Autism spectrum disorders and oral health status: review of the literature

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Abstract

Aim Autism Spectrum Disorder (ASD) is characterised by impairments in communication and social relationships and by a narrow, repetitive and stereotyped repertoire of activities, behaviours and interests. The aim of this work is to evaluate how these characteristics have an impact on oral health.

Materials and methods A search was conducted through MEDLINE/PubMed and Web of Science in order to evaluate the oral health status of children with ASD and the correlation between ASD and dental caries, periodontal disease, dental injuries, oral microbiota, as well as the different strategies, approach and treatments in ASD patients. Forty-six articles were selected.

Results Children with ASD are at higher risk of caries, alteration of the periodontal status, alterations of the oral microbiota and increased risk of traumatic injuries.

Conclusion Since ASD is a haeterogeneous disease with a wide range of expressions in individuals, adapted and specific strategies are needed. ASD children represent a challenge for the dental community.

KEYWORDS ASD Children, Autistic spectrum disorders, Dental injuries, Dental treatments, Oral health, Oral status

Introduction

Autism disorder (AD) was first described by the American child psychologist, Leo Kanner. He presented 11 children whose behaviours were obviously different from each one. Kanner suspected that they had an inborn feature, which had prevented their regular social contacts [Kanner, 1968]. Autism Disorder is sometimes referred to as early infantile autism, childhood autism, or Kanner's autism. More precisely, due to the variety of symptoms and the complexity in providing a coherent and uniform clinical definition, the use of a, more correctly speaking, definition of Autism Spectrum Disorders (ASD) has recently been enforced, including a whole series of pathologies or syndromes with behavioural characteristics as a common denominator, although at varying degrees or levels of intensity [Pearson et al., 2018].

The National Institute of Child Health and Human Development has defined the autism spectrum disorders as: "A complex biological disorder that generally lasts for a person's entire life, beginning before the age of three, in the developmental period, and causes delays or problems in many different ways in which a person develops or grows".

At the nosographic classification level, in the DSM V (Diagnostic and Statistical Manual of Mental Disorders, 5th ed) [American Psychiatric Association, 2013] ASD is considered to fall within the clinical category of neurodevelopmental disorders.

As for the aetiology, considering the complex nature of ASD, a single cause is unlikely. Possible etiologies of ASD are genetics, prenatal factors, brain biological factors, coexisting medical conditions [Dall'Aglio et al., 2018].

As for the prevalence, according to ASDEU (Autism Spectrum Disorder in European Union) results, 1 child on 100 is affected by ASD in Italy [Internation Society for Autism Research, 2018]. According to the recent statistics, incidence rates have increased from 10% to 17% per year (ISTAT 2018). There is no shared explanation for this continuous increase; a factor that is often mentioned, however, concerns the improvement of the diagnostic process that has allowed a correct diagnosis to children that would not have been correctly diagnosed in the past [Myers and Johnson, 2007].

ASD is a life-long heterogeneous psychiatric disorder, characterised by impairments in communication and social relationships and a restricted, repetitive and stereotyped repertoire of activities, behaviours and interests [American

Psychiatric Association, 2000]. Literature suggests that the population with ASD presents with similar health problems as that of the typical population, but, due to factors including poor dietary preferences, behaviours and specific aversions, like incapacity to take care of themselves independently, self-injurious behaviour or drugs, this population is at a greater risk and more susceptible to developing chronic non-communicable oral health conditions [Christopher et al., 2002; Medina et al., 2003, Jaber, 2011; Vajawat and Deepika, 2012].

Since it is possible to prevent most oral diseases and to educate children, though special pathways, it is essential to establish the real correlation between oral pathologies and ASD, in order to draw up a preventive-therapeutic plan to improve the quality of life of these patients.

In the literature it is possible to find many articles dealing with single oral problems in children with ASD [Nakao et al., 2015; Morales-Chávez, 2017; Fakroon et al., 2015], but there is no recent revision that can give a general picture of oral health in children with ASD. The purpose of the work is, therefore, to combine all the information available in the scientific literature, in order to evaluate how ASD characteristics may impact oral health and quality of life in ASD children.

Materials and methods

Searches were conducted through MEDLINE/PubMed and Web of Science using the following key words: "ASD", "autistic spectrum disorders", "oral health" "oral status" "dental injuries" "dental treatments" "ASD children", "autism". Studies were included if fulfilled the following eligibility criteria: to evaluate the oral health status of children with ASD; to be an observational study; to be a RCT; to be a meta-analysis; to evaluate the correlation between ASD and dental caries, periodontal disease, dental injuries, oral microbiota, and to evaluate different strategies, approach and treatments in ASD patients. From 234 articles, 46 have been selected as eligible.

Results

Correlation between ASD and oral health

Children with ASD do not have peculiar oral characteristics related to their pathology. However, their disorders have consequences on the oral sphere and the oral health of people with ASD is worse than that of the general population [Delli et al., 2013; Gandhi and Klein, 2014; Lu et al., 2013]. Thus, some of their characteristic behaviours or disorders, such as communication limitation, personal negligence, self-injurious behaviour, eating habits (uncontrolled and restrictive feeding), side effects of drugs, opposition to dental care, hyposensitivity to dental pain and hypersensitivity to external stimuli are often responsible for the deterioration of the oral health of children with ASD [Jaber, 2011]. These characteristics have an impact on oral health: children with ASD have a poor collaboration in practicing proper oral hygiene. In fact, a recent study showed that about 25% of the analyzed ASD children do not do any brushing during the day [Sarnat et al., 2016].

Correlation between ASD and caries risk

Tooth decay, also known as dental caries or cavities, is a breakdown of teeth due to acids made by bacteria [Ferrazzano et al., 2008]. The cause of caries is acid from bacteria dissolving the hard tissues of the teeth (enamel, dentin and cementum). The acid is produced by the bacteria when they break down food debris or sugar on the tooth surface. Simple sugars in food are these bacteria's primary energy source and thus a diet high in simple sugar is a risk factor [Kalyoncu and Tanboga, 2017].

It can be expected that caries risk is higher in these patients because of the difficulties in brushing and flossing their teeth and it could be caused by the lack of manual skills of autistic children, resulting in inadequate oral hygiene [Onol and Kırzıoğlu, 2018]. In fact, a recent meta-analysis, conducted considering prevalence of dental caries in patients with ASD, showed that all the analyzed studies reported dental caries prevalence, and the pooled prevalence was 60.6% (95% CI: 44.0-75.1) [da Silva et al., 2017]. Furthermore, children with ASD exhibited a higher caries prevalence in primary teeth than in permanent ones with a ratio of 1:2.51 [Morales-Chávez, 2017]. It was also observed that salivary pH and buffering capacity were lower in children with ASD, with a related dental caries incidence higher in ASD children when compared to their healthy siblings [Bhandary and Hari, 2017].

The current literature shows the validity of considering ASD as an indicator of high caries risk and oral hygiene may be the most influential risk indicator associated with new caries in children with ASD [Marshall et al., 2010].

With regards to the dietary pattern, ASD individuals have an inclination for soft and sweetened food [Weddell et al., 2004], which makes them more prone to dental caries [Ferrazzano et al., 2016]. The use of alternative therapy, such as gluten-free/casein-free diets for children with ASD, restricts them from protein intake and inadvertently causes an increase in the carbohydrate content of saliva. The role of protein intake in the maintenance of oral health is that it elevates the urea level in saliva and increases the buffering capacity of saliva. It may also have an enamel coating effect [Adair, 2005]. According to recent literature, intervention trials, evaluating the effects of a gluten-free and casein-free diet on ASD symptoms, have so far been contradictory and inconclusive and the evidence to support the therapeutic value of this diet is limited and weak [Lange et al., 2015].

The use of sweet snacks is also favoured because they are used as a reward provided by the "Special Personal Training Program", part of the behavioural therapy [Myers and Johnson, 2007], together with the increased use of syrups or sweet drinks used to promote drugs assumption orally.

In general, children with ASD prefer soft and sweetened foods and they tend to pouch food inside the mouth instead of swallowing it, due to poor tongue coordination, thereby increasing the susceptibility to caries [Bailey and Retter, 1991].

Correlation between ASD and periodontal status

Periodontal diseases are infections of the structures around the teeth, which include the gums, periodontal ligament and alveolar bone. In the earliest stage of periodontal disease, gingivitis, the infection affects the gums. In more severe forms of the disease, all tissues are involved [Mummolo et al., 2014 a; Ferrazzano et al., 2006].

Majority of ASD children have poor oral hygiene, and almost all of them have gingivitis [Fakroon et al., 2015]. These changes could be related to irregular brushing habits, because of the difficulties the trainers and the parents encountered when they brushed the children's teeth. They could also be caused by lack of the necessary manual dexterity of ASD children, which may have resulted in inadequate tooth brushing [McKinney et al., 2014]. Another possible explanation for the presence of generalised gingivitis might be the side effects of medications,

which were used to control the manifestations of ASD, such as psychoactive drugs or anticonvulsants like phenytoin, correlated to an increasing of hypertrophic-hyperplastic gingivitis and an eruption delay. Other common drug classes used in these patients are antidepressants, stimulants, and antipsychotics that may have oral side effects [Alaluusua and Malmivirta, 1994]. The pooled prevalence of periodontal disease in ASD children was 69.4% (95% CI: 47.6-85.0) according to a recent meta-analysis [da Silva et al., 2017].

Correlation between ASD and dental injuries

The rate of dental injuries is higher among ASD children. The most common dental injury was enamel fracture and the most frequently injured teeth were the permanent maxillary central incisors [Altun at al., 2010]. It has been estimated that almost 70% of individuals with ASD present with self-injurious behaviours (SIB) located in the head and neck region [Medina et al., 2003]. Oral findings reported in patients with ASD included traumatic ulcerated lesions, frequently a consequence of SIB, such as head banging, face tapping, and gingival picking. Another consequence of SIB noted in ASD is auto extraction. Autoextraction refers to the self removal of teeth [Keles et al., 2015]. Unusual oral habits include bruxism, tongue thrusting, non nutritive chewing on objects such as gravel, cigarette butts, or pens and repeated regurgitation [Mummolo et al., 2014 b]. Furthermore, in these children, due to their behavioural characteristics, the risk of damaging oral habits such as bruxism and oral self-injures is increased [Kopycka-Kedzierawski and Auinger, 2008; DeMattei et al., 2007].

Correlation between ASD and oral microbiota

Children with ASD demonstrated characteristic changes in the oral microbiome, according to a recent study [Qiao et al., 2018], where, via high-throughput sequencing of 111 oral samples in 32 children with ASD and 27 healthy controls, it was showed that the salivary and dental microbiota of ASD patients were different from controls. Lower bacterial diversity was observed in ASD children. Specifically, pathogens such as Haemophilus in saliva and Streptococcus in plaque showed significantly higher prevalence in ASD patients, whereas commensals such as Prevotella, Selenomonas, Actinomyces, Porphyromonas, and Fusobacterium were reduced. In the end, diagnostic models based on key microbes were constructed, with 96.3% accuracy in saliva. Taken together, this study characterised the habitat-specific profile of the oral microbiota in ASD patients, which might help develop unexpected strategies for the diagnosis of ASD [Qiao et al., 2018].

ASD and therapeutic/preventive approach

Children with ASD often provide limited or null collaboration with medical procedures, particularly those considered invasive such as dental examination. Children with ASD are prone to agitation, self-injury, and emotional dysregulation; they can also present hypersensitivity to sensory input [Summers et al., 2017]. These features make it difficult for dentists to examine and treat children with ASD; they interfere with dental care and constitute a wall against it, in fact, most of them are treated under general anesthesia or sedation [Capp et al., 2010]. Therefore, children with ASD present a challenge for the dental community [Mansoor et al., 2018]. Adapted and specific strategies are required to allow children with ASD adequate dental care, however, ASD is a heterogeneous disease with a various expression range. Therefore, the therapeutic approach that can lead to a successful result in a particular special patient can prove ineffective for another one [Delli et al., 2013; Dangulavanich et al., 2017]. Because of the limited attention span of AD patients, short and well organised appointments should be planned and the waiting time should not exceed 10-15 minutes, to avoid upsets [Kamen and Skier, 1985].

Different tools and techniques of evidence-based practice can be considered: behavioural approaches, visual pedagogy and electronic devices can be used.

Applied Behavioral Analysis (ABA) is a branch of psychology focused on the analysis and modification of human behaviour. The ABA practices are based on the basic principles, developed by Skinner, according to which, behaviours are controlled by their consequences and defined as "operating", since their "responses" operate on the environment and generate consequences. The behaviour of a subject, understood as an answer to a stimulus, produces reactions on the environment that have consequences. Depending on the nature of the consequence, it is possible to distinguish positive reinforcement, negative reinforcement, omission and punishment [Skinner, 1953].

Visual pedagogy is a technique analyzed in a prospective study, that included clinical examinations and structured interviews, in which a series of images, showing a structured method and a tooth brushing technique, were placed in the bathroom or wherever tooth brushing was performed. The study showed that, after 12 months, the amount of visible plaque in ASD children was reduced. After 18 months, most parents felt their children maintained good oral hygiene easier than they had found before the study and concluded that visual pedagogy was a useful tool to help people with ASD to improve their oral hygiene [Nilchian et al., 2017].

According to a randomised controlled study conducted on ASD children, it is possible to have an improvement in oral hygiene also through video tutorials. In this study, in fact, the effectiveness of video tutorials on brushing techniques, delivered to patients via internet, was examined over a period of three weeks, observing an improvement in the plaque indexes, compared to the baseline after an adequate brushing learned through the videos [Popple et al., 2016].

Since the prevalence rates for ASD have risen significantly in the past decade, increased emphasis has been placed on educational and behaviour guidance techniques, which can be helpful for children with ASD because of their increased capabilities in visual processing. The purpose of a recent literature review was to summarise the interventions available to reduce dental anxiety in children with ASD, and to determine which strategies are best suited for implementation. This study identified three ideal interventions: picture cards, video technologies and mobile applications [Elmore et al., 2016].

Further aids, according to a clinical microbiological study conducted on ASD patients, consist in using an electric toothbrush compared to the manual one, as it improves the quality of oral hygiene with a reduction of plaque index and gingival index with a statistically significant difference (respectively 0.024 and 0.042) [Vajawat et al., 2015].

An additional aid can be provided by the type of toothpaste used, in fact, the use of toothpaste with calcium sucrose phosphate is more effective than a toothpaste with a low content of fluorine (0.042) as showed by a recent clinical study conducted on autistic patients [Awasthi et al., 2015].

Furthermore, in children with ASD, harmful habits for the oral cavity are common, which consist of bruxism, thrust of the tongue, and traumas resulting from mucosal and lips biting. Bruxism or grinding is one of the sleep problems that are

commonly observed in children with ASD. The dentist can recommend a mouthguard or a bite to limit this self-injurious behaviour [Summers et al., 2017].

Finally, dental health education should be carried out, including information/guidance on reducing the frequency of sugary foods and drinks in the diet, good oral hygiene, use of fluoride toothpaste and casein phosphopeptides supplements [Ferrazzano et al., 2012], early attendance at the dentist or dental nurse for advice and care.

Conclusion

Over the past three decades, there has been an explosion of interest in ASD. Knowledge and awareness on the condition has grown exponentially at all levels: general public, parents, health professionals, the research community and more recently, at parliamentary level. The world has begun to recognise the scope of this problem and act internationally and locally to improve the quality of lives of the growing number of children and families affected by this devastating disorder.

In conclusion, the literature showed that ASD children may have a major risk of developing caries, periodontal lesions, alteration of the oral microbiome and, because of their hyperactivity and their stereotypical and selfinjurious attitudes, a greater probability of having oral trauma. However, all these diseases can be, if not eliminated, reduced, thanks to personalised preventive approaches and a correct personalised educational model for the ASD patient. Paediatricians have a key role in the oral care of children with ASD, as they can intercept and direct ASD children towards specialised care in early age, increasing compliance and allowing the development of a relationship between the child and the dentist, who is able to approach the child and ensure prophylactic therapy and adequate care.

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