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Zizzi A, Piemontese M, Gesuita R, Nori A, Berlin RS, Rocchetti R, Carle F, Rubini C, Aspriello SD. Periodontal status in the Down's syndrome subjects living in central-eastern Italy: the effects of place of living.

Periodontal status in the Down's syndrome subjects living in central-eastern Italy: the effects of place of living

Abstract: *Aim:* The purpose of this study was to determine the influence of the place of living on periodontal status of 62 Down's syndrome (DS) subjects resident at home (DSH) or in specialized institutes (DSI) in central-eastern Italy. *Methods:* The demographic characteristics of the subjects and the periodontal variables were evaluated according to their living conditions. Descriptive analyses were conducted by stratifying subjects into three age groups (0–13; 14–22; >23 years), using medians and 25th–75th percentiles to summarized data. Comparisons between DSH and DSI subjects were performed using Wilcoxon rank sum test. The effect of demographic and clinical variables on periodontal status was evaluated by means of quantile regression analysis. *Results:* No significant differences resulted between DSH and DSI patients, when compared for gender, age and mental retardation. No significant differences were found in the periodontal variables for the subjects with 0–13 years, while DSI subjects between 14 and 22 years of age presented higher levels of plaque index, probing depth, clinical attachment loss and a lower number of surviving teeth compared to DSH subjects. When DSI and DSH groups ≥23 years of age were compared, no differences were observed in the periodontal conditions except for PI and the number of surviving teeth. Age, body mass index and severe mental retardation were found to be significant predictors of periodontal conditions. *Conclusions:* Institutionalization has a negative effect on surviving teeth number of Down's syndrome subjects. Furthermore, the home care seems to produce benefits on the periodontal conditions of DSH 14–22 years of age.

Key words: dental care; Down's syndrome; institutionalization; periodontal status

Introduction

Down's syndrome (DS) is one of the most common human genetic disorders, usually caused by the presence of an extra chromosome-21 (1). It clinically manifests as an illness rich in physical and odontostomatological aspects when compared with the healthy population, which could affect social acceptability and quality of life (2).

It is commonly observed that patients with Down's syndrome are abnormally susceptible to infections and present a high frequency of serious periodontal disease (3).

Signs of alveolar bone loss, mainly localized in the mandibular region, have been reported in DS subjects as early as 11 years of age (4). In addition, it has been reported that the same amount of plaque accumulation induces a faster and more extensive gingival inflammation in the deciduous dentition in DS children when compared to healthy control children (5). A higher prevalence of advanced periodontal diseases has been reported in DS subjects with rates varying between 60% and 100% for those under 30 years of age (6, 7) and 65% for those over 35 years (8). Some authors reported bone loss of 5 mm or more in 70% of DS patients, who had a mean age of 24 years. Periodontal diseases have a high prevalence in DS subjects, which negatively affects and compromises the quality of their life (9, 10).

Several studies reported that DS institutionalized subjects (age: 14–22 years) have a higher susceptibility to periodontal diseases when compared to healthy subjects (6, 11) and exhibit a higher prevalence of periodontitis than DS individuals resident at home (12, 13). Thus, the purpose of this study was to determine the influence of the place of residence on periodontal status of 62 Down's syndrome (DS) subjects resident at home (DSH) or in specialized institutes (DSI) in central-eastern Italy.

Materials and methods

Study population

The study included 62 individuals affected by trisomy 21: 31 DSH and 31 DSI. The subjects were referred for oral examinations and dental care at the Department of Clinical Specialty and Dental Science, Polytechnic University of Marche, Ancona, Italy, and O.U. of Odontostomatological and Special Surgery, United Hospital of Ancona, Ancona, Italy, from 2001 to 2011. This project was approved by Committee of Ethics in Research, the families of the subjects were informed regarding the aims and scopes of the study, and an informed consent was signed.

Parents of DS individuals participated in the interviews at each point of data collection and completed the self-administered questionnaires. The inclusion criteria of subjects in this study were as follows: (i) good general health; (ii) not having received periodontal surgery in the previous 2 years; (iii) not having received antibiotic, corticosteroid or non-steroidal anti-inflammatory drugs within the previous 6 months; (iv) not having lost teeth because of traumatic events; (v) institutionalization of DS subjects at least for 3 years. The mother was the primary respondent throughout the study period.

Clinical and periodontal examinations

For all patients, the independent variables included a series of clinical and demographic characteristics: body mass index (BMI), level of mental retardation and place of residence. We collected the subjects' height and weight for BMI determination. The mothers of the subjects completed a three-page self-administered questionnaire, which was divided into three sections. The first section contained demographic variables such as age, gender, race, religion and spoken and written languages, parent's age, family education, family status (living environment), family history of DS. The second section contained specific questions directed at assessing the DS subjects' qualitative life, such as whether their child participated in general group activities which involved other children, both for DSH and DSI subjects, general health, height and weight history, and their oral hygiene modalities and routine, while the final section referred to the source and mother's perception of the quality of the information provided during oral counselling.

To evaluate the periodontal conditions, the following measurements were performed on all patients by one of us (S.D.A.), blinded to the groups, using a periodontal probe [15 mm University of North Caroline (UNC-15) periodontal probe; Hu-FriedyA, Chicago, IL, USA]: (i) plaque index (PI) (14); (ii) gingival index (GI) (15); (iii) bleeding on probing (BOP) according to the sulcus bleeding index (16) and scored as 0 = no bleeding, 1 = point bleeding within 30 s, 2 = immediate overt bleeding; (iv) probing depth (PD) measured from the gingival margin to the bottom of the pocket with a calibrated periodontal probe to the nearest millimetre (diameter of probe tip = 0.5 mm); (v) clinical attachment level (CAL) measured in mm from the cemento-enamel junction (CEJ) to the bottom of the pocket; (vi) bone loss (BL); (vii) number of teeth present. The periodontal examinations were performed with a UNC-15 periodontal probe to the nearest 0.5 mm and same manual pressure of 0.3 N. The periodontal BL severity was examined and categorized from a standardized orthopantomograph. The extent of bone loss was established using the modified Hugoson and Jordan classification method, whereby the distance from the CEJ to the tooth apex was measured (17). This measurement was divided into thirds (1/3, 2/3 and >2/3 of the root length) and used as a scale to assess the amount of BL measured from the crest of the alveolar bone to the CEJ. The most severe bone loss was used to classify the status of teeth as follows: P0: 0, none; P1: 1/3, mild; P2: 2/3, moderate; and P3: >2/3, severe. CAL, PD, BL and the number of surviving teeth were considered to evaluate periodontal status of DS subjects. The number of teeth present did not consider the third molars, which were excluded from clinical and radiographic measurements.

During the oral examination, a preformed questionnaire, provided by the psychological team of our hospital institution, was administered by the same examiner (S.D.A.) blinded to the groups. The questionnaires were then analysed by the psychological team, and IQ level for each patient was scored as mild, moderate or severe (Table 1). These scores are intended to provide more detailed information on cognitive abilities and mental retardation, and are not intended to provide a diagnosis of mental disorders. The questionnaire measured intelligence quotient (IQ) level of each subject using the Wechsler intelligence scale for children (WISC) for 5- to 16-year-old subjects

Table 1. **Main clinical features of DS subjects**

Variable	Living at home	Living in institutions	*P*
Gender [*n* (%)]			
Male	14 (31.3)	16 (38.6)	0.275*
Female	27 (68.7)	25 (61.4)	
Mentally retarded [*n* (%)]			
Mild	16 (38.6)	14 (31.3)	0.854*
Moderate	12 (30.1)	12 (30.1)	
Severe	14 (31.3)	15 (33.6)	
Body mass index [median (25°–75° percentile)]	28 (25–30)	25 (24–28)	<0.001**
Age [median, (25°–75° percentile)]	19 (13–26)	20 (12–27)	0.090**
[median (range)]	19.8 (10–37)	18.2 (9–35)	

*Fisher's test.
**Wilcoxon test.

and Wechsler adult intelligence scale for subjects older than 16 years.

Statistical analysis

Subjects' characteristics according to their living conditions were evaluated by the chi-square test or the Fisher's exact test. The Shapiro–Wilk test was performed to verify whether the quantitative variables that described the periodontal status of the subjects were normally distributed. As variables resulted in non-normal distribution, the Wilcoxon test was applied to compare the periodontal conditions between individuals living in institutions and at home. Descriptive analyses were conducted by stratifying subjects into three age groups (0–13; 14–22; >23 years of age). Results were expressed as median and 25th–75th percentiles. Level of significance of 5% was defined; as 15 comparisons were performed, the Bonferroni's adjustment was applied to the chosen level of significance.

The quantile regression analysis was used to evaluate the effects of demographic and clinical variables (age, gender, place of residence, mental retardation and BMI) on periodontal status, using teeth number, PD, CAL and BL as dependent variables. The 95% confidence intervals of the coefficients were evaluated, and the estimated parameters were considered statistically significant when the intervals did not include zero values. All the analyses were performed using the software R PACKAGE, version 10.1 (R Foundation for Statistical Computing, Vienna, Austria). Significance was set at $P < 0.05$.

Results

Table 1 shows clinical and demographic characteristics of patients according to their living condition – no significant differences were observed between individuals living in institutions and at home when compared for gender, age and level of mental retardation. The DSI subjects with 14–22 and ≥23 years lived in specialized institutes at least for 5 years. Subjects living at home, however, had a significantly higher BMI than institutionalized subjects ($P < 0.01$).

As evidenced by self-administered questionnaire, oral hygiene education received by DSH and DSI subjects was the same and consisted of modified Bass technique three times a day with medium brushes changed about every 3 months. However, DSI subjects showed an irregular oral hygiene daily routine.

Table 2 shows the results of periodontal status analysis. No significant differences were found in the periodontal variables for the subjects between 0 and 13 years, while institutionalized subjects between 14 and 22 years of age were characterized by higher levels of PI, GI, BP, PD, CAL and a lower number of teeth compared to subjects of the same age living at home (Table 2).

When institutionalized and home resident subjects >23 years of age were compared, no differences were found in the periodontal status except for the PI and the number of surviving teeth. BL was present in all DS groups and was not significantly different between DSH and DSI subjects.

The effects of clinical and demographic variables on the periodontal status are shown in Table 3. Age resulted in a

Table 2. **Clinical outcomes according to DS subjects living at home or in institutes (Wilcoxon test)**

	≤13 years			14–22 years			≥23 years		
	Living			Living			Living		
Variables [median (25°–75° percentile)]	Home (*n* = 12)	Institute (*n* = 15)	*P*	Home (*n* = 14)	Institute (*n* = 14)	*P*	Home (*n* = 15)	Institute (*n* = 12)	*P*
Plaque index	0.0 (0.0–1.0)	0.0 (0.0–1.0)	0.472	1.0 (0.8–1.0)	3.0 (1.0–4.0)	<0.001	1.0 (0.6–2.0)	2.6 (1.0–3.4)	<0.001
Gingival index	0.5 (0.3–1.0)	0.7 (0.2–1.2)	0.532	1.3 (0.8–2.3)	2.9 (2.2–3.8)	<0.001	2.6 (1.3–3.1)	3.2 (1.6–4.0)	0.374
Bleeding on probing	0.5 (0.4–1.3)	0.4 (0.2–1.0)	0.451	0.6 (0.2–1.4)	2.0 (1.8–2.0)	<0.001	1.5 (1.0–2.0)	2.0 (1.0–2.0)	0.318
Probing depth (mm)	2.9 (2.0–4.0)	3.2 (2.1–4.0)	0.471	3.4 (3.0–4.3)	5.7 (3.6–5.8)	<0.001	5.5 (3.5–6.1)	6.2 (4.0–6.8)	0.446
Clinical attachment level (mm)	2.8 (2.6–3.5)	3.0 (3.0–4.0)	0.425	2.8 (2.5–3.8)	4.7 (3.2–5.5)	<0.001	4.5 (4.0–6.0)	5.0 (4.0–5.0)	0.271
Bone loss	0.9 (0.4–1.3)	1.2 (0.3–1.4)	0.311	1.2 (1.0–2.0)	2.0 (1.0–2.3)	0.031	2.2 (1.8–2.0)	2.4 (2.0–3.0)	0.434
Number of teeth present	25 (23–26)	24 (24–25)	0.255	22 (20–26)	19 (16–22)	<0.001	17 (16–20)	12 (8–14)	<0.001

Table 3. **Effects of demographic and clinical variables on periodontal status. Results of quantile regression analysis**

	Teeth number			Probing depth			Clinical attachment loss			Bone loss		
		95% CI			95% CI			95% CI			95% CI	
Independent variables		Lower limit	Upper limit		Lower limit	Upper limit		Lower limit	Upper limit		Lower limit	Upper limit
Age (years)	−0.59	−0.68	−0.50	0.06	0.03	0.08	0.09	0.06	0.12	0.06	0.04	0.09
Gender (F versus M)	0.03	−1.00	1.06	−0.14	−0.46	0.18	0.08	−0.20	0.36	−0.05	−0.30	0.19
Living conditions (Institution versus home)	−3.51	−4.71	−2.31	0.35	−0.05	0.74	0.21	−0.25	0.68	0.26	0.00	0.51
Mental retardation												
Moderate versus mild	−0.17	−1.40	1.06	0.26	−0.20	0.72	0.21	−0.27	0.70	0.18	−0.24	0.61
Severe versus mild	−0.48	−1.82	0.85	1.15	0.68	1.61	1.15	0.78	1.51	0.5	0.09	0.91
BMI (Kg/m^2)	−0.09	−0.28	0.10	0.05	0.002	0.11	0.01	−0.05	0.07	0.05	0.004	0.09

significant predictor of all the dependent variables: the higher the age, the higher the number of missing teeth, and higher PD, CAL and BL were observed. Institutionalization had a significant negative effect on the number of surviving teeth. A severe level of mental retardation was significantly associated with increased PD, CAL and BL. An increase in BMI also resulted in increased CAL and in reduced number of teeth. Gender and moderate level of mental retardation had no significant effect on the periodontal status.

Discussion

Cross-sectional as well as longitudinal studies indicated that the prevalence of periodontal diseases in individuals with DS under 30 years of age is extremely high, with often a high percentage of gingival bleeding (5, 18–20). A positive association between age and periodontal disease in DS subjects was highlighted by two previous studies (21, 22). They found that BL and PD were age dependent in young adults with DS. Modéer *et al.* (4) reported signs of alveolar bone loss mainly localized in the mandibular region, in DS subjects as early as 11 years of age. The prevalence of bone loss of 5 mm or more was about 70% in DS individuals with a mean age of 24 years (9) and 65% in those with age higher than 35 years (8). Longitudinal studies reported that the progression of periodontal diseases was high in young DS subjects (4, 18, 23, 24); progressive periodontitis was found in adult DS subjects, but it was not shown in younger people (25).

In our study, age was an important factor influencing all the variables and was used to describe the subjects' periodontal status. As the subjects' age increased, the periodontal status became worse, perhaps due to the occurrence of continuous and numerous inflammatory and angiogenetic events, linked also to systemic conditions as diabetes (26, 27), obesity, metabolic syndrome (28) and cardiovascular diseases (29), to which an individual might be exposed and which might damage the periodontal tissues. In addition, inflammation response and alterations of the immune system related to periodontitis induce and increase the autophagy phenomenon mediated by mitochondrial dysfunction, characterized by lower CoQ10 levels and citrate synthase activity, together with high levels of reactive oxygen species (ROS) production (29, 30).

Furthermore, in our study, we found that BMI was positively associated with CAL and negatively with teeth number in DS subjects. Obesity, sometimes related to a metabolic syndrome, was significantly associated with increased severity extent and self-amplification of inflammation in periodontal diseases (31), through a mitochondrial dysfunction, ROS production, cytokines activation (28, 32).

Furthermore, Cutress *et al.* (12) found that the oral hygiene index score was significantly associated with the periodontal index score for all groups considered (healthy subjects, metal retarded and DS subjects), to show that when the oral hygiene became worse, more evident periodontal problems were observed. However, no significant difference in the Oral Hygiene Index score between DSI and DSH subjects was found in the mentioned study and what suggests that the periodontal disease could be associated with factors other than, or in addition to, oral hygiene for DS subjects. In our study, we found that severe level of mental retardation was associated with increased PD, CAL and BL in DS subject, probably due to poor oral hygiene procedures.

Several authors found out that the alterations in the immune response may contribute to the development of periodontal disease and bone loss, which mostly lead to loss of the dentition, with or without exacerbation of the inflammation process (5, 33–36).

The data from our study agreed only partially with the above mentioned findings. In fact, this study found that institutionalization negatively affected the number of surviving teeth, underling an important influence of the living condition on the number of teeth. There was general agreement that DSI subjects exhibit a higher prevalence of periodontitis than other institutionalized mental retarded subjects (8, 12, 13). The prevalence of periodontitis was significantly lower in DSH than in DSI subjects, as was also observed in this study.

DSI subjects had an assistance provided by the socio-medical staff, whereas DSH patients had a family structure with father, mother and/or siblings, sometime grandmother or grandfather and other parents, that working part-time or full-time or not working (data not showed), allowing a continued assistance. Theoretically, oral hygiene modalities/routine was the same for DSH and DSI subjects, but practically, a major attention for a regular and accurate performance of the oral hygiene modalities was assured by the family. In our opinion, this family environment constitutes a fundamental stimulus to the care of one's own relatives and consequently to a more accurate, careful, regular oral hygiene and systematic preventive dental care. This potential improvement in dental hygiene and oral health may be effective in suppressing the progression and the severity of periodontal diseases in DSH patients (*22*, 35, 37). In fact, in this study, the place of residence plays an important role on the number of surviving teeth. We suggest that the periodical removal of microbial biofilm and a rigorous educational family plan for oral hygiene of DS subjects could result both in the removal of the inflammatory component and in the reduction of periodontal lesions. BMI, severe level of mental retardation and age influenced the periodontal status of DS individuals, and their effects were independent from institutionalization; in fact, we found that the living condition did not affect PD, CAL and BL in DS subjects. As Down's syndrome is one of the most frequent congenital disorders, additional investigations should be conducted to elucidate whether further etiological factors are involved in the development of periodontal disease in these patients.

Clinical relevance

Scientific rationale for the study

Patients with Down's syndrome are accepted abnormally susceptible to infections and serious periodontal diseases. Studies demonstrated no significant difference in the oral hygiene index score between Down's syndrome subjects institutionalized and resident at home.

Principal findings

We highlight the importance of the family environment that constitutes a fundamental stimulus to the care of the oral hygiene of the patients with Down's syndrome.

Practical implication

Accurate family oral hygiene plan and systematic preventive dental care decrease the risk of progression and severity of periodontal diseases in these patients.

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