (Lin et al. 2001). Parents were asked to rate their agreements to the following eight statements (agree/disagree):

1. Just like birth, aging and death, loss of teeth is a natural process. (F)
2. State of teeth is decided at birth and is not related to self-care. (F)
3. Poor teeth are detrimental to one's appearance. (T)
4. State of my teeth is of great importance to me. (T)
5. Keeping natural teeth is not important. (F)
6. Dental problems can affect the body as whole. (T)
7. False teeth will be less of a bother than natural teeth. (F)
8. Regular visits to the dentist prevent dental problems. (T)

A dental attitude score was produced by counting the total number of statements, which the subjects showed a positive appropriate attitude (Lin et al. 2001). The oral health attitude scores can range from 0 to 8, with a higher score indicating a more positive dental attitude.

Data Analysis

All the data were analyzed using SPSS for Windows version 17.0. Descriptive statistics of knowledge, attitudes, barriers and behaviours related to oral health were produced. Statistical differences (between children with and without ASD) were determined using *t test* for independent samples or its non-parametric equivalent for continuous data and *Chi square test* for categorical data.

Results

Two hundred and fifty-seven of the 515 children with ASD participated in the study with parental consent. The mean age of the children was 59 ± 10 months (range from 32 to 77 months), of whom 84.4% (217) were males. For the control group, a gender and age (± 3 months) matched sample of 257 children were recruited from the neighbouring preschools.

The demographic backgrounds of the 257 children with ASD and 257 children without ASD is presented in Table 1.

There was a significant difference in reported oral health behaviours of the preschool children with and without ASD in terms of tooth brushing, Table 2. There were observed significant differences in *tooth brushing habits: frequency of tooth brushing* ($p < .05$); *use of toothpaste* ($p < .001$); and *provision of assistance in tooth brushing* ($p < .001$).

There was a significant difference in the reported barriers to oral self-care among preschool children with and without ASD in terms of perceived difficulty of tooth brushing ($p < .001$), Table 3. Among those who reported that '*tooth-brushing is a difficult task*', there were significant differences in several cited reasons: child being scared of tooth-brushing ($p < .01$), child not liking anything in their mouths ($p < .01$) and child not understanding what tooth-brushing is about ($p < .05$).

There was a significant difference in reported barriers to access to dental services among preschool children with and without ASD ($p < .001$), Table 4. Among those who reported that it was 'challenging for child to visit a dentist', significant differences for environmental reasons [inability to find a dentist willing to treat the child ($p < .001$); finding a dentist near the child's home ($p < .001$); dental staff being anxious or nervous about treating the child ($p < .01$); time to take child to the dentist ($p < .05$) and dental costs ($p < .001$)]. Significant differences were also observed in the following non-environmental reasons [child does not like to have anything done in his/her mouth ($p < .001$); child cannot behave cooperatively at the dentist ($p < .001$); child's medical conditions make dental treatment very complicated ($p < .001$); and child has other more urgent health care needs ($p < .001$)].

Table 1 Demographic backgrounds of preschool children with and without ASD (n = 257)

	ASD % (n)	Non-ASD % (n)	P-value*
Parents education level*			
None/primary	6.2 (15)	8.4 (21)	.004**
Secondary school	47.3 (114)	59.8 (149)	
Tertiary	46.5 (112)	31.7 (79)	
Family income (HKD per month)			
< $10,000	13.6 (32)	19.2 (46)	< .001***
$10,000–$19,999	31.1 (73)	48.1 (115)	
$20,000 or above	55.3 (130)	32.6 (78)	
Mother completed questionnaire	73.4 (179)	67.7 (172)	.095^{NS}

Not all the parents disclosed their education level or family income

*p-value obtained from Chi square test

^{NS}p > .05; *p < .05; **p < .01; ***p < .001

Table 2 Oral health behaviours of preschool children with and without ASD

	ASD % (n)	Non-ASD % (n)	*p*-value
Dental attendance			
Ever attended the dentist			
Yes	29.5 (74)	22.5 (57)	.08^{NS}
No	70.5 (177)	77.5 (196)	
Last dental visit			
Within the past year	74.3 (55)	78.9 (45)	.57^{NS}
More than a year ago and never	27.0 (20)	22.8 (13)	
Experience of GA for dental treatment			
Yes	8.1 (6)	0.2 (1)	.11^{NS}
No	93.2 (69)	98.3 (56)	
Tooth brushing habits			
Frequency of brushing			
At least twice a day	62.9 (158)	71.7 (180)	.04*
Less than twice a day	37.1 (93)	28.3 (71)	
Use of toothpaste when brushing			
Always	77.4 (192)	90.9 (229)	< .001***
Sometimes	13.3 (33)	7.5 (19)	
Never	9.3 (23)	1.6 (4)	
Assisted brushing with parent			
Always	73.0 (181)	32.4 (81)	< .001***
Sometimes	23.8 (59)	61.6 (154)	
Never	3.2 (8)	6.0 (15)	
Snacking habit			
Snacking habit between meals (usual)			
Once	55.6 (138)	64.1 (161)	.05^{NS}
Twice or more	44.4 (110)	35.9 (90)	

p-value derived from Chi square test; ^{NS}p > .05; *p < .05; **p < .01; ***p < .001

Table 3 Barriers to oral self-care of preschool children with and without ASD

	ASD % (n)	Non-ASD % (n)	*p*-value
Tooth-brushing is a difficult task			
Yes	46.1 (113)	19.7 (48)	< .001**
No	53.9 (132)	80.3 (196)	
Reasons of difficulties (child)			
Scared of tooth-brushing	36.9 (41)	13.6 (6)	.004**
Cannot keep still for tooth-brushing	49.5 (55)	52.3 (23)	.760^{NS}
Does not understand tooth-brushing	46.8 (52)	25.0(11)	.013*
Does not like anything in his/her mouth	36.0 (40)	13.6(6)	.006**
Medical condition	2.7 (3)	6.8 (3)	.231^{NS}
Too complicated for the child	23.4 (26)	11.4 (5)	.091^{NS}
It takes too much time and effort	50.9 (57)	38.6 (17)	.168^{NS}

p-value derived from Chi square test; ^{NS}p > .05; *p < .05; **p < .01; p < .001

Table 4 Barriers to dental services of preschool children with and without ASD

	ASD % (n)	Non-ASD % (n)	*p*-value
Challenging for child to visit a dentist			< .001***
Yes	78.4 (182)	52.1 (124)	
No	21.6 (50)	47.9 (114)	
Environmental reasons			
It is hard to find a dentist willing to treat my child because of his/her medical condition	48.9 (89)	8.1 (10)	< .001***
It is hard to travel to the dental office	3.3 (6)	3.2 (4)	.980^{NS}
It is hard for me to find a dentist for my child near my home	17.5 (32)	4.0 (5)	< .001***
I cannot get convenient appointment times	7.1 (13)	12.9 (16)	.088^{NS}
I cannot find a dentist who will accept my child's dental insurance/benefit programme	11.5 (21)	5.6 (7)	.082^{NS}
Dental staffs are anxious or nervous about treating my child	16.4 (30)	6.5 (8)	.009**
It is hard to take time off from work to bring child to the dentist	7.7 (14)	15.3 (19)	.033*
Dental care is too expensive	40.1 (73)	63.7 (79)	< .001***
Non-environmental reasons			
My child is afraid of the dentist	40.7 (74)	38.7 (48)	.762^{NS}
My child does not like to have anything done in his/her mouth	63.7 (116)	39.5 (49)	< .001***
My child cannot behave cooperatively at the dentist	59.9 (109)	25.0 (31)	< .001***
My child's medical conditions make dental treatment very complicated	11.5 (21)	0.8 (1)	< .001***
My child is too young to see a dentist	29.1 (53)	33.9 (42)	.361^{NS}
My child has other more urgent health care needs	17.0 (31)	3.2 (4)	< .001***

p-value derived from Chi square test; ^{NS}p > .05; *p < .05; **p < .01; ***p < .001

There was a significant difference in the overall oral health knowledge scores of parents of children with and without ASD, $p = .001$, Table 5, Furthermore, there were significant differences in knowledge relating to *causes of gum disease* ($p < .01$), *prevention of dental caries* ($p < .01$), and *prevention of gum disease* ($p < .01$) among parents of preschool children with and without ASD.

There was a significant difference in the overall oral health attitude scores among parents of preschool children with and without ASD, $p < .05$, Table 6. With respect to the individual attitudes considered (items)—there were significant differences in the frequency of agreement that 'poor teeth were detrimental to one's health' ($p = .001$); and that 'dental problems can affect the body as a whole' ($p = .01$) among parents of preschool children with and without ASD.

Table 5 Oral health knowledge among parents of preschool children with and without ASD

	ASD Mean (SD)	Non-ASD Mean (SD)	*p*-value*
Overall scores	7.21 (2.48)	6.40 (2.55)	.001**
Causes of caries	2.26 (0.61)	2.19 (0.62)	.286^{NS}
Causes of gum diseases	1.14 (0.94)	0.92 (0.84)	.009**
Prevention of caries	2.33 (0.78)	2.12 (0.86)	.008**
Prevention of gum diseases	1.49 (1.02)	1.16 (1.04)	.001**

p-value derived from *t* test for independent samples

^{NS}p > .05; *p < .05; **p < .01; ***p < .001

Discussion

This was a community-based epidemiological case–control study with a relatively large sample size on oral health behaviours of preschool children with ASD. Most parents completed the questionnaires as well as disclosed their socioeconomic backgrounds. In this study, parents of children with ASD have higher education levels and higher family incomes compared to those of children without ASD. This may affect the quality of their primary care for children with ASD.

It was anticipated that children with ASD would have more dental experiences under general anaesthesia compared to children without ASD. This was consistent with the findings reported by both parents and dentists on the barriers to dental care; specifically in that dentists found it difficult to treat children with ASD in a regular dental setting.

There were significant differences in the reported oral health behaviours between children with and without ASD with respect to tooth-brushing, use of toothpaste and assistance with tooth-brushing. The frequency of tooth-brushing was lower for children with ASD, more assistance with brushing from parents was reported and there was less usage of toothpaste. This may be attributed to the intellectual challenge (low cognitive functioning) as well as physical challenge (oral sensitivity) in performing this self-care skills. Some parents reported no usage of toothpaste for their autistic children during tooth-brushing due to extensive swallowing of toothpaste; while their non-autistic peers have developed the ability of spitting out toothpaste after brushing. Therefore, in order to maintain a good oral health for their autistic children, the parents, teachers and nurses in the SCCCs should establish various strategies of tooth-brushing for these children, for example, massage of oral muscles before brushing, simplified tooth-brushing under a gentle physical restraint as well as oral muscle training class. In terms of snacking habits, parents reported that children with ASD do not have interest in snacking, which may be associated with their food selectivity or sensory specialty. This may be the reason why children with ASD have lower caries experience when compared to children without ASD as reported in a number of previous studies (Lowe and Lindemann 1985; Namal et al. 2007; Loo et al. 2008; Orellana et al. 2012; Du et al. 2015).

Moreover, parents of children with ASD more frequently reported difficulties in performing the task of tooth-brushing because their children were scared of tooth-brushing and could not keep still during brushing. Furthermore, children with ASD did not understand the importance of tooth-brushing nor anything in their mouths. Likewise, parents

Table 6 Oral health attitudes among parents of children with and without ASD

	ASD Mean (SD)	Non-ASD Mean (SD)	*p*-value
Overall scores	6.94 (1.10)	6.69 (1.18)	.016*
	ASD % (n)	Non-ASD % (n)	*p*-value
% with appropriate attitude to the following statements:			
Just like birth, aging and death, loss of teeth is a natural process (F)	67.8 (162)	70.0 (166)	.594^{NS}
State of teeth is decided at birth and is not related to self-care (F)	98.3 (235)	96.2 (228)	.155^{NS}
Poor teeth are detrimental to one's appearance (T)	84.1 (201)	71.3 (169)	.001**
State of my teeth is great importance to me (T)	85.4 (204)	81.0 (192)	.205^{NS}
Keeping natural teeth is not important (F)	97.9 (234)	98.3 (233)	.746^{NS}
Dental problems can affect the body as a whole (T)	75.3 (180)	64.6 (153)	.010*
False teeth will be less of a bother than natural teeth (F)	95.0 (227)	97.5 (231)	.155^{NS}
Regular visits to the dentist prevent dental problems (T)	90.4 (216)	87.3 (207)	.293^{NS}

p-value derived from *t* test for independent samples for overall scores and Chi square test for individual attitudes

^{NS}p > .05; *p < .05; **p < .01; ***p < .001

of children with ASD more frequently reported challenges of bringing their children to the dentist and specifically reported several environmental and non-environmental reasons as specific barriers in bringing their children to the dentist compared to parents of children without ASD.

Barriers to dental care have been reported among children with ASD, which influence their access to regular dental care and the interval between dental appointments (Brickhouse et al. 2009; Lai et al. 2012; Barry et al. 2014). Similar barriers to tooth-brushing and accessing dental care have been observed among preschool children with cerebral palsy in Hong Kong (Du et al. 2014). This suggested that building capacity and capital for parents/caregivers of children requiring special dental care through behavioural interventions, such as tooth-brushing social stories and oral desensitization are warranted. Parents also reported that the ASD condition itself, is a significant barrier for their children to undergo dental treatment due to their compromised cooperation. Given the multiple barriers to oral health care for children with ASD, more training programmes for local dental practitioners and community-based oral health care projects for children with special health care needs (including ASD) are advocated.

The parents of children with ASD had significantly higher overall oral health knowledge scores than parents of children without ASD; specifically, the parents of children with ASD had better knowledge of the causes of periodontal disease and the ways to prevent dental caries and periodontal disease. Conversely, the parents of children with ASD had significantly higher overall oral health attitude scores; specifically higher positive attitudes relating to the effects of poor dental health on appearance and on the body as a whole. This greater oral health knowledge and more favourable oral health attitudes are a plausible explanation for the observed better oral health among children with ASD.

It has been reported that there was a correlation between the child's dental decay and low family income, as well as low parent's education and non-Swiss nationality of the parents (Glaser-Ammann et al. 2014). The inadequate knowledge and awareness of importance of the primary teeth, dental fear of the parents and the myths associated with dental treatment, created barriers to early preventive dental care of preschool children (Chhabra and Chhabra 2012). There were very few studies in the literature evaluating parental knowledge and attitude towards oral health among children with ASD, but a study among children with ADHD reported that parents experienced a lack of child neuropsychiatric knowledge, which may influence behavioural practices (Staberg et al. 2014). The parents of children with ASD in this study have higher education levels and family incomes compared to those children without ASD, which may have attributed to their better oral health knowledge and attitudes. More oral health promotion programmes and seminars among parents of children with ASD should be advocated in the Special Child Care Centres to increase the oral health awareness among parents' communities for children with ASD.

Conclusions

Difference in the oral health behaviours existed among children with and without ASD, particularly with respect to tooth-brushing habits. In general, children with ASD reported more barriers to tooth brushing and dental services. In this study, parents of children with ASD had significantly better oral health knowledge and more positive oral health attitudes than parents of children without ASD. The need for behavioural intervention and professional support to assist and build capital for parents of children with ASD is required.

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Author Contributions RYD principal and investigator of this research project, manuscript writting and editting. CKYY participated in the research project supervision, manuscript editting. NMK contributed to research project supervision.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval This study was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (HKU/HA HKW IRB) [IRB Reference Number: UW 11-184].

Informed Consent Informed consent was obtained from all the individual participants (parents of children with and without ASD) included in the study.

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