Life-conditions and anthropometric variables as risk factors for caries in children in Ladakh: A cross-sectional survey.

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Abstract

Backgrounds The aim of this survey was to evaluate the severity of dental caries among Ladakh children and its association with anthropometric and background variables. Methods This cross-sectional epidemiological survey was conducted on Ladakh schoolchildren divided into four age groups (<6, ≥6<11, ≥11≤14 and >14 years of age). A total of 1474 schoolchildren (607 males 41.18% and 867 females 58.82%) were examined. Actual dental caries prevalence (dt/DT) and gingival bleeding were recorded by four calibrated examiners. An ad hoc questionnaire evaluated general health, eating habits, oral hygiene and the self-perception of oral conditions. Height, weight, waist circumference, heart-rate and oxygen-saturation were also collected. Responses to questionnaire items were treated as categorical or ordinal variables. Relation between children's caries data, gingival bleeding, gender, Body Mass Index (BMI) following the International Obesity Task Force, waist circumference and questionnaire items were assessed using the Kruskal–Wallis test. Conditional ordinal logistic regression was used to analyse associations among caries severity, gender, BMI, waist circumference, oxygen saturation and questionnaire. A forward stepwise logistic regression procedure was also assessed to estimate the ORs of gingival bleeding prevalence and the covariates derived from examination or questionnaire. Results Caries was almost ubiquitarian with only 10.04% of caries-free children (dt/DT=0). Caries severity, in both primary and permanent dentitions was statistically significantly related to gender, waist circumference, BMI, oral hygiene frequency and self-reported chewing problems ($p<0.01$ in both dentitions). An increasing relative risk for caries in permanent dentition compared to caries-free subjects was observed in children with a low BMI (RRR=1.67, 95% CI=1.54/2.83 for subjects with 1-3 caries lesions and RRR=1.52, 95% CI=1.36/1.74 for subjects with more than 3 caries lesions); also children with reduced waist circumference had a higher relative risk to have 1-3 caries lesions (RRR=2.16, 95% CI=1.84 / 2.53) and an even higher risk to have more than 3 caries lesions (RRR=4.22, 95% CI=3.33 / 5.34). Conclusion A significant impact of untreated caries lesions was observed; low BMI values and reduced waist circumference showed to be the main caries risk predictors. Preventive and intervention programmes should be implemented to improve children's oral health living in Ladakh.

Background

Ladakh is a region administered by India, covering an area slightly larger than Croatia; it is part of the larger region of Kashmir and Jammu, which has been the subject of dispute between India, Pakistan, and China since 1947. Ladakh, which became a union territory on October 2019, comprises two districts namely Leh, with a Buddhist majority, and Kargil, the Islamic district. It is surrounded by the Great Himalayan mountains facing south, Karakorum towards west and Tibet towards east and for this geographical condition, the Region is isolated by the snow for about 9 months a year. Its population in 2020 is estimated to be about 280 thousand inhabitants (last census 2011: 274.289), with a population density of three people per square kilometer; the main spoken language is called Ladakhi, a Tibetan language. Agriculture is the core of both society and economy with a mean per capita income in 2010 of 768 US dollars. Education is free of charge and compulsory from the age of 6 to 14 years [1]. Indian

Government reports Ladakh to be one of the districts that are below standards regarding health services and conditions [2]. The complex terrain and diverse topography of the plateau provides a unique climate. It has rarefied air and low atmospheric pressure, with an oxygen content equivalent to two third of that at sea level. It has strong solar radiation and long hours of sunlight exposure with a significant difference in temperature between day and night. The whole year can be divided into two distinct dry and wet seasons. In winter and spring, there is little rain and frequent strong winds, with a lower oxygen content in the atmosphere. The high altitude, above 9000 ft, is responsible for cold weather, a limited diet, a limited availability of drinking water and the poor socioeconomic conditions, factors affecting the population's wellbeing [3-5]. Low obesity rates, physical growth patterns in height and arm circumference were also observed in highlander children and adolescents, effects of altitude on human body [6,7]. Nevertheless, malnutrition was more frequent in Jammu and Kashmir than in Ladakh [8].

The Italian National Association of Dentists Foundation (ANDI) has among its main aims to improve the quality of life of populations with socio-economic inequalities in various parts of the world, as the population living in the Zanskar Valley of Ladakh. Dental care is limited to small dental clinics, as at the medical center in Padum (CHC, Community Health Center). During summertime, when the valley is accessible, teams of volunteers from ANDI foundation work as dentists at the Padum's facility and promote oral health in schools.

At the best of Authors' knowledge, no data of Ladakh population's oral health are available in literature. Studies have been carried out in the past to assess the health of Tibetan refugees. In Indian troops, dryness of mouth was experienced by the dental officers of the Indian Army working in high altitude areas, which probably has an effect on salivary volume and oral health [9].

The aim of the present survey was to assess the oral health conditions of a large sample of the children population aged from 5 to 17 years living in Ladakh and to evaluate the association of oral variables with anthropometric measures, general health variables and life-style behaviors.

Methods

The survey was planned as a cross-section evaluation. The study was conducted in Summer 2019. The study population comprised schoolchildren aged 5-17 years.

Study area and population

The study was carried out from July to August 2019 in Zanskar Valley (Ladakh): in Padum city, in some Buddhist monasteries and in some rural areas. The content of fluoride in the water of the examined areas was ≤0.02 ppm/l. The total schoolchildren population aged 5-17 years amounted to 2,407 children. The study gained the approval of all the schools' authorities. Due to language problems and the low literacy rate of the population, parents or guardians verbal approval was obtained for children's participation.

Methods

Due to the large number of subjects to be examined, the number of raters was set at four. The team received training and inter-examiner reliability was assessed before the start of the study; sensitivity, specificity, percentage agreement and kappa statistics were recorded. Inter-examiner reliability ranged from 0.75 to 0.84 (K-Cohen) for sound and from 0.82 to 0.88 for caries lesions. Intra-examiner reliability ranged from 0.82 to 0.90 for sound teeth and from 0.84 to 0.91 for caries lesions. One examiner (EC) served as benchmark and conducted the theoretical and calibration sessions. During calibration, the team of examiners was also trained to measure and record the anthropometric indices. Dental caries prevalence (dt/DT) and severity (number of lesions) was recorded with caries at the dentinal lesion level [10]. Every subject was examined using: a plain mirror (Hahnenkratt, Königsbach, Germany) and the WHO CPI ballpoint probe (Asa-Dental, Milan, Italy), under standard light. No bitewing radiographs or fiber-optic trans-illumination were used. The presence of gingival bleeding after probing was evaluated only six teeth [11].

An *ad hoc* questionnaire was build-up to assess general health, eating habits, oral hygiene and the self-perception of oral conditions, based on previous surveys [12-15]. Direct face to face interviews were conducted with at least one parent of the children under the age of 12, while older children were asked to answer a self-administered questionnaire. Five items were related to general health: height, weight, waist circumference, heart-rate, oxygen saturation; ten items were related to dietary habits as the consumption of fresh fruit, biscuits, cakes, jam/honey, sweets/candy, meat, cheese, rice, chewing gum, soft drinks, sugared drinks; three items were related to hygiene habits as frequency of oral hygiene, use of a toothbrush and the perception of oral conditions.

The height (cm) was measured using a portable stadiometer (Seca 700, DE, Seca.com) asking the children to stand upright with the back (head, buttocks and heels) touching the device, wearing the school uniform and no cap or shoes were admitted; the weight (Kg) was also measured using a digital weight scale (Seca Clara 803, Seca, DE Seca.com). The waist circumference as the midway between lower ribs and the iliac crest was measured in cm after asking the children to stand with their arms wide open and feet positioned close together. The body mass index (BMI) was calculated dividing the weight by the height squared (kg/cm^2). Oxygen saturation and heart-rate were measured using a portable pulse oximetry device (Mindray PM-60, Mindray Medical Italy S.R.L).

Statistical analysis

Data were entered into a database (Excel 2018; Microsoft Corporation, Redmond, WA, USA). Statistical analyses were performed using Stata® 16.0 software (http://www.stata.com). Responses to questionnaire items were treated as categorical or ordinal variables. The BMI data and waist circumference were then considered by the ethnicity of the population, re-coded using the International Obesity Task Force [16-19] and then categorized into three categories each. Oxygen saturation data was divided in two classes under 90% and above 90% [20].

Mean caries data, BMI, waist circumference and oxygen saturation were calculated by age groups (<6,≥6<11,≥11≤14 and >14 years of age). The relation between children's caries data, gingival bleeding, gender, BMI, waist circumference and questionnaire items were assessed using the Kruskal–Wallis test and a linear trend was calculated to aid the interpretation of data to determine if the measurements indicate an increasing or decreasing trend. Caries severity was evaluated separately for primary and permanent dentition following the distribution frequencies as follows: dt/DT=0 (caries-free subjects), low caries severity dt in the range between 1 and 5 lesions, and DT in the range between 1 and 3 lesions, high caries severity dt >5 and DT >3 caries lesions. Conditional ordinal logistic regression was used to analyse associations among caries severity level (dt/DT), gender, BMI, waist circumference, oxygen saturation and questionnaire items. The Akaike information criterion (AIC) was used to measure the goodness of fit of the statistical model. Multicollinearity might sometimes cause problems with regression results. This problem was solved using the DFBETA command in Stata, dropping the information that have too much influence on the regression line [15, 21].

A forward stepwise logistic regression procedure was also assessed to estimate the ORs of gingival bleeding prevalence and the covariates derived from clinical examination or questionnaire data.

Results

Overall, 1474 children (61.23% of the population) were examined (table 1), 607 males (41.18%) and 867 females (58.82%). The gender ratio was statistically different between living areas stratified by age group ($c^2_{(6)}$=56.62 p<0.01). Caries was almost ubiquitarian in the examined population with only 10.04% of children without caries lesions (dt/DT=0) as is possible to read in table 2. The highest mean number of caries lesions affecting primary dentition was recorded in younger groups (below 6 years of age and ≥6<11 years of age), as in permanent dentition the highest values were observed in the oldest age group. Caries severity, both in primary and permanent dentitions was statistically significantly related to gender, waist circumference, BMI, oral hygiene frequency and self-reported chewing problems (p<0.01 in both dentition), while oxygen saturation was statistically significantly related to caries severity in permanent dentition (table 3, 4). For these variables, significant linear trends (p<0.05) of caries severity were found in all exposure categories.

Estimates related to caries severity in primary and permanent dentitions according to gender, waist circumference, BMI, oral hygiene frequency, self-reported chewing problems, oxygen saturation and sugared foods and drinks consumption (the latter two related to permanent dentition) are displayed in Table 5 without outliers. All the models were statistically significant (p<0.01). An increasing relative risk for caries in permanent dentition compared to caries-free subjects was observed in children with a low BMI (RRR=1.67, $_{95\%}$CI=1.54/2.83 for subjects with 1-3 caries lesions and RRR=1.52, $_{95\%}$CI=1.36/1.74 for subjects with more than 3 caries lesions); children with reduced waist circumference also had a higher relative risk of having 1-3 caries lesions (RRR=2.16, $_{95\%}$CI=1.84/ 2.53) and an even higher risk of having more than 3 caries lesions (RRR=4.22, $_{95\%}$CI=3.33/5.34). The goodness of fit (AIC criterion) was 4012.67.

Table 6 presents the OR estimates via the forward procedures in logistic regression by gingival bleeding. Subjects with reduced waist circumference were found to have twice the risk of gingival bleeding; also subjects with reduced oxygen saturation showed an increased risk of gingival bleeding (OR=1.75 $_{95\%}$CI=1.60 / 2.44).

Discussion

This is the first epidemiological survey carried out in an isolated valley of the remote region of Ladakh, which contributes to the characterization of oral health of a particular population of children living in an area where environmental conditions are extremely difficult due to clime and isolation. About two-thirds of the entire school population living in this region was examined at school for oral conditions, weight and height, waist circumference, Oxygen saturation, heart-rate and dietary and oral hygiene habits. Findings show caries as a very high prevalence disease for all age groups, of both gender and from different living areas. Females were more prevalent in all age groups compared to males; in the oldest group (>14 years) especially, males represented less than a third of the sample. Two different hypothesis can be done to explain this gender disparity: early school leaving of males caused by their involvement in work activities, as reported in previous studies [22,23] or their transfer in more prestigious schools outside the Valley, as families prefer to invest on the education of the male children than females [24]. For both dentitions, caries experience was high and entirely due to caries prevalence since filled teeth were few in all age groups. Scarce data are available regarding caries in children population with similar background characteristics. While Nepalese schoolchildren showed in both dentitions a high caries prevalence with values lower than those recorded in Ladakh [25], caries prevalence in Mongolian adolescents was higher, although the sample size was quite reduced [26]. Caries severity as the number of dentine caries lesions for both dentitions was associated to gender, waist circumference, BMI, oral hygiene frequency and self-reported chewing related problems. A quite high number of papers investigated the association between caries and anthropometric variables [13, 27-29]. Children and adolescents living at high altitude present lower growth patterns such as weight, height, and body circumferences than their counterparts living at sea level [5]. The Body Mass Index provides a convenient measure of a person’s fatness. The BMI proposed by the International Obesity Task Force (IOTF) was used to assess the prevalence of child overweight, obesity and thinness, since it provides more effective values of thinness especially in populations with a high prevalence of under-weight children [19]. No agreement is reported in literature regarding the relationship between BMI and dental caries due to the effect of confounders and effect modifiers [27]. Furthermore, in the majority of the studies, the BMI was calculated according to the World Health Organization guidelines. Although evidence of the coexistence of obesity and dental caries has been reported, as the same risk factors are shared, a U-shaped relationship between severe dental caries and the two ends of anthropometric measures has been reported in Chinese children [28]. Dental caries was more prevalent among low weight Indian children compared to normal weight and overweight-obese children [29]. According to these findings, children from Ladakh in the thinness BMI category and with a low waist circumference present a higher risk rate of caries than their peers with normal or high anthropometric variables. Waist circumference as well as BMI index, have shown to predict risk factor

clustering of cardiovascular disease and coronary artery disease [30,31]. Waist circumference was also associated to gingival health: children with a reduced circumference show a double risk rate of bleeding on probing compared to normal or high values. Obesity was related to increased inflammatory activity in gingival fluid [32] and obese children with Type 2 diabetes show a trend towards poorer oral health compared to normal weight and obese children without diabetes [33]. As far as the Authors know, this is the first paper that found and association between gingival health and low anthropometric values.

Poor oral hygiene habits are recognized as a risk factor both for caries and gingivitis in children and adults [12, 14 34, 35]. Behavioral changes in childhood in relation to hygiene habit can have an important influence on the oral health status of future adults [35]. About a quarter of children in Ladakh, both with primary and permanent dentition, brush their teeth less frequently than once a day and this poor habit increases the risk rate for caries, especially in younger children. Both pre-school children as well as adolescents who brushed their teeth more than once daily show less caries experience than those who brushed their teeth once per day [36,37].

Conclusion

The present data highlight the need of the restorative treatment emphasized by the significant impact of untreated dental caries on daily activities such as chewing, as previously reported [23,38]. Other self-reported health-related quality of life variables such as the satisfaction or the discomfort created by smiling were investigated, but no association with caries was found, probably because the aesthetics concern is not particularly felt in this ethnic group.

The present survey highlight to what extent oral health can be considered a burdensome issue in this children population as a significant impact of untreated caries lesions was observed. Preventive and intervention programmes should be implemented to improve children's oral health living in Ladakh.

Abbreviations

dmft: decayed, missed, filled teeth (primary dentition); DMFT: Decayed, Missed, Filled Teeth (permanent dentition); CPI: Community Periodontal Index; RRR: Relative Risk Ratio; 95%CI: 95% Confidence Interval; BMI: Body Mass Index; IOTF: International Obesity Task Force; WHO: World Health Organization; ORs: Odds Ratio

Declarations

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Availability of data and materials

All data generated or analyzed during this study are included in this published article (and its additional files).

Authors' contributions

MGC: designed the survey, performed the papers validity assessment and drafting the manuscript; FC: performed the data analysis, realized tables and figure and contributed to write the manuscript; EC: participated to the survey, data collection; DA: performed data collection; PG: help to organized the survey; GC: designed the survey, checked data analysis and drafting the manuscript. All authors read and approved the final version of the manuscript.

Ethics approval and consent to participate

No official Ethical committee was present in the area of the survey. The study proposal was submitted to the authorities of the Zanskar Health Care & Sowa Rigpa Research Institute and its coordinator the Lama Zopta gave the approval for the study. Each school involved in the survey gave also the approval. Due to language problems and the low literacy rate of the population, parents or guardians verbal approval was obtained for children's participation.

Consent for publication

Not Applicable

Competing interests

The authors declare that they have no competing interests. There are no financial completing interests as we have not received any grants. The authors alone are responsible for the content and writing of the paper.

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Tables

Table 1. Sample distribution according to gender and living areas, stratified by age groups.

Age groups	Gender	Living areas			
		Padum *n (%)*	Rural areas *n (%)*	Monastery *n (%)*	Total *n (%)*
<6 years	Males	77 (27.30)	45 (15.96)	2 (0.71)	124 (43.97)
	Females	84 (29.79)	48 (17.02)	26 (9.22)	158 (56.03)
≥6<11 years	Males	123 (25.57)	68 (14.14)	19 (3.95)	210 (43.66)
	Females	144 (29.94)	93 (19.33)	34 (7.07)	271 (56.34)
≥11≤14 years	Males	116 (25.95)	61 (13.65)	15 (3.35)	192 (42.95)
	Females	147 (32.89)	103 (23.04)	5 (1.12)	255 (57.05)
>14 years	Males	56 (21.21)	18 (6.82)	7 (2.65)	81 (30.68)
	Females	150 (56.82)	32 (12.12)	1 (0.38)	183 (69.32)
	Total	*897 (60.85)*	*468 (31.75)*	*109 (7.40)*	*1474 (100)*

Males vs females by age-groups $\chi^2_{(3)}=14.72$ $p<0.01$

Males vs females by living areas $\chi^2_{(6)}$*=56.62 p<0.01*

Table 2. Mean value and Standard Deviation (SD) of BMI, waist circumference adjusted by age, hearth-rate/min, oxygen saturation, caries indices (dt/DT, mt/MT, ft/FT, dmft/DMFT)

	<6 years of age *mean (SD)*	≥6<11 years of age *mean (SD)*	≤11≤14 years of age *mean (SD)*	>14 years of age *mean (SD)*
BMI (IOTF)	13.15 (2.35)	13.30 (4.42)	14.76 (2.54)	17.18 (2.22)
Waist circumference	55.91 (5.24)	59.26 (5.26)	67.77 (7.21)	75.42 (6.75)
Hearth-rate/min	98.31 (22.62)	90.89 (21.07)	86.52 (18.83)	84.53 (17.54)
O_2 saturation	91.94 (3.98)	90.04 (6.52)	91.76 (6.28)	92.33 (7.63)
dt/DT	6.35 (4.22) / 0.18 (0.64)	4.95 (3.52) / 0.97 (1.21)	0.87 (1.54) / 1.87 (2.25)	0.11 (0.64) / 2.48 (2.36)
mt/MT	-- (--) / -- (--)	-- (--) / -- (--)	-- (--) / -- (--)	-- (--)/0.69 (0.21)
ft/FT	0.23 (0.01) / -- (--)	0.49 (0.14) / 0.14 (0.26)	0.13 (0.32) / 0.40 (0.73)	0.02 (0.53) / 0.20 (1.13)
dmft/DMFT	6.58 (4.35) / 0.18 (0.64)	5.44 (3.66) / 1.11 (1.35)	1.00 (1.78) / 2.27 (2.25)	0.13 (0.78) / 3.31 (2.67)

Table 3. Sample distribution by gender, waist circumference adjusted by age, BMI, oral hygiene frequency and Self-reported chewing problem stratified by caries lesions categorization in primary dentition.

Number of subjects=916

Gender	0 caries lesions *n(%)*	1-5 caries lesions *n(%)*	>5 caries lesions *n(%)*
Males	132 (14.41)	130 (14.19)	115 (12.55)
Females	255 (27.84)	173 (18.88)	111 (12.11)

$\chi^2_{(1)}$ *linear trend =27.07 p<0.01*

Waist circumference	0 caries lesions *n (%)*	1-5 caries lesions *n (%)*	>5 caries lesions *n (%)*
Reduced	77 (8.41)	219 (23.90)	198 (21.62)
Normal	123 (13.43)	66 (7.20)	24 (2.62)
Higher	187 (20.42)	17 (1.86)	5 (0.55)

$\chi^2_{(2)}$ *linear trend 543.46 p<0.01*

BMI (IOTF classification)	0 caries lesions *n (%)*	1-5 caries lesions *n (%)*	>5 caries lesions *n (%)*
Thinness	108 (11.79)	113 (12.33)	105 (11.46)
Normal	268 (29.26)	175 (19.10)	109 (11.90)
Over weight	12 (1.31)	14 (1.53)	13 (1.42)

$\chi^2_{(2)}$ *linear trend 43.70 p<0.01*

Oral Hygiene Frequency	0 caries lesions *n (%)*	1-5 caries lesions *n (%)*	>5 caries lesions *n (%)*
Seldom	14 (1.53)	40 (4.37)	48 (5.24)
Less once a day	47 (5.13)	55 (6.00)	52 (5.68)
Once a day	218 (23.80)	135 (14.74)	86 (9.39)
Twice/day	109 (11.90)	72 (7.86)	40 (4.37)

$\chi^2_{(3)}$ *linear trend 114.12 p<0.01*

Self-reported chewing problem	0 caries lesions *n (%)*	1-5 caries lesions *n (%)*	>5 caries lesions *n (%)*
No	4 (0.44)	12 (1.31)	17 (1.86)
Seldom	108 (11.79)	87 (9.50)	65 (7.09)
Often	275 (30.02)	205 (22.38)	143 (15.61)

$\chi^2_{(2)}$ *linear trend 28.36 p<0.01*

Table 4. Sample distribution by gender, waist circumference adjusted by age, BMI, oxygen saturation, sugared foods and drinks, oral hygiene frequency and Self-reported chewing problem stratified by caries lesions categorization in permanent dentition.

Number of subjects=1248

Gender	0 caries lesions *n (%)*	1-3 caries lesions *n (%)*	>3 caries lesions *n (%)*
Males	274 (21.96)	187 (14.98)	53 (4.25)
Females	264 (26.15)	307 (24.60)	101 (8.09)

$\chi^2_{(1)}$ *linear trend =12.19 p<0.01*

Waist circumference	0 caries lesions *n (%)*	1-3 caries lesions *n (%)*	>3 caries lesions *n (%)*
Reduced	429 (34.38)	212 (16.99)	31 (2.48)
Normal	93 (7.45)	150 (12.02)	47 (3.77)
Higher	77 (6.17)	132 (10.58)	75 (6.00)

$\chi^2_{(2)}$ *linear trend =202.41 p<0.01*

BMI (IOTF classification)	0 caries lesions *n (%)*	1-3 caries lesions *n (%)*	>3 caries lesions *n (%)*
Thinness	212 (16.99)	181 (14.50)	51 (4.09)
Normal	353 (28.28)	298 (23.88)	99 (7.93)
Over weight	36 (2.88)	14 (1.12)	3 (0.24)

$\chi^2_{(2)}$ *linear trend =9.25 p<0.01*

Oxygen Saturation	0 caries lesions *n (%)*	1-3 caries lesions *n (%)*	>3 caries lesions *n (%)*
≤90 %	238 (19.07)	218 (17.47)	72 (5.77)
>90 %	362 (29.00)	277 (22.20)	81 (6.49)

$\chi^2_{(1)}$ *linear trend =4.37 p=0.04*

Oral Hygiene Frequency	0 caries lesions	1-3 caries lesions	>3 caries lesions
	n (%)	*n (%)*	*n (%)*
Seldom	88 (7.05)	41 (3.28)	9 (0.72)
Less once a day	110 (8.81)	86 (6.89)	14 (1.12)
Once a day	252 (20.19)	254 (20.35)	93 (7.45)
Twice/day	149 (11.94)	114 (9.13)	37 (2.96)

$\chi^2_{(3)}$ *linear trend = 33.13 p<0.01*

Sugared foods and drinks	0 caries lesions	1-3 caries lesions	>3 caries lesions
	n (%)	*n (%)*	*n (%)*
Seldom	3 (0.24)	6 (0.48)	-- (--)
Once a day	311 (24.92)	279 (22.35)	77 (6.17)
More than once a day	286 (22.92)	210 (16.83)	76 (6.09)

$\chi^2_{(2)}$ *linear trend = 0.53 p=0.75*

Self-reported chewing problem	0 caries lesions	1-3 caries lesions	>3 caries lesions
	n (%)	*n (%)*	*n (%)*
No	30 (2.40)	14 (1.12)	1 (0.08)
Seldom	140 (11.22)	156 (12.50)	57 (4.57)
Often	430 (34.46)	324 (25.96)	95 (7.61)

$\chi^2_{(2)}$ *linear trend =25.53 p<0.01*

Table 5. Multivariate analysis. Conditional multinomial regression between caries lesions categorization and background variables.

Primary Dentition

Number of observation = 916 $\chi^2_{(8)}$*=706.16* *p<0.01 log likelihood=-1231.86*

Base outcome dt=0

	1-5 caries lesions			> 5 caries lesions		
	RRR (SE)	*p>|z|*	*95% CI*	RRR (SE)	*p>|z|*	*95% CI*
Gender *(male)*	0.79 (0.12)	0.12	0.60 / 1.06	**1.56 (0.19)**	**<0.01**	**1.40 / 2.77**
Waist circumference *(reduced)*	**2.18 (0.12)**	**<0.01**	**1.15/ 3.22**	**1.40 (0.11)**	**<0.01**	**2.07/ 4.13**
BMI *(thinness)*	**1.34 (0.18)**	**0.03**	**1.02 / 1.75**	1.10 (0.17)	0.53	0.82 / 1.48
Oral Hygiene Frequency *(seldom)*	**1.75 (0.16)**	**<0.01**	**1.63 / 2.89**	**1.58 (0.15)**	**<0.01**	**1.48 / 3.19**

Permanent Dentition

Number of observation = 1248 $\chi^2_{(14)}$*=240.22* *p<0.01 log likelihood=-1318.35*

Base outcome DT=0

	1-3 caries lesions			> 3 caries lesions		
	RRR (SE)	*p>|z|*	*95% CI*	RRR (SE)	*p>|z|*	*95% CI*
Gender *(male)*	1.22 (0.15)	0.09	0.97 / 1.54	1.26 (0.24)	0.21	0.87 / 1.82
Waist circumference *(reduced)*	**2.16 (0.17)**	**<0.01**	**1.84/ 2.53**	**4.22 (0.51)**	**<0.01**	**3.33/ 5.34**
BMI *(thinness)*	**1.67 (0.17)**	**<0.01**	**1.54 / 2.83**	**1.52 (0.14)**	**<0.01**	**1.36/ 1.74**
O2 saturation *(≤90%)*	1.21 (0.10)	0.07	0.98 / 1.02	0.93 (0.13)	0.05	0.98 / 1.03
Oral Hygiene Frequency *(seldom)*	1.05 (0.07)	0.44	0.93 / 1.19	1.41 (0.13)	0.24	0.92/ 1.42
Sugared foods/drinks *(seldom)*	**1.75 (0.14)**	**0.01**	**1.60 / 1.94**	0.99 (0.17)	0.94	0.70 / 1.39
Self-reported chewing problem *(yes)*	0.83 (0.09)	0.08	0.68 / 1.03	1.12 (0.12)	0.05	0.98 / 1.22

Table 6. Multivariate analysis. Logistic regression between bleeding on probing and background variables.

Number of observation = 1474 $\chi^2_{(6)}$*=24.90 p<0.01 log likelihood=-931.25*

	OR (SE)	*p>|z|*	*95% CI*
Waist circumference *(reduced)*	**2.16 (0.17)**	**<0.01**	**1.84/ 2.53**
BMI *(underweight)*	0.87 (0.07)	0.07	0.67 / 1.02
O_2 saturation *(≤90%)*	**1.75 (0.18)**	**0.01**	**1.60 / 2.44**
Oral Hygiene Frequency *(seldom)*	1.07 (0.07)	0.27	0.95 / 1.21
Sugared foods/drinks *(seldom)*	1.20 (0.13)	0.09	0.97 / 1.48
Self-reported chewing problem *(yes)*	0.83(0.09)	0.08	0.68 / 1.03

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- STROBEchecklistcrosssectional.doc
- RowData.xlsx
- analisidentdecidua.log
- logmultivariate.log
- risultati30032020.log