

## Oral Health Status and Treatment Needs for Children with Special Needs: A Cross-Sectional Study

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### Abstract

**Objective:** To determine the oral health status along with the treatment need among Arabian children with special health care needs. **Material and Methods:** Fifty-seven special health care needs children aged 17 or younger, studying at RAK-RCD were recruited for the study. In addition to demographic data, the subjects were screened for the type of disability, oral health status, dental caries, occlusion abnormalities, and type of treatment required. Dental caries was recorded according to the WHO oral health survey criteria and methods. Oral hygiene status was recorded as good, fair, or poor according to the Simplified Oral Hygiene Index (S-OHI). Occlusion anomalies were categorized using Angle's classification of occlusion. **Results:** Fifty-four subjects aged 3-17 year old, comprising 70.4% males and 29.6% females participated in the study. There were 7 (13%) subjects 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. Twenty-two (26%) subjects had Down Syndrome (DS), 14 (25.9%) Mental Disability, 9 (16.7%) Autism, 5 (9.3%) deafness and hearing loss and 4 (7.4%) multiple disabilities. Forty-six (85.2%) had dental caries with a mean dmft/DMFT score of  $(5.67 \pm 4.69)$ . Only eight (14.8%) were caries-free. Thirty-five (64.8%) had good oral hygiene, 25.9% fair oral hygiene and 9.3% poor oral hygiene, with statically insignificant differences across gender ( $p=0.43$ ), age groups ( $p=0.11$ ). Nevertheless, there was a significant difference between oral hygiene and the types of disabilities ( $p=0.0004$ ). Up to 41% of the subjects required oral prophylaxis, 89% restorations, 13% extractions, 20% orthodontic treatment, and 11% dental prosthesis. **Conclusion:** There was a high prevalence of dental caries and periodontal diseases among the subjects. The study highly recommends the education of the children's parents and caregivers on the need for diet modification, meticulous oral hygiene, and regular dental visits. Furthermore, there is a great deal of oral health program the RAK Rehabilitation Center for Disabled need to achieve.

**Keywords:** Dental Caries; Disabled Children; Health Services for Persons with Disabilities.

## Introduction

Children with Special Health Care Needs (CSHCN) are defined as those children or youth “have or are at increased risk for chronic physical, developmental, behavioral, or emotional conditions and who also require health and related services of a type or amount beyond that required by children generally” [1]. Good oral health is a critical component of overall health. For many children with developmental disabilities, their smile is probably the most effective way of interacting with the world [2].

Dental care for special needs children are often neglected by both the dentists and the parents; since dentists may be reluctant to treat special needs children due to fear and lack of knowledge of various disorders that afflict special needs patients. On the other hand, the parents may prioritize other medical problems over oral healthcare, lack of awareness of the need for dental treatment or depression, and embarrassment. Financing and reimbursement issues can also affect the availability and accessibility to dental care for these patients [3]. Other factors that can interfere with access to oral healthcare include language and psychosocial, structural, and cultural barriers [3]. The aforementioned factors can delay dental care until a significant oral disease has developed.

Individuals with special needs may have considerable limitations in oral hygiene performance due to their potential motor, sensory, and intellectual disabilities [4,5]. Individuals with special healthcare needs have been reported in the literature to have more inadequate oral hygiene and periodontal status, more untreated caries, and fewer remaining teeth [6]. Oral health problems in many special health care need children can be caused by a special diet and medication containing sugar [7].

Family or caregivers and dentists should work together for oral healthcare maintenance especially for children exhibiting damaging oral habits like behavior issues, movement difficulty and seizures which can often lead to oral trauma or damage to the teeth. Communication with SHCN children could be unsuccessful because of the disability of the patient; thus, behavior guidance or management can be challenging and interfere with the safe delivery of dental treatment. Many difficulties could lead to postponement or denial of care, which can result in unnecessary pain, an increase in treatment need and cost, diminished oral health outcomes, and discomfort [8]. Furthermore, it is essential for the dentist or physician to know the child's level of understanding. Many of the SHCN children can communicate reasonably well when enough time, a smile, and a friendly communication manner are practiced [8].

The government of the UAE recognizes the need to support students with special needs. In February 2008, the UAE signed the Optional Protocol to the United Nations (UN) Convention on the Rights of Persons with Disabilities in line with the Federal Law 29/2006, which guarantees the rights for people with special needs [9,10]. Vocational and rehabilitation centers have been developed throughout the country in state of the art encompassing many facilities. Based on 2012 statistics from the Ministry of Social Affairs, there are 17 federal and local government centers and 25 private centers in the UAE for special needs children. These centers provide support to parents

and children in terms of early intervention, therapy, psychological and social counseling, among other services [11].

The purpose of this study was to determine the oral health status of special health needs children. Such information is pivotal for immediate treatment intervention and forthcoming oral health care plans.

## **Material and Methods**

### **Study Design and Sample**

Fifty-seven special healthcare needs children studying at Ras Al-Khaimah Rehabilitation Center for Disabled (RAK-RCD), United Arab Emirates (UAE), were recruited for the study. The center offers an intensive rehabilitation program for only children with special healthcare needs. All children in the center had been previously examined and medically diagnosed according to the center's protocol with full medical records.

### **Data Collection**

The inclusion criteria included children who agreed and signed the consent forms and aged 17 years or younger at the time of dental intervention and regularly attending the center. The children who failed to sign the provided informed consent were excluded from the study. In addition to the demographic data (age and gender), other data including type of the disability, oral health status, dental caries, occlusion abnormalities, and type of treatment required were recorded. The types of disabilities were obtained and recorded from the patient's medical records filed in the center. The children attending the center were diagnosed by the center specialists during the first admission to the center and were categorized as Down syndrome, Autism, Mental disability, Deafness, or Hearing loss. The children with more than one disability were considered to constitute the multiple disabilities category.

### **Oral Examination**

To ensure the intra-examiner consistency of the clinical examinations, a group of 10 children and 5 adults attending the dental clinic at RAK College of Dentistry were selected randomly and examined for dental caries and periodontal charting using the World Health Organization (WHO) criteria [12]. After three weeks, the same group of subjects was recalled and re-examined by the same principal investigator. Three of the recalled children were unable to make it for the re-examination. Intra-examiner reliability data demonstrated a high percentage agreement (Kappa Coefficient =0.83).

The examination of the children was performed in the center. Each child was accompanied by his/her teacher and brought to the examination room and asked to set on an adjustable chair. The principle of "Tell-Show and Do" technique was used during the examination. The intraoral examination was performed using torchlight, dental explorer, and mouth mirror. The dental

explorer was used to gently examine the teeth surfaces, detect subgingival and supragingival calculus, and to remove any food debris from cavities. The examination was carried out by a single calibrated examiner in the presence of assistant and a teacher.

Dental caries was recorded based on the WHO oral health survey criteria and methods using decayed, missing, and filled teeth (DMFT) index for permanent dentition [12]. In cases of early and late-mixed dentition, the two indices were combined to assess the degree of total caries [13]. Only cavitated teeth due to caries were considered carious but not the demineralized surfaces. Another method of caries detection, such as fiber-optic trans-illumination, compressed air, or radiographs, were not used in caries diagnosis.

Oral hygiene status was recorded as good, fair, or poor according to the Simplified Oral Hygiene Index (S-OHI). Six teeth surfaces were scored; four posterior and two anterior. At least two of the possible six surfaces must have been included to calculate the score, and adjacent teeth may be substituted for the selected teeth if they were missing. Debris (plaque) was scored on a scale of 0 to 3. Calculus deposits were scored for the same surfaces on a scale of 0 to 3. The index values were calculated from the recordings of the calculus and debris scores. The oral hygiene was considered; "good" if the score is between 0-1.2; as "fair" when it is 1.3-3; or "poor" when the score is between 3.1 to 6 [14,15].

Occlusion anomalies were categorized using Angle's classification of occlusion. Crowding, spacing, and anterior open bite were also recorded. Types of treatment required were categorized as periodontics, surgical, restorative, orthodontics, and prosthodontics. The Modified Index of Orthodontic Treatment Need (IOTN) was used to identify children in need of orthodontic treatment. The index has been simplified into two categories; a definite need for treatment and no definite need for treatment. Every case with IOTN Dental HealthCare component  $\geq 4$  and /or IOTN Aesthetic Component  $\geq 8$  is classified as needing treatment [16].

### Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows Software, version 20 (IBM Corp., Armonk, NY, USA). Chi-square test was used where applicable when comparing findings across age groups, gender, and types of disabilities. A p-value less than 0.05 was considered significant.

### Ethical Aspects

The study has been approved by the RAK Medical and Health Sciences University (RAK MHSU) and Ras Al-khaimah Research and Ethics Committee (REC Reference Number: 008/14) and by the RAK-RCD, UAE. Consent forms were sent to the parents of the children, which explain the details of the study protocol.

### Results

Out of the 57 subjects included initially in the study, only 54(94.7%) of the subjects returned signed consent forms and considered valid for the study. The three subjects neither signed the consent form nor attended the examination. The age range was between 3-17 years; comprising 70.4% males and 29.6% females. There were 13% subjects in the age group 3-5 years and 44.4% in the 11-17 years age group. Twenty-two (40.7%) subjects had Down Syndrome (D.S.), 25.9% Mental Disability (M.D.), 16.7% Autism, 9.3% Deafness and Hearing Loss (D&HL) and 7.4% Multiple Disabilities (Multi) (Table 1).

**Table 1. Demographic characteristics of the study population.**

Variables	N	%
Gender		
Male	38	70.4
Female	16	29.6
Age (in Years)		
3-5	7	13.0
6-10	23	42.6
11-17	24	44.4
Disabilities		
Down Syndrome (D.S)	22	40.7
Mental Disability (M.D)	14	25.9
Autism	9	16.7
Deafness & Hearing Loss (D&HL)	5	9.3
Multiple (Multi)	4	7.4
Total	54	100.0

Forty-six (85.2%) of the subjects had caries with a mean dmft/DMFT score of (5.67± 4.69), whereas only eight (14.8%) were caries-free. About 62% of DS and MD subjects had caries, but it was only 24% in Autistic subjects.

Thirty-five (64.8%) had good oral hygiene, 14 (25.9%) fair oral hygiene, and 5 (9.3%) poor oral hygiene, with no significant statistical differences between oral hygiene and gender (p=0.43) or age groups (p=0.11). However, there was a statistically significant difference between oral hygiene and the type of disabilities (p=0.0004) (Figures 1 to 3).



**Figure 1. Oral hygiene status of the study population according to gender.**

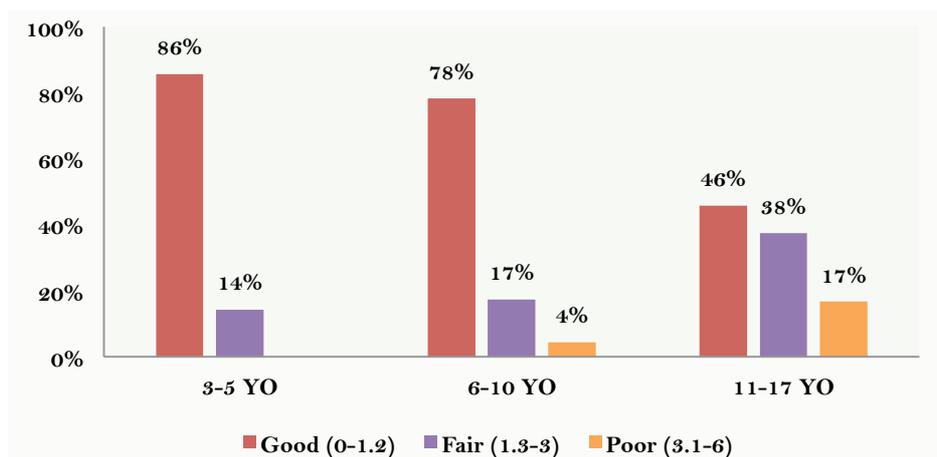


Figure 2. Oral hygiene status of the study population according to age group.

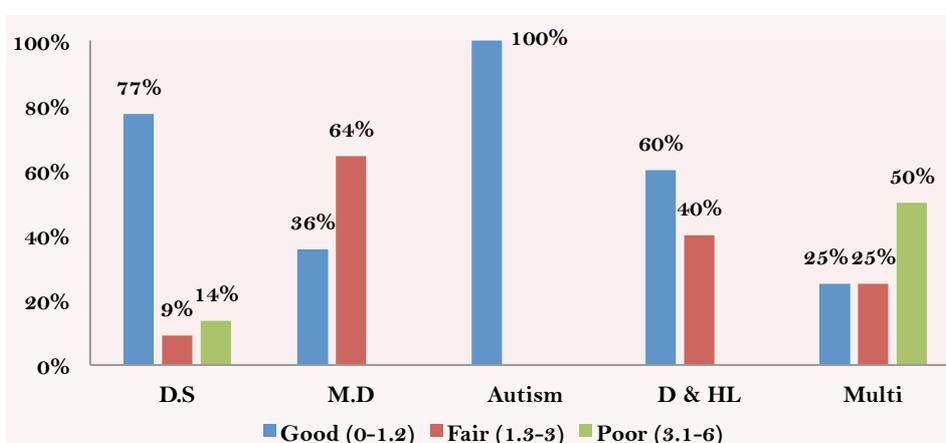


Figure 3. Oral hygiene status of the study population according to the type of disability.

Eleven (20.37%) had Angle's class II malocclusion, 25 (46.3%) class III, 2 (3.7%) class II subdivision, 7 (12.96%) had a combination of class II/III, and the remaining 9 (16.67%) were not included in the classification because of the absence of the first permanent molars (Figure 4). There was a statistically significant differences between Angle's class III malocclusion and Down syndrome ( $p=0.000001$ ), and Angle's class III malocclusion and mental disability ( $p=0.04$ ).

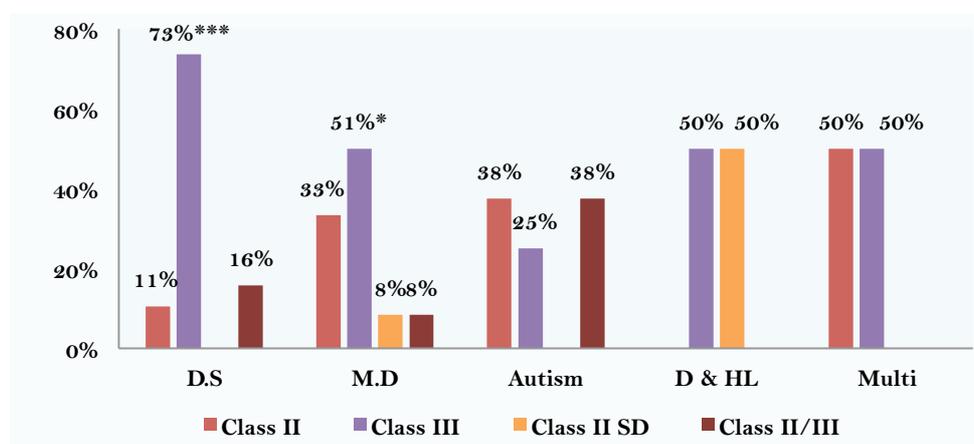


Figure 4. Angle's classification of occlusion of the study population according to the type of disability.

Forty-one percent of the total population required oral prophylaxis, 89% restorations, 13% extractions, 20% orthodontic treatment, and 11% dental prosthesis.

## Discussion

Special health care needs is defined as “any physical, developmental, mental, sensory, behavioral, cognitive, or emotional impairment or limiting condition that requires medical management, health care intervention, and/or use of specialized services or programs” [17]. According to the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) and the American Association on Mental Retardation, a below-average intellectual ability affects at least two of the following areas: communication, self-care, house chores, social skills, interpersonal relationships, use of community resources, academic skills, work, self-sufficiency, health and safety, entertainment and leisure administration [18]. In addition to systemic diseases and specific features of certain conditions, we believe that oral diseases are one of the main problems affecting individuals with special needs reflecting their mental or physical condition.

Despite the UAE government’s efforts in promoting oral health programs and the availability of the specialized centers for children with special needs, there is still a lack of specially trained professionals to perform patient oral care. Individuals who are intellectually challenged require enhanced dental care. The caring professionals need to have broad knowledge, understanding that some of the limitations and deficiencies of the special needs patients are linked to dental problems, including dental caries, malocclusion, periodontal diseases, and bruxism. The latter problems are consistently due to unsatisfactory oral hygiene performance and patients’ diet [19].

In the current study, most of the subjects were presented with dental caries. Generally, CSHCN has a high prevalence of dental caries. This could be attributed to uncoordinated chewing in some conditions, difficulty in performing efficient toothbrushing, fermentable diet intake, xerostomia related to medicine, intake of flavored medications, crowding of teeth and related gingival hyperplasia [20]. The high caries index in this report is in line with many of the previous studies [21,22]. It is inevitable to say that the UAE has one of the highest caries indexes of healthy children in the region [23,24]. The subjects with DS and MD revealed high caries prevalence, approximately (62%), although, the literature shows conflicting reports, in particular, the individuals with DS. This could be attributed to variations in study design, sample size, or other confounding factors [22,25]. Although our sample size is small to valid comparison, the result showed high caries percentage, which is a consistent finding in the literature. It is mandatory for the local health authority to take major steps to alleviate this dominating dental problem.

In contrast to dental caries, nearly 65% of the subjects in this study had good oral hygiene. There was an insignificant difference in the oral hygiene status between females and males and the age groups. This could be explained that the majority of the subjects rely on their parents or the care providers to perform the required oral hygiene activities, as they do not reside in the center. On the other hand, there was a significant difference in oral hygiene status when the types of the various

disabilities are considered ( $p=0.0004$ ). As a matter of fact, it is expected to see a lower hygiene status among individuals with multiple disabilities, particularly those with conditions causing cognitive and psychomotor impairment. Previous authors reported that there is a correlation between the level of oral hygiene and the degree of disability [26]. Obviously, this group of subjects needs extra attention and probably the efforts of the caregivers at home are insufficient to provide efficient oral care. Therefore, meticulous oral hygiene practices and follow-up programs need to be implemented by well-trained professionals during their presence in the center.

DS is a multisystem congenital disease presented by several mental anomalies, behavioral alterations, and physical malformations. Dental problems are common in these patients, including dental caries, periodontal problems, and occlusion abnormalities. More than half of the subjects with DS had class III malocclusion ( $p=0.000001$ ). This is in line with many reported studies [27,28]. The current result reveals that there is a statically significant association between class III malocclusion and mental disability ( $p=0.04$ ) when it is considered an independent subset. Malocclusion among individuals with mental and physical disabilities has been widely reviewed. The reports found that malocclusion was more frequent in individuals with a mental disability rather than physical origin. Furthermore, class II and class III malocclusions were more frequent in individuals with Cerebral Palsy and Down syndrome, respectively [29,30]. We believe that the mental or physical impairments should not be a barrier against receiving orthodontic treatment and should start as soon as possible, as this would reduce the potential dental complications, namely dental caries, and periodontal diseases and facilitate oral hygiene measures.

On the whole, when treatment needs of the subjects are considered, operative and periodontal treatments are on the to requirements; (89%) and (41%) respectively. Many cases showed a severe form of dental caries with massive destruction of teeth. These cases need urgent attention to avoid further complications.

Many studies reported that periodontal disease in individuals with DS is very high and may progress rapidly, particularly in the young age group [31,32]. In the current report, a substantial percentage of subjects need advanced and meticulous periodontal treatment. The orthodontic treatment is also needed for 20% of the subjects presented some form of malocclusion, such as crowding and spacing

We do understand that some factors may affect the efficacy of prevention and treatment, such as lack of proper control, difficulty during dental assistance, inattention to patient's pain or treatment needs, in addition to communication problems and bad behavior. Nevertheless, it imperial to establish an intimate relationship with such patients to enable their care. Furthermore, we strongly believe that not only the caregiver but also the center for disabled should prepare and conduct oral hygiene programs to reduce the two oral health burdens, namely the cavity and periodontal disease indices, considering that these students spend many hours in the center, with minimum or no access to adequate oral hygiene.

Our study was primarily intended to have an overview of the oral health among Children with Special Health Care Needs at RAK-RCD. However, it is limited by the small number of subjects since some subjects did not return their consent forms, others were absent, and some were uncooperative, so they had to be excluded from the study.

## Conclusion

The primary data reveals a high prevalence of dental caries and periodontal diseases among the subjects regardless of the type of disability. A thorough oral health care program, including screening, prevention, and management, should be instituted. The latter should be established in consultation with other parties, including physicians, social workers, and caregivers. It is mandatory to educate the parents, caregivers, and patients about the importance of diet and preventive oral care to achieve optimum oral health.

**Authors' Contributions:** JOSA collaborated in the concept and study design, methods and materials, preparing documents for ethical approval, partial contribution in the introduction, data analysis and discussion. EZE and AMA performed clinical examination, data acquisition, analysis and interpretation. AAJ contributed in the discussion drafting, critical revision and proofreading of the manuscript. All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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## References

- [1] Health Resources and Services Administration. Maternal and Child Health Topics. Children with Special Health Care Needs. Available from: <https://mchb.hrsa.gov/maternal-child-health-topics/children-and-youth-special-health-needs#ref>. [Accessed on July 31, 2018].
- [2] Norwood KW Jr, Slayton RL; Council on Children With Disabilities; Section on Oral Health. Oral health care for children with developmental disabilities. *Pediatrics* 2013; 131(3):614-9. <https://doi.org/10.1542/peds.2012-3650>
- [3] Dean JA, Avery Dr, McDonald RE. *Dentistry for the Child and Adolescent*. 9<sup>th</sup>. ed. Maryland Heights: Mosby/Elsevier; 2010. Chapter 23; pp. 460-484.
- [4] Nunn JH. The dental health of mentally and physically handicapped children: A review of the literature. *Community Dent Health* 1987; 4(2):157-68.
- [5] Dahle AJ, Wesson DM, Thornton JB. Dentistry and the patient with sensory impairment. In: Thornton JB, Wright JT. *Special and Medically Compromised Patients in Dentistry*. London: PSG Publishing Co.; 1989; pp. 66-67.
- [6] Nunn JH, Gordon PH, Carmichael CL. Dental disease and current treatment needs in a group of physically handicapped children. *Community Dent Health* 1993; 10(4):389-96.
- [7] Moursi AM, Fernandez JB, Daronch M, Zee L, Jones CL. Nutrition and oral health considerations in children with special health care needs: Implications for oral health care providers. *Pediatr Dent* 2010; 32(4):333-42.
- [8] American Academy of Pediatric Dentistry. Council on Clinical Affairs. Guideline on Management of Dental Patients with Special Health Care Needs. *Clinical Practice Guidelines* 2012; 34(5):160-65.
- [9] United Nations Treaty Collection. Convention on the Rights of Persons with Disabilities Available from: [https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg\\_no=IV-15&chapter=4&lang=\\_en&clang=\\_en](https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-15&chapter=4&lang=_en&clang=_en). [Accessed on August 01, 2018].
- [10] Abu Dhabi Digital Government. Education for people of determination. Available from: <https://government.ae/en/information-and-services/education/education-for-people-with-special-needs>. [Accessed on February 12, 2019].
- [11] Cultural Division. Embassy of United Arab Emirates. Available from: <http://uaecd.org>. [Accessed on August 2, 2018].
- [12] World Health Organization. *Oral Health Surveys Basic Methods*. 4<sup>th</sup>. ed. Geneva: WHO; 1997.

- [13] Chen CY, Chen YW, Tsai TP, Shih WY. 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. *J Chin Med Assoc* 2014; 77(4):198-202. <https://doi.org/10.1016/j.jcma.2014.01.008>
- [14] Greene JC, Vermillion JR. The simplified oral hygiene index. *J Am Dent Assoc* 1964; 68:7-13.
- [15] Wei SH, Lang NP. Periodontal epidemiological indices for children and adolescents: II. Evaluation of oral hygiene; III. Clinical applications. *Pediatr Dent* 1982; 4(1):64-73.
- [16] Avinash B, Shivalinga BM, Balasubramanian S, Shekar S. The Index of Orthodontic Treatment Need - A review. *Int J Rec Sci Res* 2015; 6(8):5835-9.
- [17] American Academy of Pediatric Dentistry. Guideline on Management of Dental Patients with Special Health Care Needs. Available from: [www.aapd.org/media/Policies\\_Guidelines/G\\_SHCN.pdf](http://www.aapd.org/media/Policies_Guidelines/G_SHCN.pdf). [Accessed on January 18, 2019].
- [18] Varellis MLZ. O paciente com necessidades especiais na Odontologia: Manual Prático. 2<sup>nd</sup>. ed. São Paulo: Santos; 2013. [In Portuguese].
- [19] Oredugba FA, Akindayomi Y. 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* 2008; 8:30. <https://doi.org/10.1186/1472-6831-8-30>
- [20] Dharmani CK. Management of children with special health care needs (SHCN) in the dental office. *J Med Soc* 2018; 32(1):1-6. [https://doi.org/10.4103/jms.jms\\_115\\_16](https://doi.org/10.4103/jms.jms_115_16)
- [21] Chen CY, Chen YW, Tsai TP, Shih WY. 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. *J Chin Med Assoc* 2014; 77(4):198-202. <https://doi.org/10.1016/j.jcma.2014.01.008>
- [22] Pini DM, Fröhlich PC, Rigo L. Oral health evaluation in special needs individuals. *Einstein* 2016; 14(4):501-7. <https://doi.org/10.1590/S1679-45082016AO3712>
- [23] Al Mashhadani SS, Al Khoory T, Saleh NM, Fargali K, Mathew R, Al Qasem N. National Survey of the Oral Health Status of School Children in Dubai, UAE. *EC Dental Science* 2017; 8:48-58.
- [24] Kowash MB, Alkhabuli JO, Dafaalla SA, Shah A, Khamis AH. Early childhood caries and associated risk factors among preschool children in Ras Al-Khaimah, United Arab Emirates. *Eur Arch Paediatr Dent* 2017; 18(2):97-103. <https://doi.org/10.1007/s40368-017-0278-8>
- [25] Fung K, Lawrence H, Allison P. A paired analysis of correlates of dental restorative care in siblings with and without Down syndrome. *Spec Care Dentist* 2008; 28(3):85-91. <https://doi.org/10.1111/j.1754-4505.2008.00018.x>
- [26] Lee J-Y, Lim K-C, Kim S-Y, Paik H-R, Kim Y-J, Jin B-H. Oral health status of the disabled compared with that of the non-disabled in Korea: A propensity score matching analysis. *PLoS One* 2019; 14(1):e0208246. <https://doi.org/10.1371/journal.pone.0208246>
- [27] Shukla D, Bablani D, Chowdhry A, Thapar R, Gupta P, Mishra S. Dentofacial and cranial changes in down syndrome. *Osong Public Health Res Perspect* 2014; 5(6):339-44. <https://doi.org/10.1016/j.phrp.2014.09.004>
- [28] Alkhadra T. Characteristic of malocclusion among Saudi special need group children. *J Contemp Dent Pract* 2017; 18(10):959-63.
- [29] Winter K, Baccaglini L, Tomar S. A review of malocclusion among individuals with mental and physical disabilities. *Spec Care Dentist* 2008; 28(1):19-26. <https://doi.org/10.1111/j.1754-4505.2008.00005.x>
- [30] Rao D, Hegde S, Naik S, Shetty P. Malocclusion in individuals with mental subnormality – A review. *Oral Health Dent Manag* 2014; 13(3):786-91.
- [31] Frydman A, Nowzari H. Down syndrome-associated periodontitis: A critical review of the literature. *Compend Contin Educ Dent* 2012; 33(5):356-61.
- [32] Macho V, Coelho A, Areias C, Macedo P, Andrade D. Craniofacial features and specific oral characteristics of Down syndrome children. *Oral Health Dent Manag* 2014; 13(2):408-11.