

# Oral health care in children with disabilities: A narrative review

Musliana Mustafa<sup>1\*</sup>, Ahmad Faisal Ismail<sup>2</sup>, Farah Natashah Mohd<sup>3</sup>

<sup>1</sup> Department of Restorative Dentistry, Kulliyah of Dentistry, International Islamic University Malaysia, 25200 Kuantan, Pahang, Malaysia.

<sup>2</sup> Department of Paediatric Dentistry and Dental Public Health, Kulliyah of Dentistry, International Islamic University Malaysia.

<sup>3</sup> Special Care Dentistry Unit, Dental and Oral Maxillofacial Surgery Clinic, Kulliyah of Dentistry and Sultan Ahmad Shah Medical Centre, International Islamic University Malaysia.

## Abstract

Children with disabilities face discrepancies in receiving oral health services due to several barriers. This article aims to provide an overview on the oral health status of children with disabilities, impact on Quality of Life of children with disabilities and their family members, approaches in oral health education and/or services, roles of medical/oral health care providers, carers/parents, and special schools/centres, and future aspiration concerning these children. Articles were searched using online databases (Google Scholar, MEDLINE/PubMed) using various terms. Additional articles were searched manually from the reference list of the previously searched articles. Children with disabilities showed a higher prevalence of caries and periodontal disease and had irregular dental visits owing to the limitations encountered by the carers/parents. The psychological and physical health of carers/parents, and the well-being of children with disabilities are interrelated, suggesting the need for a comprehensive support system to address the specific needs of these groups. Oral hygiene care services for these children could be improved using oral health education tools, strengthening dental outreach programs, and/or adopting behaviour modification techniques. Oral health in children with disabilities is a global concern, therefore a holistic approach addressing this problem from the individual to international level, including interprofessional collaboration is imperative.

**Keywords:** children with disabilities, oral health care, oral health services, oral health status, special needs children

## Introduction

According to the World Health Organization (WHO), disabilities or impairments are problems in body function or structure such as a significant deviation or loss, and can involve an anomaly or defect (WHO, 2001). There are three components classified in the international classification of functioning, disability and health WHO namely body functions and structures, activities and

participation, and environmental factors. Examples of impairments in body functions and structures include mental function, sensory function, loss of a limb, loss of vision/speech/memory. The limitation in activities and participation include the difficulty communicating, seeing, hearing, mobility, self-care, working, problem solving, engaging in social activities, and obtaining health care services. The environmental factors include support and

### Received:

19 May 2023

### Revised:

26 June 2023

### Accepted:

26 October 2023

### Published Online:

29 February 2024

### How to cite this article:

Mustafa, M., Ismail, A. F., & Mohd, F. N. (2024). Oral health care in children with disabilities: A narrative review. *IIUM Journal of Orofacial and Health Sciences*, 5(1), 67-84. <https://doi.org/10.31436/ijoh.v5i1.232>

### Article DOI:

<https://doi.org/10.31436/ijoh.v5i1.232>

### \*Corresponding author

#### Address:

Kulliyah of Dentistry, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia.

**Telephone:** +609 5705500

#### Email address:

[muslianamustafa@iium.edu.my](mailto:muslianamustafa@iium.edu.my)  
[drmusliana@gmail.com](mailto:drmusliana@gmail.com)

relationships, individual and societal attitudes, services, systems and policies.

The variety in distribution and severity of oral diseases in children with disabilities in different parts of the world and within the same country or region could be due to disparities in the accessibility and/or utilisation of oral health services (Petersen, 2004). Several factors are reported in literature including lack of training and skills among oral health care providers specific to these children, difficulties in dealing with behavioural issues, inadequate referral facilities, inadequate exposure during undergraduate studies, prioritisation of other medical issues by carers/parents, socioeconomic background of the carers/parents, poor oral health literacy (OHL) of carers/parents/public/oral health care providers/policymakers, time constraints, insufficient financial reimbursement, lack of support from family members and society, as well as unmet needs for routine medical care that lead to unmet needs for oral care (Shenkin *et al.*, 2001, Kane *et al.*, 2008, Bindal *et al.*, 2015, Abduludin *et al.*, 2019, Craig *et al.*, 2019, Zhou *et al.*, 2021).

Apart from these factors, the child's developmental profile also influences accessibility to oral health services (Zhou *et al.*, 2021). This includes children with multiple developmental disabilities, Autism Spectrum Disorders (ASD), developmental delays, cerebral palsy, epilepsy, or other syndromes who might be fully dependent on their carers/parents not only for the access to oral health services but with their daily oral health care as well (Zhou *et al.*, 2021). Data from Medicaid (a federal and state program that helps cover healthcare costs of low income groups) in Washington, United State of America showed underutilised preventive dental care in preschool children with disabilities under the Access to Baby and Child Program compared to those without disabilities (Craig *et al.*, 2019).

Various oral health education programs targeting these children and their carers/parents have been developed to improve oral health services and patient

care. However, due to several barriers in the accessibility to oral health services, the oral health care of these children seem insurmountable although there are evident of positive outcomes when the appropriate approaches are utilised. This article aims to provide an overview on the oral health status of children with disabilities, impact on Quality of Life of children with disabilities and their family members, approaches in oral health education and/or services, roles of medical/oral health care providers, carers/parents, and special schools/centres, and future aspiration concerning these children.

Literature search was carried out on Google Scholar using keywords 'children with disabilities', 'oral health services', 'oral health status' and 'oral health care'. Another search strategy was MEDLINE/PubMed database using keywords 'children with disabilities', 'special needs children', 'oral health services', 'oral health status', and 'oral health care'. The literature search was conducted from September to December 2021 by two authors independently. Then, the discussion was made on the potential articles to be included in the manuscript. Articles published in English from 2001 to 2021 were reviewed for their scientific contents. Additional articles were selected from the reference list of the previously searched articles. 52 published articles were included in this review, most of them are cross-sectional and qualitative studies, and also review articles.

### **Oral health status of children with disabilities**

The oral health status of children with disabilities has been assessed in several countries. A recent study in China reported of poor oral health status; caries experience in 30.3%, gingivitis in 90% and visible dental plaque in 95% of the recruited children (Zhou *et al.*, 2019). The age of these children were 2-6 years old with the average age of  $3.87 \pm 0.93$  years old. In the United Arab Emirates (UAE), 85.2% of children with disabilities had caries with a mean decayed, missing, filled teeth (dmft/DMFT) score of  $5.67 \pm 4.69$  (Alkhabuli *et al.*, 2019). The age

of these children were 3-17 years; 7 (13%) children in the 3-5 years age group, 23 (42.6%) in the 6-10 years age group and 24 (44.4%) in the 11-17 years age group. Despite studying at a centre for children with disabilities that offered an intensive rehabilitation program for these children, a high prevalence of dental caries was evident. Another study reported higher mean scores of the decayed component of DMFT in children with Down Syndrome (DS) in the UAE compared to children without DS;  $2.73 \pm 0.22$  and  $1.65 \pm 2.46$  respectively (Ghaith *et al.*, 2019). Findings from a case control study conducted in Serbia revealed dmft/DMFT scores of  $12.4 \pm 7.7/5.4 \pm 4.4$  in children aged 6-11 years old, and a DMFT of  $20.9 \pm 9.6$  in children aged 12-16 years old compared to the non-medically compromised children (Mandić *et al.*, 2018). In the non-medically compromised children, the dmft/DMFT scores were  $5.7 \pm 6.9/1.0 \pm 1.7$  in children aged 6-11 years old, and the DMFT score was  $7.7 \pm 5.3$  in children aged 12-16 years old. Children with disabilities had statistically higher dmft/DMFT scores in both primary and permanent dentitions than the children without disabilities. The data indicate lack of access or utilisation of oral health care could be due to a greater difficulty of treating children with disabilities owing to the inability of these children to communicate and cooperate during dental treatment (Mandić *et al.*, 2018). A screening conducted in India revealed 38% caries prevalence and 59.09% gingival bleeding in children with various disabilities, indicating significant problems in their oral health and the need for oral care (Mehta *et al.*, 2015). In Taiwan, the overall mean dmft/DMFT score was  $12.5 \pm 5.0$  in these children (Chen *et al.*, 2014). A similar study was conducted in Nigeria, however some of the children were either ill or uncooperative resulting in exclusion from the study. The study was conducted at a private institution attended by carers/parents from the upper and middle socioeconomic status, which hindered comprehensive assessment of the oral health status of these children from various socioeconomic backgrounds (Oredugba & Akindayomi, 2008). Nevertheless, authors reported a high prevalence of caries in these

children with a mean dmft score of  $0.7 \pm 1.77$  and mean DMFT score of  $0.4 \pm 1.44$  (Oredugba & Akindayomi, 2008). The dmft/DMFT scores were much lower compared to other countries. Conversely, in Libya, the mean dmft scores in children with and without ASD were  $1.13 \pm 1.84$  and  $2.85 \pm 3.32$  respectively (Fakroon *et al.*, 2015). Meanwhile, the mean DMFT scores of the former and latter were  $0.22 \pm 0.08$  and  $1.15 \pm 0.27$  (Fakroon *et al.*, 2015). These findings suggested that children with ASD had lower caries prevalence compared to children without ASD, could be attributed to the higher awareness among their carers/parents (Fakroon *et al.*, 2015). Based on the majority of reported studies, the needs for oral health care in children with disabilities were somewhat equivalent (Chen *et al.*, 2014; Mehta *et al.*, 2015; Mandić *et al.*, 2018; Alkhabuli *et al.*, 2019; Ghaith *et al.*, 2019; Zhou *et al.*, 2019).

In Malaysia, caries prevalence in these children was 54.9% with a mean dmft of  $1.03 \pm 2.13$  and DMFT of  $1.22 \pm 2.23$  (Mokhtar *et al.*, 2016). The majority of carious teeth (85.2%) in these children aged 2 to 6 years old were untreated and required dental treatment (Mokhtar *et al.*, 2016). This condition could be associated with multiple factors, one of them is the recruited children mostly had mental disabilities and possibly fully dependant on their carers/parents with their daily oral health care. In another study, caries prevalence in visually impaired children was much higher (85.2%) (Vinoven *et al.*, 2021), almost similar to caries prevalence in children with cerebral palsy (81.7%) (Ahmad *et al.*, 2020b). Approximately 56% of the children with cerebral palsy could not walk, crawl, creep, or scoot, 31.2% of them could crawl, creep and scoot while 12.9% could walk with the support from carers/parents (Ahmad *et al.*, 2020b). This indicates that the majority of children with cerebral palsy are dependent on their carers/parents with their daily oral health care, and this situation could explain a higher prevalence of caries in these children; 97.9% and 81.7% of the caries affected deciduous and permanent dentition

Table 1. Caries prevalence and dmft/DMFT scores in children with disabilities from different countries.

Studies	Country	Age of children	Type of impairments/disabilities	Findings
Zhou <i>et al.</i> , 2019	China	2-6 years old (mean age of 3.87 ± 0.93)	<ol style="list-style-type: none"> <li>Intellectual impairments:                             <ul style="list-style-type: none"> <li>Mild (IQ 50-70)</li> <li>Moderate to profound (IQ below 50)</li> <li>Unspecific (too young or too uncooperative to receive the IQ test)</li> </ul> </li> <li>Adaptive behaviours; conceptual skills, social skills, and practical skills. Each of them was ranked as “high or average,” “limited (need assistance or supervision)” or “low (totally depend on others)”</li> </ol>	Caries prevalence was 30.3% among the recruited children
Alkhabuli <i>et al.</i> , 2019	United Arab Emirates	3-17 years old	<ol style="list-style-type: none"> <li>DS</li> <li>ASD</li> <li>Mental disability</li> <li>Hearing impairment</li> <li>Multiple disabilities</li> </ol>	Caries prevalence was 85.2% of among the recruited children with a mean (dmft/DMFT) score of 5.67 ± 4.69
Ghaith <i>et al.</i> , 2019	United Arab Emirates	4-18 years old	DS	DMFT score was 2.73 ± 0.22
		DS (mean age of 9.3 ± 2.8) Children without DS (mean age of 11.7 ± 4.4)	Without DS	DMFT score was 1.65 ± 2.46
Mandić <i>et al.</i> , 2018	Serbia	6-11 years old	Medically compromised (no specific disabilities mentioned)	dmft/DMFT scores of 12.4 ± 7.7/5.4 ± 4.4
		12-16 years old		DMFT score was 20.9 ± 9.6
		6-11 years old	Non-medically compromised	dmft/DMFT scores were 5.7 ± 6.9/1.0 ± 1.7
		12-16 years old		DMFT score was 7.7 ± 5.3

Mehta <i>et al.</i> , 2015	India	3-15 years old	<ol style="list-style-type: none"> <li>1. Intellectual impairment</li> <li>2. Visual impairment</li> <li>3. Hearing impairment</li> <li>4. Physical impairment</li> </ol>	Caries prevalence was 38% among the recruited children
Chen <i>et al.</i> , 2014	Taiwan	≤14 years old	<ol style="list-style-type: none"> <li>1. ASD</li> <li>2. Mental retardation</li> <li>3. Limb disability</li> <li>4. Infrequent disease caused by DNA impairment</li> <li>5. Visual impairment</li> <li>6. Voice/speech mechanism disability</li> <li>7. loss of function of primary organs</li> <li>8. Balance mechanism disability</li> <li>9. Multiple disabilities</li> </ol>	Mean dmft/DMFT score was 12.5 ± 5.0
Oredugba & Akindayomi, 2008	Nigeria	0-21 years old	<ol style="list-style-type: none"> <li>1. Attention deficit hyper activity disorder (ADHD)</li> <li>2. ASD</li> <li>3. Cerebral palsy</li> <li>4. DS</li> <li>5. Learning disability</li> <li>6. Seizure disorder</li> </ol>	Mean dmft score was 0.7 ± 1.77 and mean DMFT score was 0.4 ± 1.44
Fakroon <i>et al.</i> , 2015	Libya	3-14 years old	ASD	Mean dmft scores was 1.13 ± 1.84 and mean DMFT score was 0.22 ± 0.08
			Without ASD	Mean dmft scores was 2.85 ± 3.32 and mean DMFT score was 1.15 ± 0.27
Mokhtar <i>et al.</i> , 2016	Malaysia	2-17 years old (mean age of 11.57 ± 3.53)	<ol style="list-style-type: none"> <li>1. Mental disabilities <ul style="list-style-type: none"> <li>• DS</li> <li>• ASD</li> <li>• Attention deficit hyperactivity disorder ADHD</li> <li>• Global developmental delay</li> <li>• Slow learner</li> </ul> </li> </ol>	Caries prevalence was 54.9% among the recruited children with a mean dmft of 1.03 ± 2.13 and DMFT of 1.22 ± 2.23

			2. Physical disabilities <ul style="list-style-type: none"> <li>• Hearing impairment</li> <li>• Blindness and limb deficiency</li> <li>• Multiple disabilities</li> </ul>	
Vinoven <i>et al.</i> , 2021	Malaysia	7-18 years old (mean age of 11.4 ± 3.05)	Visual impairment	Caries prevalence was 85.2% among the recruited children
Ahmad <i>et al.</i> , 2020b	Malaysia	5-17 years old (mean age of 12.0 ± 4.89)	Cerebral palsy	Caries prevalence was 81.7% among the recruited children  97.9% and 81.7% of the caries affected deciduous and permanent dentition respectively
John <i>et al.</i> , 2017	Malaysia	6-12 years old (mean age of 9.22 ± 1.785)	1. Global developmental delay 2. ASD 3. Intellectual disability 4. Slow learner 5. CHARGE syndrome 6. Speech disabilities 7. Attention deficit hyperactivity disorder ADHD 8. DS 9. Dyslexia 10. Cerebral palsy	62% of the recruited children had caries, 80% had no dental restoration

respectively (Ahmad *et al.*, 2020b). Assessment of the oral health status of children with different types of learning disabilities in a Special Education Integrated Programme school showed that 62% of the children had caries, 70% had moderate to severe plaque score index and 80% had no dental restoration (John *et al.*, 2017). Caries prevalence in these children was corroborated with caries prevalence reported in the UAE (Alkhabuli *et al.*, 2019). Despite studying at a special school, poor oral health status in these children was observed. However, education tools facilitated by their teachers appeared to have a positive impact on promoting good oral hygiene in these children (Shahabudin *et al.*, 2016). This was observed in visually impaired children in two schools (Shahabudin *et al.*, 2016). A systematic review analysing the oral health status of children with disabilities in Asia revealed that children who suffered from intellectual disability or ASD had significantly more caries than children without intellectual disability or ASD, and lived in the countries with high DMFT scores in children 12 years old (Ningrum *et al.*, 2021). However, not all Asian countries offer Special Care Dentistry (SCD), therefore the prevalence of oral health problems in these children may be underestimated (Ningrum *et al.*, 2021). The summary of findings from different studies is shown in Table 1.

Besides caries, the assessment of periodontal status was also conducted in some studies. The prevalence of periodontal disease was high at 86.8% indicating poor periodontal status in these children (Alsanabani *et al.*, 2012). In another study, poor knowledge on oral health, poor oral hygiene practice and high plaque maturity was observed in hearing-impaired children compared to children without disabilities (Tugeman *et al.*, 2016). In children with cerebral palsy, 90.3% of them had dental plaque, suggesting ineffective oral hygiene practice could be due to impairment and dependency on carers/parents, as well as irregular dental visits (Ahmad *et al.*, 2020b). The simplified Oral Hygiene Index score for children with mixed and permanent dentition was not significantly different

between children with DS compared to children without DS; mean scores were  $1.36 \pm 1.16$  and  $1.42 \pm 1.14$  respectively (Ghaith *et al.*, 2019). However, the Calculus Index was observed to be significantly higher in children with DS compared to children without DS; mean scores were  $0.25 \pm 0.52$  and  $0.07 \pm 0.27$  respectively (Ghaith *et al.*, 2019). The prevalence of gingivitis was equivalent between children with DS compared to children without DS; 65.4% and 70.4% respectively (Ghaith *et al.*, 2019). Although caries prevalence in children with ASD showed lower dmft/DMFT scores, more than 90% of these children presented with gingival bleeding or had supra and/or subgingival calculus (Fakroon *et al.*, 2015), indicating the need for oral hygiene measures. The summary of findings from different studies is shown in Table 2.

Apart from caries and periodontal status, much attention has been directed towards the orthodontic aspect of children with disabilities. Findings documented in literature provide insights into this side of oral health in these children. For example, the occurrence of anterior crossbite in children with DS is associated with bottle feeding, and non-nutritive sucking habits for 24 months or more, whereas the posterior crossbite is associated with bottle feeding and non-nutritive sucking habits for 24 months or more, in addition to respiratory infection in the previous 6 months (Oliveira *et al.*, 2011). In children with cerebral palsy, the occurrence of anterior open bite is associated with non-nutritive sucking habits for 24 months or more (Oliveira *et al.*, 2011). In another study, assessment of the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) showed that 50.0% of children with DS and learning disabilities, 40.0% of children with ASD, 20.0% of children with visually impairment and 18.2% of children with hearing impairment required 'Great' need of orthodontic treatment (Soni *et al.*, 2011). Meanwhile, 32.5% of children with mental retardation required 'Great' and 'Very Great' need of orthodontic treatment (Soni *et al.*, 2011). When the Aesthetic Component of IOTN is assessed, 50.0% of children with DS,

Table 2. Periodontal status in children with disabilities from different countries.

Studies	Country	Age of children	Type of disabilities	Findings
Zhou <i>et al.</i> , 2019	China	2-6 years old (mean age of 3.87 ± 0.93)	<ol style="list-style-type: none"> <li>Intellectual impairments; <ul style="list-style-type: none"> <li>Mild (IQ 50-70)</li> <li>Moderate to profound (IQ below 50)</li> <li>Unspecific (too young or too uncooperative to receive the IQ test)</li> </ul> </li> <li>Adaptive behaviours; conceptual skills, social skills, and practical skills. Each of them was ranked as “high or average,” “limited (need assistance or supervision)” or “low (totally depend on others)”</li> </ol>	Gingivitis in 90% and visible dental plaque in 95% of the recruited children
Mehta <i>et al.</i> , 2015	India	3-15 years old	<ol style="list-style-type: none"> <li>Intellectual impairment</li> <li>Visual impairment</li> <li>Hearing impairment</li> <li>Physical impairment</li> </ol>	59.09% gingival bleeding among the recruited children
Alsanabani <i>et al.</i> , 2012	Malaysia	7-18 years old (mean age of 13.9 ± 3.17)	Not mentioned	Prevalence of periodontal disease was 86.8%
Tugeman <i>et al.</i> , 2016	Malaysia	7-14 years old (mean age of 12.0 ± 2.12)	Hearing impairment	50.8% of hearing-impaired children had matured plaque compared to children without hearing impairment 13.2%
Ahmad <i>et al.</i> , 2020b	Malaysia	5-17 years old (mean age of 12.0 ± 4.89)	Cerebral palsy	90.3% of the children had dental plaque
Ghaith <i>et al.</i> , 2019	United Arab Emirates	4-18 years old  DS (mean age of 9.3 ± 2.8)	DS	Mean score of the Simplified Oral Hygiene Index for children with mixed and permanent dentition was 1.36 ± 1.16



		Children without DS (mean age of 11.7 ± 4.4)		Mean score of the Calculus Index was 0.25 ± 0.52 Prevalence of gingivitis was 65.4%
			Without DS	Mean score of the Simplified Oral Hygiene Index was 1.42 ± 1.14 Mean score of the Calculus Index was 0.07 ± 0.27 Prevalence of gingivitis was 70.4%
Fakroon <i>et al.</i> , 2015	Libya	3-14 years old	ASD	90% of the children presented with gingival bleeding or had supra and/or subgingival calculus
			Without ASD	41.8% of the children had no signs of periodontal disease
John <i>et al.</i> , 2017	Malaysia	6-12 years old (mean age of 9.22 ± 1.785)	<ol style="list-style-type: none"> <li>1. Global developmental delay</li> <li>2. ASD</li> <li>3. Intellectual disability</li> <li>4. Slow learner</li> <li>5. CHARGE syndrome</li> <li>6. Speech disabilities</li> <li>7. Attention deficit hyperactivity disorder ADHD</li> <li>8. DS</li> <li>9. Dyslexia</li> <li>10. Cerebral palsy</li> </ol>	70% had moderate to severe plaque score index

Table 3. Orthodontic aspects in children with disabilities from different countries.

Studies	Country	Age of children	Type of disabilities	Findings
Oliveira <i>et al.</i> , 2011	Brazil	3-12 years old	DS	The occurrence of anterior crossbite is associated with bottle feeding, and non-nutritive sucking habits for 24 months or more, whereas the posterior crossbite is associated with bottle feeding and non-nutritive sucking habits for 24 months or more, in addition to respiratory infection in the previous 6 months
			Cerebral palsy	The occurrence of anterior open bite is associated with non-nutritive sucking habits for 24 months or more
Soni <i>et al.</i> , 2011	India	12-15 years old	1. DS 2. Learning disabilities 3. ASD 4. Visual impairment 5. Hearing impairment	Assessment of the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) showed that the children required 'Great' need of orthodontic treatment Assessment of the Aesthetic Component of IOTN showed that the children required 'Great' need of orthodontic treatment
			Mental retardation	Assessment of the Dental Health Component of the Index of Orthodontic Treatment Need (IOTN) showed that the children required 'Great' and 'Very Great' need of orthodontic treatment Assessment of the Aesthetic Component of IOTN showed that the children required 'Great' need of orthodontic treatment

23.3% of children with mental retardation and 10.0% of children with ASD required 'Great' need of orthodontic treatment (Soni *et al.*, 2011). The summary of findings from different studies is shown in Table 3.

A study conducted in Hong Kong, China highlighted that a high percentage of children with disabilities (77.5%) had never visited a dentist (Zhou *et al.*, 2019). Even though the percentage of children with disabilities who had never visited a dentist was high, they had a lower dmft score than those who had visited a dentist. Children with disabilities who had higher dmft score were associated with other factors; night bottle-feeding habit, the use of a non-fluoride-containing toothpaste and lower household income family. In contrast, a study in Belgium reported a high percentage of children with DS (66%) had visited a dentist within the last six months (Descamps & Marks, 2015). More than half (67%) of the parents graduated from tertiary education level and they had no problem in the accessibility to oral health services, probably might explain a higher percentage of dental visit among these children (Descamps & Marks, 2015). In Netherlands, a much higher percentage of children with ASD (81%) had visited a dentist within the last six months (Kind *et al.*, 2021). A higher percentage of dental visit reported in the Netherlands could be due to highly motivated parents who are involved in ASD specific programs or participating in the conferences or websites, dental costs that are covered by the medical insurance for all children up to 18 years old, and the accessibility to oral health services (Kind *et al.*, 2021). In Malaysia, 61.3% of children with cerebral palsy had at least one dental visit in their lifetime, while 38.7% of these children had never visited a dentist since birth (Ahmad *et al.*, 2020b). Of these, 19.4% had been to a dentist about more than three years ago (Ahmad *et al.*, 2020b). The plausible explanation of this could be attributed to the limited access to oral health services which includes logistic difficulties, behavioural issues, lack of educational experience and training in providing the treatment, as such precludes effective management of these children (Vozza *et al.*, 2015).

### **Impact on Quality of Life of children with disabilities and their family members**

In Brazil, the worst Quality of Life observed in carers/parents of children with disabilities was linked to the need for daily care including the daily living, educational and rehabilitation process of these children (Barros *et al.*, 2019). Carers/parents with low educational level were unable to enter the labour market and instead dedicated themselves to household tasks and caring for their children (Barros *et al.*, 2019).

A study investigating Oral Health Related Quality of Life (OHRQoL) revealed a negative impact of untreated caries and caries severity on children with disabilities and their family members (Faker *et al.*, 2018). Most carers/parents reported the impacts was more toward the children with disabilities (69.5%) than to the family members (49.6%), and the most frequently reported impacts were 'pain in the teeth, mouth, or jaws'. However, comprehensive dental rehabilitation followed by recall visits and provision of dental kits for self-oral hygiene care showed positive long-term clinical effects on OHRQoL in these children (El-Meligy *et al.*, 2016). These findings suggest that OHRQoL of these children can be improved when appropriate measures are undertaken. However, limited studies addressing the OHRQoL in these children and their family members hinder effective evaluation of the overall situation, thus the actual impact of OHRQoL on them remain unknown. Perhaps, this limitation warrants more studies on OHRQoL involving these children and their family members so that the intervention strategies can be implemented.

Another aspect is that, carers/parents of children with disabilities tend to face negative social stigma from society, resulting in social isolation (Abduludin *et al.*, 2019). Instead of receiving social support, some carers/parents may experience prejudice while struggling to care for their children with disabilities. Family function plays an important role in the physical and

psychological health of carers/parents, and social support from extended family members, friends, and neighbours in addition to immediate family members allow collective care for these children (Raina *et al.*, 2005).

A study on the financial expenses to cater to the needs of a child with cerebral palsy in Malaysia averaged RM29,710.76 per year (Kamaralzaman *et al.*, 2018). These expenses include healthcare costs, developmental costs and non-healthcare costs resulting in a huge financial burden for the carers/parents (Kamaralzaman *et al.*, 2018). In another study involving carers/parents of children with cerebral palsy in Malaysia, families with three or more children from lower socioeconomic backgrounds and with lower education levels shouldered a larger total financial burden (Abduludin *et al.*, 2019). Most of the carers/parents need financial help for basic necessities and/or special equipment for their children with disabilities, and accompanying their children for dental visits incur additional transportation cost. While financial support from the Social Welfare Department is available, the policymakers must plan effective long-term solutions to support carers/parents of children with various disabilities (Kamaralzaman *et al.*, 2018). In the United State of America, although children with disabilities are eligible for Medicaid oral health care coverage, their carers/parents experience other treatment barriers such as inability to get time off from employment, lack of child care services for other children, and difficulty accessing public transportation for the handicapped (Schultz *et al.*, 2001). Although family members receive financial assistance from policymakers, carers/parents have to bear other costs that place a significant impact on the family's financial stability, especially in family from lower socioeconomic backgrounds.

Another aspect highlighted in literature is the interrelation between well-being of children with disabilities and their carers/parents. The psychological and physical health of carers/parents was greatly influenced by their child behaviour

and caregiving demands (Raina *et al.*, 2005), and the well-being of children with disabilities is also closely related to the well-being of their other family members (Abduludin *et al.*, 2019). This situation must be tackled effectively so that the well-being of these children and their carers/parents are taken care of from various authorities.

### **Approaches in oral health education and/or services to children with disabilities**

In order to improve the quality of patient care involving children with disabilities, the oral health education programs targeting these children and their carers/parents have become effective platform for the oral health care providers. For example, children with visual impairment were given oral health modules printed in braille for the blind and in font size 18 for the partially blind, including an audio narration of the module (Shahabudin *et al.*, 2016). The use these modules, facilitated by their teachers were proven to be effective where a reduction in the plaque score in partially blind and totally blind children was observed after 1 month, indicated a positive impact on promoting good oral hygiene among these children (Shahabudin *et al.*, 2016). In Hong Kong, China, the use of a toothbrushing visual module that was provided to the carers/parents to facilitate toothbrushing of their children with ASD at home showed a significant improvement in the oral hygiene status and gingival health over 6 months observation period (Du *et al.*, 2021).

The behavioural management by means of tell-show-do method during clinical examination could improve the child's behaviour (Alkhabuli *et al.*, 2019; Zhou *et al.*, 2019). A multistage visual protocol to facilitate children with ASD to undergo dental treatments as behavioural management showed an effective approach as well (Cagetti *et al.*, 2015). This can be observed when these children were able to proceed through each stage of treatment with minimal refusal (Cagetti *et al.*, 2015). Additionally, multisensory-adapted dental

environments could improve the behaviour of children with disabilities and would be an alternative approach in the clinical settings (Ismail *et al.*, 2021). Apart from that, the use of intravenous sedation in uncooperative child with DS prior to oral examination was also effective in managing behaviour (Primarti & Pertiwi, 2007). Evaluation of salivary cortisol levels could be useful to help in treatment planning and appointment scheduling in children with ASD because the oral health care providers could consider behaviour modification techniques in these children (Abdulla & Hegde, 2015). This is because a significant correlation was observed between salivary cortisol levels and behaviour during the day and in the evening in children with ASD (Abdulla & Hegde, 2015). As the salivary cortisol levels increased, the behaviour among these children became worsened and vice versa. The researchers highlighted that the salivary cortisol acts as a stress marker and evaluating the diurnal variations of salivary cortisol levels can help the oral health care providers to comprehend the behaviour pattern and eventually could utilise the appropriate behaviour modification procedures and treatment planning involving these children (Abdulla & Hegde, 2015). Despite concern pertaining to behavioural issues in children with disabilities, when an appropriate approach is used, the behaviour can be managed effectively.

In Malaysia, dental outreach programs have been used to educate these children. For example, children with cerebral palsy attending the Community Base Rehabilitation centre benefit from the dental outreach program offered by public dental clinic (Abduludin *et al.*, 2019). Another dental outreach program has benefited visually impaired children at a special education school as well (Ahmad *et al.*, 2020b). The use of a specific module in oral health education for these children consisting an innovative oral health educational tool kit and exhibition materials provided an opportunity to improve the knowledge, skills, attitudes, and personal values among dental students in developing their professionalism in patient care (Ahmad

*et al.*, 2020b). Their experience through this program could lead to a high standard of dental practice and high-quality patient care involving these children in the future (Ahmad *et al.*, 2020b). There have been limited dental outreach programs reported in literature, therefore it is rather difficult to draw robust conclusion as to whether this approach could benefit children with various disabilities. Perhaps, more dental outreach programs targeting these children can be planned by the authorities to help overcome the barriers in the accessibility and/or utilisation of oral health services among these children.

### **Roles of medical/oral health care providers, carers/parents, special schools/centres**

A survey assessing the experience of final-year dental students and new graduates in Malaysia revealed lack of training, confidence and skills to provide oral health services to patients with disabilities (Fuad *et al.*, 2015). The implication is that, it could lead to ineffective treatment, which could cause further oral health complications and increased cost burden (Alumran *et al.*, 2018). To date, most dental schools do not offer a specific module in SCD and the teachings about SCD were not properly established yet due to the limited number of trained oral health care providers in this area (Naimie *et al.*, 2020).

In order to overcome this limitation, some approaches have been carried out to improve knowledge and awareness among dental students. For example, an assessment of the knowledge and awareness of dental students in Saudi Arabia in regards to the oral health care of children with disabilities by mean of questionnaires and video education intervention revealed a valuable approach in improving their knowledge (Salama *et al.*, 2015). Early exposure, knowledge and training to provide oral health services to the children with disabilities should begin in dental colleges/schools (Salama *et al.*, 2015). In Malaysia, an outreach program involving the

undergraduate dental students and visually impaired children showed positive impact in developing professional patient care (Ahmad *et al.*, 2020a). In addition to this, the outreach program provided an opportunity for the dental students to gain early exposure to oral health services in children with disabilities (Ahmad *et al.*, 2020a). Upon graduating from dental schools/colleges, training acquired by dentists in SCD should be enhanced so that a comprehensive oral health services to this group can be provided (Bindal *et al.*, 2015). Such continuous training would not only benefit dentists but also all oral health care providers so that their skills, awareness and attitudes towards these children can be improved.

Oral health literacy refers to the ability of individuals to acquire and understand basic oral health information and services that are needed to make appropriate health decisions (Sabbahi *et al.*, 2009; Horowitz & Kleinman, 2012). To date, there are limited studies addressing the association between the OHL of carers/parents/public/health care providers/policymakers and children with disabilities. Assessment of OHL in all groups allows us to identify the contributing factors that result in poor oral health status in these children, thus significant measures targeting all groups could be undertaken to improve the situation. Despite the limitation, when the OHL of carers/parents of children with disabilities was assessed, the majority of them have moderate levels of OHL (Fabillah *et al.*, 2015). A similar study on carers/parents of children with visual impairment reported good attitude and practice towards their children's oral health, however minimal understanding on their children's oral health could lead to a higher caries prevalence (Vinovent *et al.*, 2021). Although the OHL is not assessed directly, it could be postulated that a lower OHL in carers/parents might contribute to the prevalence of malocclusion in children with disabilities due to lack of awareness on the use of bottle feeding and non-nutritive sucking habits in these children (Oliveira *et al.*, 2011). Children with cerebral palsy are usually fully dependant on their carers/parents and are unable to communicate, as a result carers/parents face

difficulties to understand the needs for oral health care (Abduludin *et al.*, 2019). This situation might explain the reason of untreated caries in children with cerebral palsy because the carers/parents are not able to recognise the early signs of oral health problem in their children.

It is understood that lower OHL levels in carers/parents are associated with decreased accessibility or utilisation of oral health services, while a higher OHL levels are associated with better communication between these children and their oral health care providers, hence improved oral health services (Bersell, 2017). This is proven when a multistage visual protocol was used by carers/parents of children with ASD in which the carers/parents demonstrated to understand the importance of oral health care for their children (Cagetti *et al.*, 2015). In a study conducted in Libya, although the OHL or carers/parents is not assessed directly, it could be suggested that carers/parents who had increased awareness of factors causing dental caries, practised healthier eating behaviours and provided conducive living conditions for their child could contribute to a lower incidence of tooth decay in their children with ASD (Fakroon *et al.*, 2015). In Malaysia, when the OHL of carers/parents of children with disabilities was assessed, the majority of them have moderate levels of OHL in which 70% had secondary education level and almost half of them (45%) had visited a dentist within the last 12 months (Fabillah *et al.*, 2015). In Saudi Arabia, some parents of children with ASD have lack of confidence in taking care of their children's oral health, perform oral health care for their children when oral health problems occur, and prefer to find a dentist who has better understanding on the condition of their children (AlHumaid *et al.*, 2020). These situations might correlate poor oral health practices and status among these children (AlHumaid *et al.*, 2020).

Due to the OHL barrier, more appropriate intervention programs for the carers/parents of children with disabilities should be carried out to improve their knowledge and understanding of the needs

of these children. This could ultimately improve oral health services to these children (Fabillah *et al.*, 2015). Undoubtedly, the needs for continuous oral health promotion (Zhou *et al.*, 2019) and/or more appropriate intervention programmes (Fabillah *et al.*, 2015) are indispensable. Another aspect that could lead to disparities in receiving oral health services in these children is the recruitment process used in research studies. Children with multiple disabilities and syndromes (Zhou *et al.*, 2019), cerebral palsy (Ahmad *et al.*, 2020b), DS (Descamps & Marks, 2015) and ASD (Kind *et al.*, 2021) have different impairments and mobility, which affect their levels of dependency for daily activities, such as tooth brushing and feeding (Ahmad *et al.*, 2020b). This dependency might include their accessibility to receiving oral health services as well. Based on the aforementioned differences, the findings imply that an effective preventive approach by oral health care providers, OHL in carers/parents, the public, health care providers and policymakers, and effective behavioural management in these children are pivotal to ensure that the discrepancies in access to oral health services in these children can be minimised. Efforts to improve prevention and quality of care, reduce costs, and reduce oral health disparities could not be achieved without improvements in OHL across various groups (Horowitz & Kleinman, 2012).

The existence of special schools/centres that provide support, rehabilitation program and/or education to these children are common in many countries. In the United Arab Emirates, children with disabilities studying at Ras Al-Khaimah Rehabilitation Centre for Disabled receive an intensive rehabilitation program, examined and medically diagnosed according to the centre's protocol with full medical records (Alkhabuli *et al.*, 2019). In Hong Kong, China, Special Child Care Centres provide training and care for preschool children with ASD, mental, physical and/or sensory impairments, helping them to prepare for primary education (Zhou *et al.*, 2021, Du *et al.*, 2021). In Libya, the Libya Benghazi Centre of Autism provides care and support

not only for these children but also to the families whose children are diagnosed with ASD (Fakroon *et al.*, 2015). In Malaysia, Special Education Integrated Program schools are available to provide support for these children with different types of learning disabilities (John *et al.*, 2017).

### Future aspirations

Transferring knowledge and experiences in disease prevention into action programmes are limited by the social, economic and cultural factors (Petersen, 2004). Minimising the disparities in oral health services require broad approaches that target populations at highest risk of oral disease, and improve accessibility to the existing care (Petersen, 2004).

Early clinical exposure to managing children with disabilities in dental schools/colleges is still inadequate and this needs to be emphasised in the curriculum (Fuad *et al.*, 2015, Naimie, 2020) to prepare undergraduate dental students for the task of providing oral health services to these children later on. It has been reported that there was positive effect of education on the likelihood of caring for children with disabilities in which the oral health care providers who had not been exposed to theoretical and hands-on training in dental schools were less likely to care for these children (Casamassimo *et al.*, 2004). Conversely, dentists who had received education in children with disabilities experienced fewer barriers to providing oral health services to these children (Casamassimo *et al.*, 2004).

Oral health education tools for visually impaired students are beneficial (Shahabudin *et al.*, 2016) and could benefit hearing-impaired children as well, however oral health education methods/tools that specifically target the needs of the latter group should also be developed (Tugeman *et al.*, 2016) to ensure that the oral health education in this group of children is equally effective. When planning interventions for the children with disabilities and their carers/parents, it is essential for the oral

health care providers to consider the child's behavioural issues as an important determinant of child and carers/parents well-being (Raina *et al.*, 2005). The implementation of interventions at mid-level oral health care providers such as dental hygienists (Bersell, 2017) and feasibility of dental home care (Abduludun *et al.*, 2019) have also been highlighted in literature. At the global level, priority actions for oral health such as fluoride supply, improvement of nutrition, control of tobacco use and health promotion in schools (Petersen, 2004) must be strengthened. An established training program should be emphasised at the national level. For example, a program entitled 'Pediatric Dentistry and Advanced Education in General Dentistry (AEGD) Residency Collaborative on ASD' conducted at the Nova Southeastern University College of Dentistry and funded by the Health Resources and Services Administration provides valuable services to a population of children with disabilities (Ocanto *et al.*, 2020). However, to develop such a program, financial assistance from policymakers and/or Non-Government Organisation (NGO) is required.

Development of a new model addressing the roles of individuals, carers/parents, society, stakeholders, and NGOs to tackle issues related to the children with disabilities, aiming to improve oral health services to these children would be helpful. This includes oral health education and promotion, inter-professional collaborations, and implementation of guidelines/policies by the decision-makers to reduce inequalities in access to oral health services in these children. Togetherness is integral, every individual needs to play a significant role to contribute to the betterment of oral health services for children with disabilities in the country. Improving OHL can be a predictable approach to reduce the disparities in the accessibility or utilisation of oral health care (Horowitz & Kleinman, 2012).

## Conclusion

The majority of children with disabilities have higher caries prevalence and periodontal disease, and show the need for orthodontic intervention. Barriers hindering accessibility to oral health services in children with disabilities must be tackled effectively, taking into consideration the various form of disabilities and the use of appropriate educational methods/tools to help these children and educate their carers/parents in oral health care. Guidelines/policies related to SCD in dental curriculum and support systems for these children and their carers/parents should be planned comprehensively to ensure their needs are fulfilled. The oral health of children with disabilities is a global concern, therefore a holistic approach addressing this problem from the individual to the international level including inter-professional collaborations is imperative.

## Acknowledgement

This article was funded by the IIUM-UMP Sustainable Research Collaboration Grant 2022 (IUMP-SRCG22-006-0006).

## Conflict of interest

None

## References

- Abdulla, A.M. and Hegde, A.M. (2015). Salivary cortisol levels and its implication on behavior in children with autism during dental treatment. *Journal of Clinical Pediatric Dentistry*, 39(2), 128-132.
- Abduludun, D.M.A., Rahman, N.A., Adnan, M.M. and Yusuf, A. (2019). Experience of Caregivers Caring for Children with Cerebral Palsy in Accessing Oral Health Care Services: A Qualitative Study. *Archives of Orofacial Science*, 14(2).
- Ahmad, M.S., Mokhtar, I.W. and Khan, N.L. (2020a). Extramural oral health educational program involving individuals with disabilities: Impact on dental students' professionalism. *Journal of International Society of Preventive & Community Dentistry*, 10(3), 323-328.
- Ahmad, R., Rahman, N.A., Hasan, R., Yaacob, N.S. and Ali, S.H. (2020b). Oral health and nutritional status of children with cerebral palsy in northeastern peninsular Malaysia. *Special Care in Dentistry*, 40(1), 62-70.



- AlHumaid J, Gaffar B, AlYousef Y, Alshuraim F, Alhareky M, El Tantawi M. (2020). Oral Health of Children with Autism: The Influence of Parental Attitudes and Willingness in Providing Care. *ScientificWorldJournal*, 2020, 8329426.
- Alkhabuli, J.O.S., Essa, E.Z., Al-Zuhair, A.M., Jaber, A.A. (2020). Oral Health status and treatment needs for children with special needs: A cross-sectional study. *Pesquisa Brasileira em Odontopediatria e Clínica Integrada*, 19.
- Alsanabani, A.A., Ismail, N.M., Ismail, A.R., Alyamani, H.A., Oo, M.M.T. (2012). Periodontal status and its relationship with sociodemographic factors among special needs children in schools of Kota Bharu, Kelantan, Malaysia. *International Medical Journal*, 19(1), 61-64.
- Alumran, A., Almulhim, L., Almolhim, B., Bakodah, S., Aldossary, H., Alakrawi, Z. (2018). Preparedness and willingness of dental care providers to treat patients with special needs. *Clinical, cosmetic and investigational dentistry*, 10, 231-236.
- Barros, A.L.O., de Gutierrez, G.M., Barros, A.O., Santos, M.T.B.R. (2019). Quality of life and burden of caregivers of children and adolescents with disabilities. *Special Care in Dentistry*, 39(4), 380-388.
- Bersell, C.H. (2017). Access to oral health care: a national crisis and call for reform. *Journal of Dental Hygiene*, 91(1), p.6-14.
- Bindal, P., Chai, W.L., Bindal, U., Safi, S.Z., Zainuddin, Z., Lionel, A. (2015). Dental treatment and special needs patients (SNPs): Dentist's point of view in selected cities of Malaysia. *Biomedical Research-India*, 26(1), 152-156.
- Cagetti, M.G., Mastroberardino, S., Campus, G., Olivari, B., Faggioli, R., Lenti, C. *et al.* (2015). Dental care protocol based on visual supports for children with autism spectrum disorders. *Medicina oral, patologia oral y cirugia bucal*, 20(5), e598-604.
- Casamassimo, P.S., Seale, N.S., Ruehs, K. (2004). General dentists' perceptions of educational and treatment issues affecting access to care for children with special health care needs. *Journal of Dental Education*, 68(1), 23-28.
- Chen, C.Y., Chen, Y.W., Tsai, T.P., Shih, W.Y. (2014). Oral health status of children with special health care needs receiving dental treatment under general anesthesia at the dental clinic of Taipei Veterans General Hospital in Taiwan. *Journal of the Chinese Medical Association*, 77(4), 198-202.
- Craig, M.H., Scott, J.M., Slayton, R.L., Walker, A.L., Chi, D.L. (2019). Preventive dental care use for children with special health care needs in Washington's Access to Baby and Child Dentistry program. *The Journal of the American Dental Association*, 150(1), 42-48.
- Descamps, I., Marks, L.A. (2015). Oral health in children with Down syndrome: Parents' views on dental care in Flanders (Belgium). *European Journal of Paediatric Dentistry*, 16(2), 143-148.
- Du, R.Y., Lam, P.P.Y., Yiu, C.K.Y., McGrath, C.P. (2021). Evaluation of visual pedagogy in improving plaque control and gingival inflammation among preschool children with autism spectrum disorder: An interventional study. *International Journal of Paediatric Dentistry*, 31(1), 89-105.
- El-Meligy, O., Maashi, M., Al-Mushayt, A., Al-Nowaiser, A., Al-Mubark, S. (2016). The effect of full-mouth rehabilitation on oral health-related quality of life for children with special health care needs. *Journal of Clinical Pediatric Dentistry*, 40(1), 53-61.
- Fabillah, N.S.A., Mustapa, N., Rohani, M.M., Esa, R. (2015). Oral health literacy among carers of special needs children in Kuala Terengganu, Malaysia. *Annals of Dentistry University of Malaya*, 22(1), 15-20.
- Faker, K., Tostes, M.A., Paula, V.A.C.D. (2018). Impact of untreated dental caries on oral health-related quality of life of children with special health care needs. *Brazilian Oral Research*, 32, e117.
- Fakroon, S., Arheiam, A., Omar, S. (2015). Dental caries experience and periodontal treatment needs of children with autistic spectrum disorder. *European Archives of Paediatric Dentistry*, 16(2), 205-209.
- Fuad, N.A., John, J., Koh, W.T., Mani, S.A., Lim, W.L.S., Wong, C.S., *et al.* (2015). Special Care Dentistry Curriculum at The Undergraduate Level: Students' Perspective. *Journal of Dentistry Indonesia*, 22(3), p.75-79.
- Ghaith, B., Al Halabi, M., Khamis, A.H., Kowash, M. (2019). Oral health status among children with Down syndrome in Dubai, United Arab Emirates. *Journal of International Society of Preventive & Community Dentistry*, 9(3), 232.
- Horowitz, A.M., Kleinman, D.V. (2012). Oral health literacy: a pathway to reducing oral health disparities in Maryland. *Journal of Public Health Dentistry*, 72, S26-S30.
- Ismail, A.F., Azmi, T.M.A.T., Malek, W.M.S.W.A., Mallineni, S.K. (2021). The effect of multisensory-adapted dental environment on children's behavior toward dental treatment: A systematic review. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, 39(1), 2-8.
- John, J., Mani, S.A., Joshi, V.K., Kuan, L.Y., Lim, H.W., LWan-Lin, S., *et al.* (2017). Oral health status and treatment needs of school children undergoing special education integrated programme in Malaysia—a pilot study. *Journal of Disability and Oral Health*, 18(2), 53-60.
- Kamaralzaman, S., Ying, T.C., Mohamed, S., Toran, H., Satari, N., Abdullah, N. (2018). The economic burden of families of children with cerebral palsy in Malaysia. *Malaysian Journal of Public Health Medicine*, 2018(Special 1), 156-165.
- Kane, D., Mosca, N., Zotti, M., Schwalberg, R. (2008). Factors associated with access to dental care for children with special health care needs. *The Journal of the American Dental Association*, 139(3), 326-333.
- Kind LS, Aartman IHA, van Gemert-Schriks MCM, Bonifacio CC. (2021). Parents' satisfaction on dental care of Dutch children with Autism Spectrum Disorder. *European Archives of Paediatric Dentistry*, 22(3), 491-496.
- Mandić, J., Jovanović, S., Mandinić, Z., Ivanović, M., Kosanović, D., Miličić, B. *et al.* (2018). Oral health in children with special needs. *Vojnosanitetski pregljed*, 75(7), 675-681.
- Mehta, A., Gupta, R., Mansoob, S., Mansoori, S. (2015). Assessment of oral health status of children with

- special needs in Delhi, India. *RSBO Revista Sul-Brasileira de Odontologia*, 12(3), 239-246.
- Mokhtar, S.M., Jalil, L.A., Noor, N.M., Tan, B., Shamdol, Z., Hanafiah, H.A. (2016). Dental status and treatment needs of special needs children in Negeri Sembilan, Malaysia. *World Journal of Research and Review*, 2(6), 64-70.
- Naimie, Z., Ahmad, N.A., Shoaib, L.A., Safii, S.H., Rohani, M.M. (2020). Curriculum for Special Care Dentistry: Are we there yet? *Journal of International Oral Health*, 12(1), 1-7.
- Ningrum, V., Bakar, A., Shieh, T.M., Shih, Y.H. (2021). The Oral Health Inequities between Special Needs Children and Normal Children in Asia: A Systematic Review and Meta-Analysis. *Healthcare* 9(4), 410.
- Ocanto, R., Levi-Minzi, M.A., Chung, J., Sheehan, T., Padilla, O., Brimlow, D. (2020). The development and implementation of a training program for pediatric dentistry residents working with patients diagnosed with ASD in a special needs dental clinic. *Journal of Dental Education*, 84(4), 397-408.
- Oliveira, A.C., Paiva, S.M., Martins, M.T., Torres, C.S., Pordeus, I.A. (2011). Prevalence and determinant factors of malocclusion in children with special needs. *The European Journal of Orthodontics*, 33(4), 413-418.
- Oredugba, F.A., Akindayomi, Y. (2008). Oral health status and treatment needs of children and young adults attending a day centre for individuals with special health care needs. *BMC Oral Health*, 8(1), 1-8.
- Petersen, P.E. (2004). Challenges to improvement of oral health in the 21st century—the approach of the WHO Global Oral Health Programme. *International Dental Journal*, 54, 329-343.
- Primarti, R.S., Pertiwi, A.S.P. (2007). Sedation as a technique to aid in the supportive examination for children with special needs. *Padjadjaran Journal of Dentistry*, 18(1), 54-57.
- Raina, P., O'donnell, M., Rosenbaum, P., Brehaut, J., Walter, S.D., Russell, D. *et al.* (2005). The health and well-being of caregivers of children with cerebral palsy. *Pediatrics*, 115(6), e626-e636.
- Sabbahi, D.A., Lawrence, H.P., Limeback, H., Rootman, I. (2009). Development and evaluation of an oral health literacy instrument for adults. *Community Dentistry and Oral Epidemiology*, 37(5), 451-462.
- Salama, F., Al-Balkhi, B., Abdelmegid, F. (2015). Dental students' knowledge of oral health for persons with special needs: a pilot study. *The Scientific World Journal*, 2015.
- Schultz, S.T., Shenkin, J.D., Horowitz, A.M. (2001). Parental perceptions of unmet dental need and cost barriers to care for developmentally disabled children. *Pediatric Dentistry*, 23(4), 321-325.
- Shahabudin, S., Hashim, H., Omar, M. (2016). The effectiveness of dental health education tools for visually impaired students in Bukit Mertajam. *AIP Conference Proceedings* 1791(1), 020011.
- Shenkin, J.D., Davis, M.J., Corbin, S.B. (2001). The oral health of special needs children: dentistry's challenge to provide care. *Journal of Dentistry for Children*, 68(3), 201-205.
- Soni, S., Aggarwal, P., Dua, V.S. (2011). The use of Index of Orthodontic Treatment Need (IOTN) in children with special needs. *International Journal of Contemporary Dentistry*, 2(3), 72-79.
- Tugeman, H., Rahman, N.A., Yusoff, A., Daud, M.K. (2016). Oral health knowledge, practice and dental plaque maturity status of hearing-impaired children. *Sains Malaysiana*, 45(5), 761-768.
- Vinoven, K., Rahman, N.A., Adnan, M.M., Shatriah, I. (2021). Oral Health Status of Visually Impaired Children and Oral Health Knowledge, Attitude and Practice of their Caregivers at Hospital Universiti Sains Malaysia: A Preliminary Study. *Malaysian Journal of Medicine and Health Sciences*, 17(3), 63-72.
- Zozza, I., Cavallè, E., Corridore, D., Ripari, F., Spota, A., Brugnoletti, O. *et al.* (2015). Preventive strategies in oral health for special needs patients. *Annali di Stomatologia*, 6(3-4), 96-99.
- World Health Organization. (2001). International classification of functioning, disability and health: ICF. World Health Organization. <https://apps.who.int/iris/handle/10665/42407>
- Zhou, N., Wong, H.M., McGrath, C. (2019). Oral health and associated factors among preschool children with special healthcare needs. *Oral Diseases*, 25(4), 1221-1228.
- Zhou, N., Wong, H.M., McGrath, C. (2021). Dental visit experience and dental care barriers among Hong Kong preschool children with special education needs. *International Journal of Paediatric Dentistry*, 31(6), 699-707.