Prevalence of Malocclusion in Down Syndrome Individuals in Benin City, Nigeria

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ABSTRACT

Objective: Malocclusion is an appreciable deviation from the ideal occlusion that is considered unsatisfactory. The prevalence of malocclusion could be affected by ethnicity, race and genetic influence. The objective of this study was to determine the prevalence of malocclusion traits with respect to sagittal, transverse and vertical relationships among Down syndrome.

Methods: The study was conducted among 19 Down syndrome and 19 control individuals (age 10 -15 years; 10 males and 9 females for each study group). The mean ages were 12.6 ± 2.1 years and 12.4 ± 1.7 years for Down syndrome and controls respectively. Statistical significance was evaluated using chi-square test. Fischer exact test was used when an expected frequency presentation was < 5. A significant level of $p<0.05$ was set for this study.

Results: This showed class III skeletal pattern (Down syndrome, 73.7%; control 21.1%) and class III incisal (Down syndrome, 73.7%; control 26.3%), Posterior crossbite (Down syndrome, 68.4%; control 10.6%) and anterior crossbite (Down syndrome, 63.2%; control 15.8%) were significantly higher among Down syndrome individuals. The prevalence of bilateral Angle class III was 31.6% and 5.3% for Down syndrome and control individuals respectively. Anterior open bite was also more prevalent among Down syndrome (26.3%) than control (5.3%).

Conclusion: Down syndrome individuals had significant higher prevalence of sagittal (skeletal pattern III, incisor class III relationship, anterior crossbite), transverse (posterior crossbite and anterior crossbite) and vertical relationships (anterior open bite) than control individuals. Orthodontists should take note of the high prevalence of malocclusion among Down syndrome

Key words: Malocclusion, Down syndrome, Prevalence, Benin City.

INTRODUCTION

Down syndrome (DS) was first described by John Langdon Down in 1866, when he published the physical characteristics of a group of individuals which he described as Mongolism (Howard-Jones, 1979). the chromosomal abnormality associated this group of individuals was discovered by Dr. Jerome Lejeune, in 1959 (Howard-Jones, 1979). It is the most common chromosomal disorder among human (Mikkelsen, 1977).

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The prevalence and incidence vary among different population (Christianson, 1996; Molteno et al.,

1997; Parker et., 2010; Brandao et al., 2012). In the United States, there is an estimated prevalence rate of 14.47 per 10,000 live births (Parker et., 2010) while an incidence of 1 in 865 was reported in Nigeria (Adeyokunnu, 1982).

Malocclusion is an appreciable deviation from the ideal occlusion that may be considered aesthetically unsatisfactory (Houston et al., 1992). A number of etiological factors ranging from genetic influences, environmental factors, early loss of deciduous teeth, dento-alveolar fractures and periodontal diseases, have been implicated for the development of malocclusion (Houston et al., 1992). Malocclusion is an oral condition of public health interest, ranking just below dental caries and periodontal disease (Ahammed et al., 2013). These factors if not promptly managed may ultimately lead to severe malocclusion with resultant complex orthodontic treatment protocol (Onyeaso, 2004; Ajayi, 2008). The complexity of the malocclusion tends to affect the quality of life of individuals and the need for orthodontic treatment (Anosike et al., 2010; Severine et al., 2018).

Several factors have been reported to play important roles in the development of malocclusion among individuals with Down syndrome and they include, mouth breathing, improper chewing, evidence of bruxism, tooth agenesis, midline deviation in the upper arch, a characteristic tongue thrust (resulting in anterior open bite and spacing of teeth), dysfunction of the temporomandibular joint, delayed eruption and/or exfoliation of both deciduous and permanent dentition, hypotonic ligamentary apparatus of the temporomandibular joint, developmental disturbances of the mandible (platybasia) and maxilla (midfacial complex), and the jaw relationships (Bangbose et al., 2014). Malocclusions in individuals with Down syndrome pose an additional obstacle to social acceptance and also compromises mastication and swallowing (Becker & Shapira, 1996).

Several researchers have reported prevalence of malocclusion among Down syndrome individuals of different age group, ethnic and racial background (Bauer et al., 2012; Rao et al., 2014; Rahim et al., 2014). Variation in the prevalence of dento-occlusal traits in Sudanese Down syndrome have been reported (Ibrahim & Abuaffan, 2015; Mahmous & Abuaffan, 2016). The few studies available in our environment on the dento-occlusal traits and skeletal anomalies among Down syndrome individuals have been carried out among only a particular ethnic group in the South West Nigeria (Oredugba, 2007; Bangbose et al., 2014). The aim of this present study was to determine the prevalence of malocclusion among a group of Down syndrome individuals in South-South region of Nigeria. This study will also assist to determine the possible effects of ethnic variation on the prevalence of malocclusion traits among this sample Down syndrome individuals in the South-South region of Nigeria. It will also provide information that will facilitate orthodontic treatment planning for Down syndrome in Benin City, South-South region of Nigeria.

MATERIALS AND METHODS

This cross-sectional study was conducted among 38 individuals comprising of 19 Down syndrome and 19 control individuals aged 10 -15 years of age (10 males and 9 females for both study groups). It was conducted in the Orthodontic unit of the University of Benin Teaching Hospital, (UBTH), Nigeria. The Down syndrome individuals were recruited from schools for special need within the Benin city metropolis. All the Down syndrome individuals were objectively karyotyped and confirmed to be Trisomy 21 using cytogenetic analysis. Clinical information of the control individuals was obtained from the records of pre-orthodontic patients of the orthodontic unit of the University of Benin Teaching Hospital, (UBTH), Nigeria. Ethical approval (ADM/E 22/A/VOL VII/1236) for this research protocol was obtained from the Hospital Ethic and Research Committee before data were collected. Informed consent was obtained from the parents and guardians of the Down syndrome individuals before they were recruited for the study. The inclusion criteria include; confirmation of the individuals to be Down syndrome using cytogenic analysis, individuals between 10-15 years of age and those who gave informed consent. Individuals with previous history of orthodontic treatment and those who had difficulty with neck stability were excluded

Clinical examinations of all the Down syndrome individuals were done under natural light in their classrooms. Mouth mirror, dental explorer and wooded spatula were used during the examination. The molar relationship was evaluated using Angle's classification (Angle, 1899). Angle class I is when the mesio-buccal cusp of the maxillary first permanent molar occludes on the buccal groove of the lower first permanent molar. Angle class II is when the mesio-buccal cusp of the maxillary first permanent molar occludes mesial to the buccal groove of the lower first permanent molar. It is class II division 1 when there is also flaring of the maxillary incisors with increase overjet with or without deep bite. In class II division 2, there is retroclination of the maxillary central incisors with deep overbite and tilting of the maxillary lateral

incisors. Angle class III is when the mesio-buccal cusp of the maxillary first permanent molar occludes distal to the buccal groove of the lower first permanent molar. A subdivision is classified when a class II or III molar relationship is present on one buccal segment and a class I molar relationship on the other buccal segment. The worst presentation is stated first while the side with the class I molar relationship is stated after the subdivision.

The incisor relationship was evaluated using the British Standards Institute classification (BSI, 1983). Class I incisor relationship is when the lower incisal edge occludes on the cingulum plateau of the upper incisor. It is described as class II when the incisal edge bite behind (palatal) to the cingulum plateau and class III when it bites anterior to the cingulum plateau. It is division 1 when the maxillary incisors are proclined with increased overjet or division 2 when the maxillary central incisors are retrocline with deep bite. Anterior crossbite or reverse overjet is when the lower incisors are labial to the maxillary incisors.

Incomplete overbite was recorded when there is lack of contact (but presence of overlap) between the maxillary incisors and the mandibular incisors. Anterior openbite was recorded when there is lack of overlap between the maxillary incisors and the mandibular incisors.

Posterior crossbite was considered when the buccal cusp of the upper tooth occluded lingual to the highest height of the buccal cusp of the opposing lower tooth.

Crowding was said to be present when there was overlapping of erupted teeth due to insufficient space or lack of space for teeth to erupt. Lack of interproximal contact between teeth in a range of 1mm or more within a segment was recorded as spacing.

Missing tooth were recorded when a tooth that should have been erupted considering the participants' dental development was missing in the arch. The facial profile was evaluated clinically in a profile view with the individual sitting in an upright position with the head positioned in the natural head position and the lips relaxed. The individual was made to look at a fixed distant object. It was by visual inspection. It was recorded as straight when there was harmonious relationship between the base of the nose and the chin. When the base of the nose appeared significantly forward, it was recorded as convex. A concave facial profile was when the chin appeared ahead of the base of the nose. Skeletal pattern relationship is the sagittal jaw relationship of the most anterior maxillary dento-alveolar segment in relation to the most anterior mandibular dentoalveolar segment (Salzman, 1996). The skeletal pattern (SP) was evaluated using the palpation method. A SP I was recorded when the maxillary dental base was just ahead of the mandibular dental base. It was class II when maxillary dental base was just ahead of the mandibular dental base and class III when the mandibular dental base was ahead of the maxillary dental base.

The intra-examiner reliability with the kappa test was 0.79 showing good reliability. The data was analysed using the International Business Machine (IBM) SPSS version 20. Statistical significance between frequencies of occurrence of malocclusion traits were evaluated using the chi-square test. Fischer exact test was used when an expected frequency presentation was <5. A statistically significant level was set at $p<0.05$.

RESULTS

The mean age for the participants were 12.6±2.1 years and 12.4±1.7 years for Down syndrome and control individuals respectively, as shown in table 1. There was no statistically significant difference ($p=0.078$) in the overall molar relationship as shown in table 2.

Table 1: Socio-demographic of the study population

Variable	Down syndrome (Mean ± SD)	Control (Mean ± SD)	*p* value
Age (years)	12.6 ± 2.1	12.4 ± 1.7	0.736§
Weight (kg)	42.6 ± 11.2	46.3 ± 13.3	0.368§
Height (m)	1.4 ± 0.1	1.5 ± 0.1	0.005§
BMI (kg/m^2)	21.2 ± 4.8	19.6 ± 3.2	0.244§

§= Fisher's exact test

However, bilateral class III molar relationship was more prevalent among Down syndrome (31.6%) when compared to control (5.3%). Unilateral class III molar relationship occurred in about 21.1% of Down syndrome and 5.3% among the control. On the overall, 52.7% of Down syndrome individuals

and 10.6% controls had class III molar relationship. Class I molar relationship (52.6%) was more prevalent among the control followed by class II molar relationship (21.1%%). Table 2 also shows that class III incisor relation (73.7%) and skeletal pattern III (73.7%) predominates among Down syndrome as against 26.3% and 21.1% among the control participants respectively. Class I (52.6%) and class II (21.1%) were more prevalent among the control participants as against Class I (31.6%) and class II (5.3%) among the Down syndrome participants, table 2. Majority of Down syndrome (63.2%) has anterior crossbite which was significantly (p=0.003) higher than the control with a frequency of 15.8% (Table 2).

Table 3 shows that posterior crossbite was present in 68.4% of Down syndrome (bilateral, 36.8%; and unilateral, 31.6%) as against 10.6% (bilateral, 5.3%; and unilateral, 5.3%) of control individuals, p=0.001. The frequency of occurrence of anterior open bite was not statistically different between both groups. Anterior open bite was observed in 26.3% of Down syndrome compared to 5.3% of control (Table 3). Spacing was more prevalent among control individuals (52.5%) than in Down syndrome individuals (21.1%) as show in table 4. The frequency of missing teeth among Down syndrome individuals was 21.1% (Table 4).

Table 2: Distribution of the anterior-posterior relationship

Features	Study Group		*p* value
	Down syndrome n (%)	Control n (%)	
Molar relationship			
Class I	6 (31.6)	10 (52.6)	0.078§
Class II	1 (5.3)	4 (21.1)	
Class III	6 (31.6)	1 (5.3)	
Class II Subdiv right	-	1 (5.3)	
Class II Subdiv left	2 (10.5)	2 (10.5)	
Class III Subdiv right	1 (5.3)	1 (5.3)	
Class III Subdiv left	3 (15.8)	-	
Incisor relationship		31.6	
Class I	4 (21.1)	10 (52.6)	0.007§
Class II	1 (5.3)	1 (5.3)	
Class III	14 (73.7)	5 (26.3)	
Class II div 1	-	3 (5.8)	
Anterior cross bite			
Yes	12 (63.2)	3 (15.8)	0.003*
No	7 (36.8)	16 (84.2)	
Facial profile			
Straight	3 (15.8)	10 (52.6)	0.006§
Convex	2 (10.5)	5 (26.3)	
Concave	14 (73.7)	4 (21.1)	
Skeletal pattern			
SP I	3 (15.8)	10 (52.6)	0.006§
SP II	2 (10.5)	5 (26.3)	
SP III	14 (73.7)	4 (21.1)	

Subdiv= subdivision; Div=division § Fisher's exact test, * Chi-square test, Statistically significant at *p* value<0.05.

DISCUSSION

The observations made in this study showed that malocclusion was more prevalent among Down syndrome when compared with control (normal) participants which corroborates results from previous researchers (Bauer et al., 2012; Bangbose et al., 2014; Marques et al., 2015). Down syndrome individuals in this study had predominantly class III incisal relationship (73.7%) when compared to the control participants with 26.3%. This is comparable with a previous study among Down syndrome in Nigeria (Bangbose et al., 2014).

Table 3: Distribution of the transverse and vertical dental-alveolar relationships

Features	Group		*p* value
	Down syndrome n (%)	Control n (%)	
Posterior cross bite			
Unilateral	6 (31.6)	1 (5.3)	0.001§
Bilateral	7 (36.8)	1 (5.3)	
Nil	6 (31.6)	17 (89.5)	
Anterior open bite			
Yes	5 (26.3)	1 (5.3)	0.182‡
No	14 (73.7)	18 (94.7)	
Incomplete over bite			
Yes	4 (21.1)	1 (5.3)	0.337‡
No	15 (78.9)	18 (94.7)	

§ Fisher's exact test, ‡ Chi-square test with Continuity Correction, Statistically significant at *p* value<0.05.

Table 4: Distribution of the spacing, crowding, and missing teeth

Features	Study Group		*p* value
	Down syndrome n (%)	Control n (%)	
Crowding			
Yes			
Upper	5 (26.3)	2 (10.6)	0.067§
Lower	2 (10.6)	3 (15.8)	
Both arches	4 (21.1)	-	
Nil	8 (42.1)	14 (73.7)	
Spacing			
Yes			
Upper mild	-	6 (31.4)	0.038§
Lower mild	2 (10.6)	-	
Upper and lower mild	2 (10.5)	4 (21.1)	
Nil	15 (78.9)	9 (47.4)	
Missing teeth			
Yes	4 (21.1)	-	0.113‡
No	15 (78.9)	19 (100.0)	

§ Fisher's exact test, ‡ Chi-square test with Continuity Correction, Statistically significant at *p* value<0.05.

A lesser percentage of incisor class III relationship (Down syndrome 55.9% and control 2.0%) was however reported by the same author (Bangbose et al., 2014). It was observed that the author had more participants less than 20 years of age in the study (Down syndrome 50, control 50) when compared to this present study. This could have accounted for the difference in the percentage observed. A high frequency of class III incisor relationship (60%) among 12-17 years has also been reported in a cross-sectional study conducted among Down syndrome in Sudan (Ibrahim & Abuaffan, 2015). Class I incisor relationship occurred more frequently among the control participants in this present study with a frequency of 52.6%, which also corroborate findings made by Bamgbose and colleagues (91.2 %) in a comparative study conducted among Down syndrome and control individuals in South-West Nigeria (Bangbose et al., 2014).

A total of 52.7% (bilateral and unilateral class III) of Down syndrome and 10.6% of control had class molar relationship. Class III molar relationship was more frequent among the Down syndrome participants while class I molar relationship (52.6%) was more prevalent among the controls. The high prevalence of Class III molar relationship among Down syndrome is similar to previous findings by preceding reports (Oredugba, 2007; Marques et al., 2015; Mahmoud & Abuaffan, 2016). This present study reported class I molar relationship (52.6%) to be more prevalent in control individuals as observed among non-DS (80.2%) in multicenter study conducted in South West Nigeria (Bangbose et al., 2014). Although this present study did not observe statistically significant difference

(p=0.078) in the molar relationship but reports by the author was statistically significant, p=0.001 (Bangbose et al., 2014). This difference could be related to larger study population, wider age range and ethnic variation. A higher frequency of occurrence of class III molar relationship was also reported by Marques and colleagues among Brazilians when compared to observations made in this current study (Marques et al., 2015). Racial difference could also be a factor to consider for the differences observed the occurrence.

Extra-oral examination in this current study revealed facial profile and skeletal pattern to be majorly concave and class III respectively with 73.7% among Down syndrome and 21.1% among control individuals, p=0.006. A significant difference in the prevalence of anterior crossbite was also observed to occur commonly in DS than control individuals (p=0.003). This finding is consistent with observations made by other authors (Bangbose et al., 2014; Mahmoud & Abuaffan, 2016). A deficient midface and anterior tongue positioning contribute to DS having concave facial profile, class III skeletal pattern and anterior crossbite (Oliveira et al., 2008; Alio et al., 2011). Muscle hypotonia tend to reduce the volume of the oral cavity, creating insufficient space for the tongue to occupy (pseudo macroglossia leading to the anterior tongue positioning observed among Down syndrome (Korbmacher et al., 2004).

In addition, this current study observed a higher occurrence of posterior crossbite (DS, 68.4% and control, 10.6%) and anterior open bite (DS (26.3%) and 5.3% in controls) among Down syndrome individuals. This trend is consistent with the study carried out by several other researchers (Bangbose et al., 2014; Marques et al., 2015; Mahmoud & Abuaffan, 2016). The preponderance of anterior open bite could be attributed to anterior tongue positioning which causes infra-eruption of the incisors This present study is at variance to a previous study that reported a less frequent posterior crossbite among DS (34.6%) when compared to normal population, 65.4% (Uchiyama, 1991; Marques et al., 2015).

This recent study shows that DS had more crowded dentition (58.0%) than control individuals 26.4%, which in keeping with findings observed among Down syndrome in Lagos (Oredugba, 2007) but at variance with observation made by another author (Marques et al., 2015).

While this current study revealed less spacing (21.1%) in DS than control individuals (52.5%), collaborating previous finding (Marques et al., 2015)., another author however has reported no difference in the frequency of occurrence of spacing (Oredugba, 2007)

Down syndrome individuals in this present study also had more missing teeth (21.1%) than the control individuals, which is consistent with findings from other researchers (Becker & Shapira, 1996; Oredugba, 2007)

The importance of race in relation to growth of the craniofacial structures which ultimately have impact on the pattern of skeletal relationship has been reported (Uchiyama, 1991). A variation could mean a tendency towards developing a particular form of malocclusion. Younger age groups have more risk of traumatic dental injuries which could increase their risk of development of malocclusion. It is important to note that variations in the frequency of the malocclusion traits observed between this current study and other authors may be attributed to the size of the study, the age range of the study participants, ethnic/racial difference and environmental factors.

CONCLUSION

This study reveals that Down syndrome individuals had significant higher prevalence of sagittal (skeletal pattern III, incisor class III relationship, anterior crossbite), transverse (posterior crossbite and anterior crossbite) and vertical relationships (anterior open bite) when compared to control individuals. The malocclusion traits most prevalent among Down syndrome in the descending order were; incisor class III, skeletal pattern III, posterior crossbite, anterior crossbite and the molar class III malocclusion. Orthodontists should therefore be aware that Down syndrome individuals have higher risk of developing severe malocclusion.

Therefore, it can be inferred that Down syndrome in Benin City, South-South Nigeria also has high prevalence of malocclusion traits as reported in South-West region of Nigeria. In spite of the varying degrees of mental sub-normality faced by these individuals, it is however important for them to also have the opportunity of receiving orthodontic care.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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