Association between age and severity of malocclusion in the pediatric age: a cross-sectional study

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Summary

The establishment and subsequent worsening of a malocclusion is the result of a combination of factors dominated by the interaction between inheritance and environment and follows a dynamic process of temporal evolution. This transversal study, based on a sample of 579 children from the Caserta area in Southern Italy, investigates the potential worsening of malocclusions with age by measuring the relationship between the severity level of orthodontic abnormalities, evaluated through the IONT-DHC classification, and the age of the subjects. Our results show that a statistically significant association exists ($p < 0.0001$) between the overall severity of the malocclusion and the age of the subjects, underlining the importance of an early orthodontic prevention and highlighting that large sections of the population still need to be sensitized to orthodontic problems.

Key words: malocclusion, pediatric age, prevention.

Introduction

The occurrence of a malocclusion is the result of a combination of factors dominated by the interaction between inheritance and environment, when favorable or unfavorable growth vectors are conditioned by postnatal risk factors, represented by spoiled habits (1-10). Primary and secondary orthodontic prevention works by guiding the growth vectors, thus preventing the establishment or aggravation of a malocclusion during the growth stages. Consequently the early timing of orthodontic intervention aims to restore the normalization of craniofacial growth vectors (11-13).
In a previous study (14) carried out on a sample of 579 children from the Caserta area in Southern Italy, we observed an overall prevalence of malocclusions of 49% with a need for orthodontic treatment equal to 19%. These values were significantly lower than those of similar studies in the literature (15,16) where, however, the average age of the samples was sensibly higher than ours, reaching the age of adolescence and pre-adolescence.
From this comparison it was clear that the establishment and subsequent worsening of a malocclusion, starting from the completion phase of the deciduous dentition, follows a dynamic process of temporal evolution. The aim of this transversal study, based on the same previously described sample, was to investigate the potential worsening of malocclusions with age, independently of early orthodontic interventions, by measuring the relationship between the severity level of orthodontic abnormalities and the age of the subjects.

Materials and methods

Our sample included 579 children aged between 2 and 9 years. The selection of the sample, which availed itself of the collaboration of 45 pediatricians from the province of Caserta, and the procedures used in collecting the data are described in full details in our previous article (14). The research was conducted in full accordance with the World Medical Association Declaration of Helsinki and approved by the Medical Ethical Committee of Sapienza University of Rome. The parents signed an informed consent before the dental visit.
For each child we measured orthodontic parameters related to the malocclusions of overjet, reverse overjet, overbite, anterior openbite, and crossbite. The need for treatment was then evaluated using the IONT-DHC (Index of Orthodontic Treatment Need - Dental Health Component) classification (17-19) to which we applied some minor modifications to take

into account our operating methods. Each child was then assigned an overall IONT-DHC index, defined as that corresponding to the most severe occlusal anomaly. The only criterion for exclusion from the study was the presence of orthodontic treatments, completed or in progress ones.

Statistical analysis

To evaluate the association between age and aggravation of the malocclusions, a transversal approach was used, thus assuming the ergodicity of the sample.

The age of the children was discretized into 8 age groups ranging from 2 to 9 years.

Starting from the IONT-DHC index, the severity of the malocclusion was divided into 3 classes (Tab. 1) corresponding to absence of pathology (class 0), presence of a mild pathology with no need for treatment (class 1) and presence of a pathology with need for treatment (class 2).

The association of age with the severity of the examined malocclusions (overjet, inverse overjet, overbite, anterior openbite, and crossbite), taken both individually and in combination through the overall IONT-DHC index, was evaluated using the multinomial logistic regression model.

For regression analysis, the Statistica software package from TIBCO Software Inc. (formerly from StatSoft Inc.) was used.

Results

The sample consisted of 579 children, 306 males (52.8%) and 273 females (47.2%), aged between 2 and 9 years (mean=5.73, SD=1.65, median=6), of predominantly Italian nationality (99.3%), and in early deciduous and mixed dentition.

As reported in our previous study (14), the sample presented an overall prevalence of malocclusions of 49.0%, with 95% CI=(44.9-53.1%), and a need for orthodontic treatment of 19.3%, with 95% CI=(16.2-22.8%), with no statistically significant differences between males and females.

Table 2 summarizes the result of multinomial logistic regression analysis for the association between age and overall severity of the malocclusion. This model shows statistically significant changes with age ($p < 0.0001$) with a negative trend for class 0 and with a positive trend for class 1, while the trend with age for class 2 is substantially constant (Fig. 1). This result indicates that as the age increases the number of subjects with all occlusal parameters in the norm (class 0) decreases from 62% to 41% while that of subjects with at least one slightly altered occlusal parameter (class 1) increases from 19% to 40%. The exclusion from the study of children with an orthodontic treatment in progress or concluded explains the trend with age approximately constant and equal to 19% of the percentage of subjects with at least one

Table 1. Correspondence between value of the IONT-DHC index, status of the occlusal parameters, need for treatment, pathology level, and statistical class.

IONT-DHC index	Occlusal parameters	Need for treatment	Class	Pathology
1	Normal	Absent	0	Absent
2	Mildly altered	Absent or not recommended	1	Mild
3,4,5	Altered	Present	2	Severe

Table 2. Results of regression analysis for the overall malocclusion gravity.

Total IONT	**Classification of cases - Odds ratio: 16.381**		**Log odds ratio: 2.796**	
Observed	**Predicted 0**	**Predicted 1**	**Predicted 2**	**Correct (%)**
0	285	0	0	100.0
1	10	114	42	68.7
2	0	21	87	80.6

Parameter estimates distribution: ORDINAL MULTINOMIAL Link function: LOGIT

Effect	Level of effect	Column	Estimate	Standard	Wald Stat.	Lower CL 95%	Upper CL 95%	p
Intercept 1		1	-4.232	0.726	34.01	-5.655	-2.810	<0.0001
Intercept 2		2	2.663	0.601	19.66	1.486	3.841	<0.0001
Age	0	3	-0.911	0.279	197.13	3.365	4.457	<0.0001
Age	1	4	0.478	0.102	22.00	0.278	0.678	<0.0001
Scale			1	0		1	1	

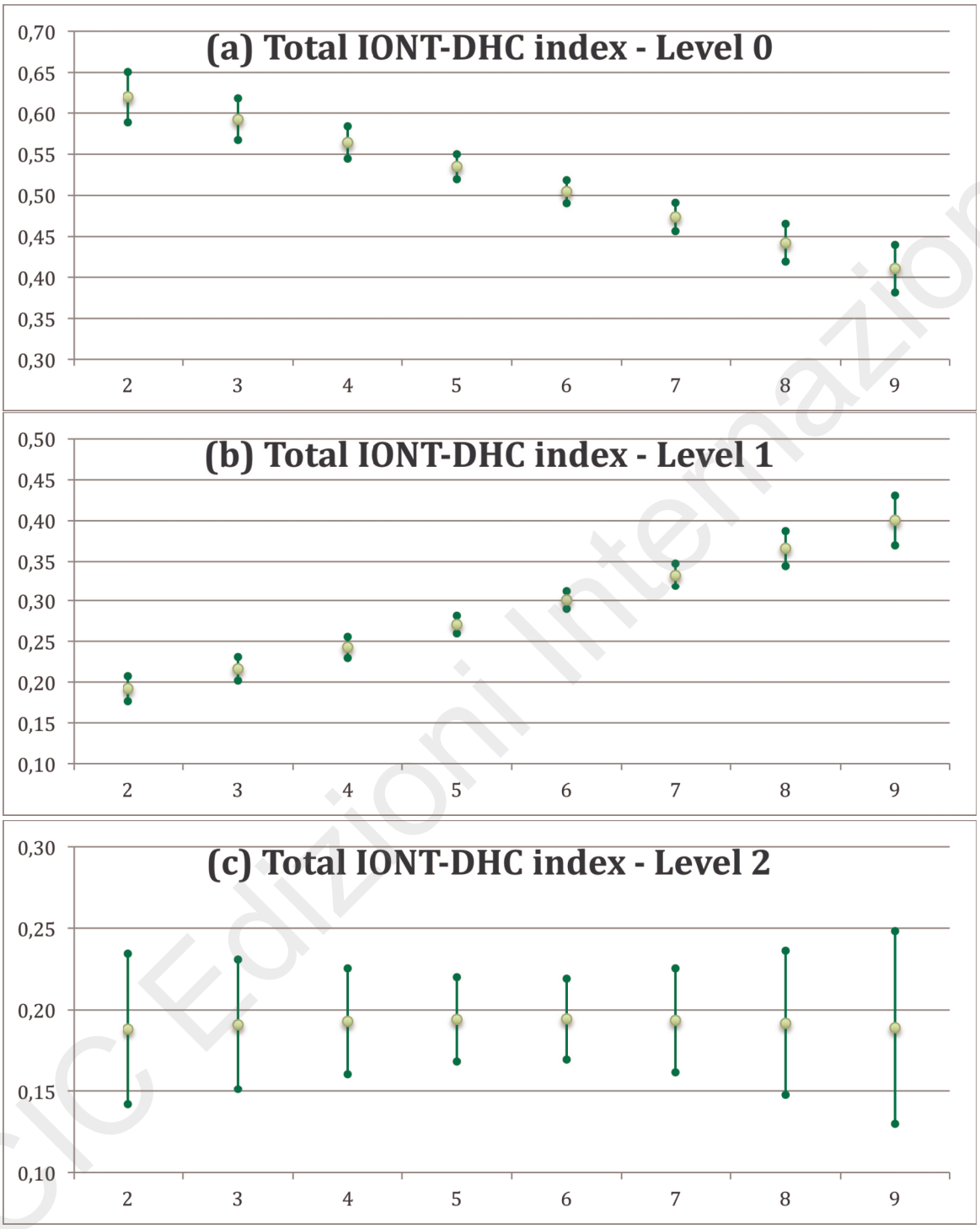

Figure 1. Association between age and total IONT-DHC index. (**a**) level 0: no malocclusion; (**b**) level 1: mild malocclusion; (**c**) level 2: malocclusion with treatment need.

severely impaired occlusal parameter (class 2), as this group only includes children whose malocclusion had not yet been treated.

Turning now to individual malocclusions, Tables 3, 4, and 5 report the results of the analysis for overjet, overbite, and crossbite malocclusions, respectively. For inverse overjet and anterior openbite, the number of cases present in the sample was not sufficient to complete the analysis. In the case of overbite (Fig. 2) and overjet (Fig. 3), the association of the severity of malocclusion with age, despite following trends similar to those seen for the severity of the overall maloc-

Table 3. Results of regression analysis for overbite.

OVERBITE	Classification of cases - Odds ratio: 0.992		Log odds ratio: -0.008	
Observed	**Predicted 0**	**Predicted 1**	**Predicted 2**	**Correct (%)**
0	369	51	2	87.4
1	61	47	5	41.6
2	0	20	4	16.7

	Parameter estimates distribution: ORDINAL MULTINOMIAL Link function: LOGIT							
Effect	**Level of effect**	**Column**	**Estimate**	**Standard Error**	**Wald Stat.**	**Lower CL 95%**	**Upper CL 95%**	**p**
Intercept 1		1	0.93	0.45	4.32	0.05	1.81	0.04
Intercept 2		2	3.79	0.50	56.47	2.80	4.78	<0.0001
Age		4	0.13	0.07	2.94	-0.02	0.28	0.09
Scale			1	0		1	1	

Table 4. Results of regression analysis for overjet.

OVERJET	Classification of cases - Odds ratio: 2,821		Log odds ratio: 1,037	
Observed	**Predicted 0**	**Predicted 1**	**Predicted 2**	**Correct (%)**
0	392	52	0	88.3
1	71	31	0	30.4
2	0	7	6	46.2

	Parameter estimates distribution: ORDINAL MULTINOMIAL Link function: LOGIT							
Effect	**Level of effect**	**Column**	**Estimate**	**Standard Error**	**Wald Stat.**	**Lower CL 95%**	**Upper CL 95%**	**p**
Intercept 1		1	2.320	0.519	20.023	1.304	3.337	<0.0001
Intercept 2		2	5.846	0.645	82.255	4.583	7.110	<0.0001
Age		4	-0.024	0.083	0.085	-0.187	0.138	0.770
Scale			1	0		1	1	

Table 5. Results of regression analysis for crossbite.

CROSSBITE	Classification of cases - Odds ratio: 2,821		Log odds ratio: 1,037	
Observed	**Predicted 0**	**Predicted 1**	**Predicted 2**	**Correct (%)**
0	392	52	0	88.3
1	71	31	0	30.4
2	0	7	6	46.2

	Parameter estimates distribution: ORDINAL MULTINOMIAL Link function: LOGIT							
Effect	**Level of effect**	**Column**	**Estimate**	**Standard Error**	**Wald Stat.**	**Lower CL 95%**	**Upper CL 95%**	**p**
Intercept		1	2.619	0.722	13.144	1.203	4.034	0.0003
Age		2	0.209	0.121	2.986	-0.028	0.447	0.084

clusion, does not show statistically significant variations. As for crossbite (Fig. 4), the presence of an alteration of any entity automatically induces a need for orthodontic treatment and consequently class 1 is empty. For class 2 there is an increasing trend with age, but even in this case it does not reach statistical significance (p=0.08).

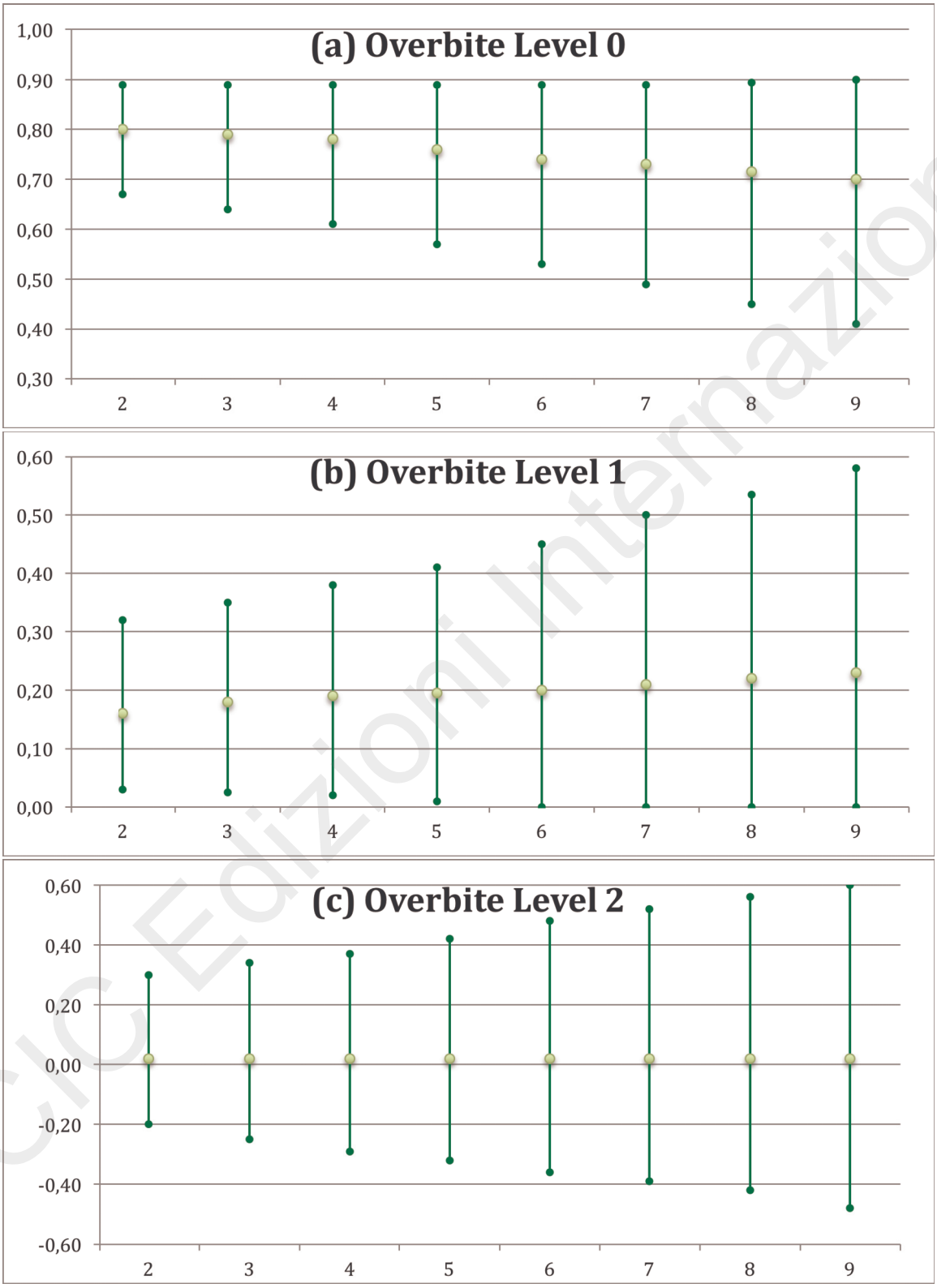

Figure 2. Association between age and overbite. (**a)** level 0: absent; (**b**) level 1: mild; (**c**) level 2: severe.

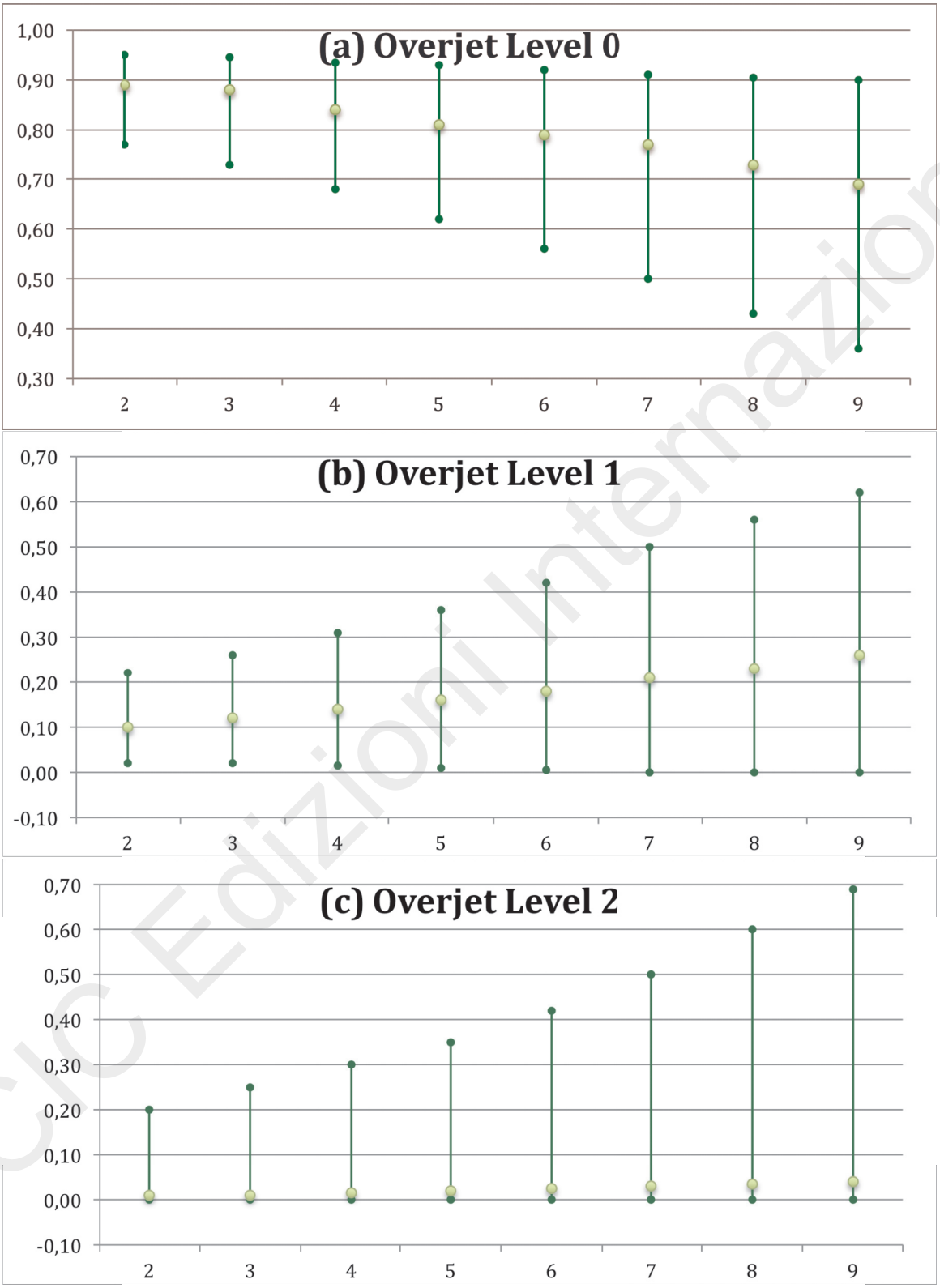

Figure 3. Association between age and overjet. (**a**) level 0: absent; (**b**) level 1: mild; (**c**) level 2: severe.

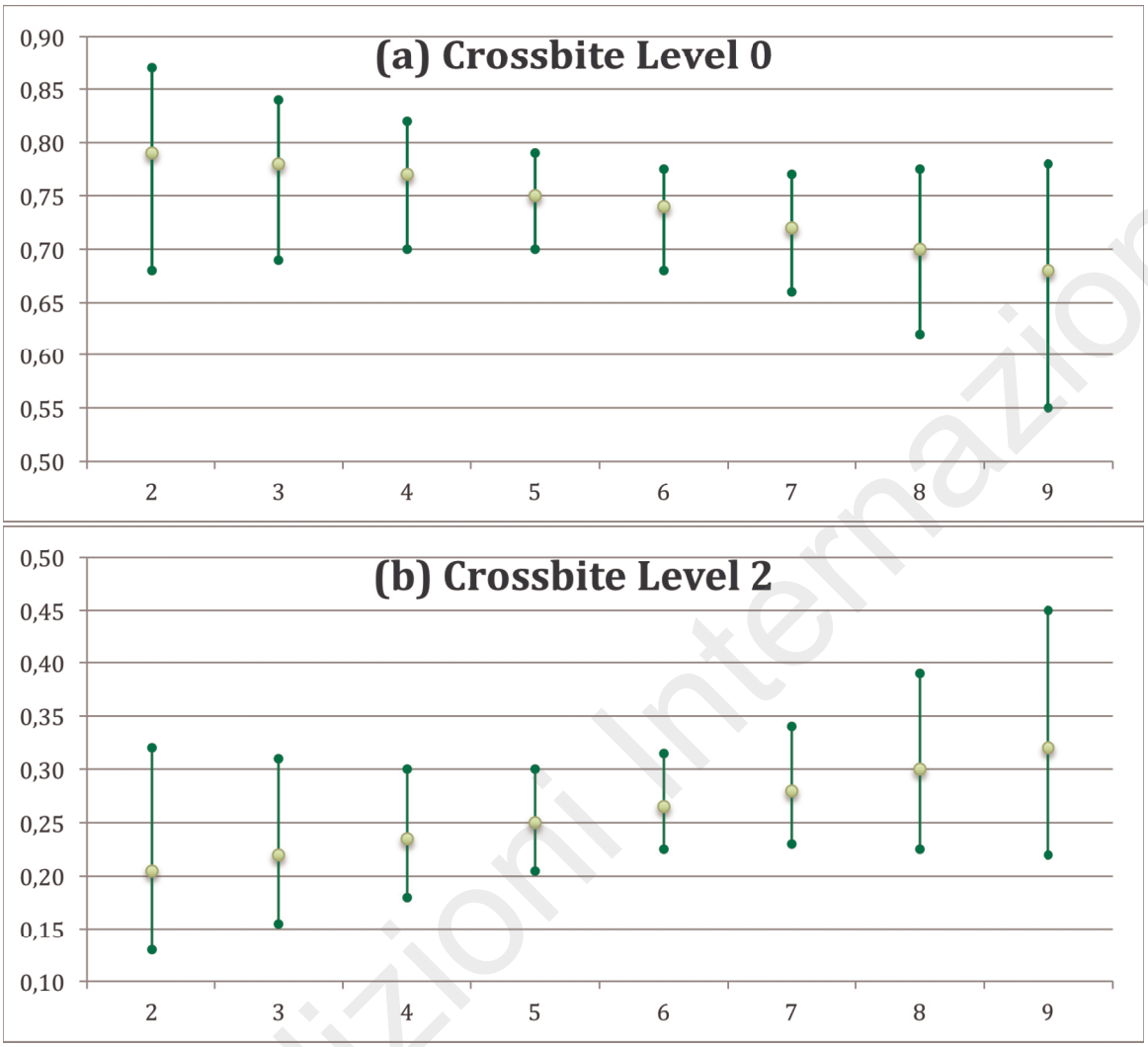

Figure 4. Association between age and crossbite. (**a**) level 0: absent; (**b**) level 2: present.

Discussion

Several Authors (20-21) agree with the implementation of preventive programs for children, as they state that oral health education to caregivers have led to great benefits. Information on oral health care should be provided to mothers during pregnancy, to increase their knowledge about gestational care of oral health, and to prevent problems that may occur both in the mothers themselves and in their children such as preterm low birth weight (22). Pregnant women who receive this information become health promoters in the family, as well as multiplying agents of oral health education. Alves et al. (23) in their study found that children who started participating in the program, and women who have received pertinent information since pregnancy, presented fewer oral diseases than those who never participated in the oral health program.

Our study shows that in the age ranged from 2 to 9 years a statistically significant association exists between the severity of the overall malocclusion, defined as the combination of all considered malocclusions, and the age of the subject. The percentage of children with class 0 (normal orthodontic parameters) range from 62% at 2 years of age to 41% at 9 years of age while those with at least one slightly impaired parameter (class 1) increase from 19% at 2 years of age to 40% at 9 years, indicating a clear trend of worsening of the occlusal state with the increasing age.

The percentage of children with at least one occlusal parameter altered in such a way as to require treatment (class 2) is equal to 19% and this is explained by the study criteria exclusion. In fact the study excluded all the children who were undergoing or had completed an orthodontic treatment; that 19% therefore indicates only the percentage of children who had not yet started orthodontic treatment despite this being necessary. Such a large number of untreated orthodontic cases indicate that in some sections of

the population there is still a lack of sensitivity to orthodontic problems.
Coming to individual malocclusions, while the visual examination of the results shows in all cases a worsening trend similar to that of the overall malocclusion, the numerical entity of the sample was not sufficient to highlight in a statistically significant way an association between the age and each of the studied malocclusions. This calls for a repetition of this study with a larger sample size.

Conclusions

The present study identified a statistically significant association ($p < 0.0001$) between the severity of orthodontic malocclusions and the age of the sample ranged between 2 and 9 years, also highlighting that there are still large sections of the population who need to be sensitized to orthodontic problems. Morphological parameters of the teeth are recorded to help assess the indication for orthodontic treatment. It is assumed that significant deviations from average values compromise the quality of life (24).
This result confirms that the establishment of a malocclusion is a process which progresses with age, underlining the importance of an early orthodontic prevention to intervene before the malocclusion stabilizes and escalates at a more advanced age. It is also necessary to strengthen the awareness of preventive measures in the orthodontic field in order to improve the oral health status in the pediatric age also through the school environment as access to health promotion for all socio-economic classes (25).

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