Olszewska Katarzyna, Mielnik-Błaszczak Maria, Plechawska Paula, Przybyś Joanna. Overweight and obesity affect skeletal maturation and dental development in children and adolescents – a retrospective study. Journal of Education, Health and Sport. 2018;8(6):139-152. eISNN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.1254151
http://ojs.ukw.edu.pl/index.php/johs/article/view/5524

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part b item 1223 (26/01/2017).
1223 Journal of Education, Health and Sport eissn 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 02.05.2018. Revised: 18.05.2018. Accepted: 28.05.2018.

Overweight and obesity affect skeletal maturation and dental development in children and adolescents – a retrospective study

Katarzyna Olszewska[1] olszewskakm@interia.pl

Maria Mielnik-Błaszczak[1] mielnikmb@gmail.com

Paula Plechawska[2] paula.plechawska@gmail.com

Joanna Przybyś[2] jmprzybys@gmail.com

[1] Chair and Department of Pediatric Dentistry, Medical University in Lublin

[2] Masovian Center of Dentistry in Warsaw

Introduction: There are many questions concerning the relationship between childhood obesity and childhood growth and development. The aim of the study was to determine if overweight and obese children and adolescents show accelerated dentition development and skeletal maturity in comparison with the normal weight individuals.

Material and Methods: In total, 109 patients divided into three groups were selected for the retrospective study. The OW group included 34 overweight patients (mean age: 10.91 ± 2.43). The OB group comprised 23 obese individuals (mean age: 10,67 ± 2.54). The control group (NW) included 52 normal weight subjects (mean age: 10.19 ± 1.81). Dental age and skeletal maturity were assessed. The data was analyzed by STATISTICA 10 for Windows Software (StatSoft Inc., Tulsa, USA).

Results: The mean dental age acceleration was 0.38 ± 1.13 in the NW group, 1,79 ± 0.96 in the OW group and 1.88 ± 0.75 in the OB group and was significantly greater in the OW and OB group than in the NW group (P<0.05). The mean CVM score accounted for 2.01 ± 1.16 in the NW group, 2.95 ± 1.47 in the OW group and 2.97 ± 1.49 in the OB group. The mean CVM score was significantly greater in the OW and OB group than in the NW group (P<0.05).

Conclusions: The study revealed accelerated dentition development and skeletal maturity in overweight and obese children and adolescents. BMI percentile is an important data that healthcare professionals should consider in the context of growth and development assessment in paediatric patients.

Keywords: children, overweight, obesity, dentition development, skeletal maturity

Introduction

Obesity is nowadays concerned as a major global health challenge due to the established health risks and its increasing worldwide prevalence [1, 2, 3].

According to WHO, worldwide obesity has nearly tripled since 1975[1]. In 2016, more than 1.9 billion adults were diagnosed as overweight and 650 million of them were found to be obese. In 2016, 41 million children under the age of 5 and over 340 million children and adolescents aged 5-19 were overweight or obese [1]. In 2013, 23.8% of boys and 22.6% of girls living in developed countries were diagnosed to be overweight or obese [2]. Global age-standardised prevalence of obesity increased from 0.7% in 1975 to 5.6% in 2016 in girls, and from 0.9% in 1975 to 7.8% in 2016 in boys [3]. The worldwide prevalence of infantile and juvenile obesity has progressively increased in recent decades, from 4.2% in 1990 to 6.7% in 2010 [4].

The vast majority of overweight or obese children live in developing countries, where the rate of increase of overweight and obesity has been more than 30% higher than that of developed countries [4]. In Europe the highest rates of obesity were reported in Eastern and Southern

European countries [5]. In Poland, between 1971– 2000, the incidence of overweight and obesity in children from Cracow doubled from 6.5% to 11.8% in girls and 7.5% to 15.2% in boys [6]. The research completed in 2009 revealed a further increase in the prevalence of overweight and obesity in children and adolescents reaching 35% in boys and almost 20% in girls [6]. In 2008 the prevalence of overweight and obesity in the south-eastern Poland was registered to be respectively 13.3% and 7.7% in girls and 14.2% and 6.4% in boys [7].

Along with the inreasing prevalence of overweight and obesity in children and adolescents, the prevalence of medical complications of the excess of adipose tissue is also alarmingly growing [8].

There are many questions concerning the relationship between childhood obesity and childhood growth and maturation. It has been suggested that an early onset obesity can accelerate skeletal growth. In particular, obesity has been considered to affect craniofacial growth and result in precocious maxillary and mandibular skeletal maturation. The biologic aspects of facial skeletal growth are fundamentally important in dentofacial orthopaedics.

A higher prepubertal BMI is associated with an earlier pubertal growth spurt. The combination of various hormonal stimuli related to the increased body fat, increased conversion of androgens to estrogens and increased bioavailability of circulating sex steroids could contribute to the earlier activation of the hypothalamic-pituitary-gonadal axis and thereby to the earlier onset of puberty in the obese individuals. It has been reported that leptin produced by the adipose tissue can stimulate skeletal growth by activation of various mediators, like insulin-like growth factor 1 and sex hormones. Moreover, leptin may act directly on the skeletal growth centers. Leptin receptors have been found in the cartilaginous growth centers that are involved in skeletal maturation. Therefore, an obese subject may show increased differentiation and proliferation of chondrocytes leading to precocious skeletal maturation [9].

Careful assessment of the developmental age is an essential part in the examination of the paediatric patients. Not only does it reflect continuity and integrity of the biological processes, but also it points to the stage of development in relation to the chronological age. There are numerous biological ages, such as morphological age, secondary sexual characteristics, as well as skeletal and dental age, which are widely recommended for this purpose [10]. For dental professionals and orthodontists skeletal and dental maturity are of the utmost importance for establishing a diagnosis and treatment plan. For the pediatricians and endocrinologists they are useful as a source of complimentary information.

The aim of the study was to determine if overweight and obese children and adolescents show accelerated skeletal maturity and dentition development in comparison with the normal weight individuals.

Material and Methods

Material

A retrospective analysis of pretreatment medical records of the patients admitted to three orthodontic clinics between 2011 and 2016 was performed. Out of total number of 856 patients 109 individuals were selected for the study. The OW group included 34 overweight patients (16 girls, 18 boys, mean age: 10.91 ± 2.43). The OB group comprised 23 obese individuals (10 girls, 13 boys, mean age: 10.67 ± 2.54). The control group (NW) included 52 normal weight subjects (27 girls, 25 boys, mean age: 10.19 ± 1.81).

Inclusion criteria

For all the individuals, only records which met the following inclusion criteria were included in the retrospective study: 1. age ranging between 6 and 16 years at the time of the pretreatment examination, 2. pretreatment panoramic radiograph and lateral cephalometric radiograph of a good quality taken within 1 month of each other, 3. weight and height recorded within 1 month of the panoramic and lateral cephalometric radiograph, 4. a full complement of mandibular permanent teeth excluding third molars, 5. cervical vertebrae well visible in the lateral cephalometric radiograph, 6. a lack of congenital dental and cervical vertebrae anomalies, 7. no history of systemic diseases or therapy that could influence physical development and growth process.

Methods

Body mass index (BMI) percentile of each patient was assessed with the use of BMI score and age- and sex specific growth charts. The BMI score was defined as the body mass divided by the square of the body height and was expressed in units of kg/m^2. The data concerning body mass and body weight of the patients was taken from the pretreatment medical records, as taking these measurements is a routine procedure in the orthodontic pretreatment examination. Patients were classified into normal-weight, overweight or obese. According to Centers for Disease Control and Prevention, for children and adolescents (aged 2-19 years), normal weight is defined as a BMI from 5th percentile to less than the

85th percentile, overweight is defined as a BMI at or above the 85th percentile and lower than the 95th percentile for children at the same age and sex, whereas obesity is defined as a BMI at or above the 95th percentile [11, 12].

Panoramic radiographs of each subject were evaluated by one investigator to determine dental age using a method introduced by Demirjian et al. considering 7 mandibular permanent teeth of the left side of the dental arch from central incisor to the second molar [13].

In order to assess skeletal maturity of the patient we used the Cervical Vertebrae Maturation (CVM) method proposed by Baccetti et al. consisting of six maturational stages (CVM stages) [14]. In accordance with the method the morphology of the second, third, and fourth cervical vertebrae in the lateral cephalometric radiograph of each subject was visually analysed by one investigator. Two features were analysed in the morphology of cervical vertebrae: the presence or absence of concavity at the lower border of C2–C4 as well as the shape of the vertebral bodies of C3 and C4 (trapezoidal, rectangular horizontal, square, and rectangular vertical). Depending on the morphology of cervical vertebrae C2-C4 each patient was classified into one of the six CVM stages (CS1 – CS6).

Dental age and skeletal maturity of all the subjects were reassessed 2 weeks after the initial assessment by the same investigator.

All data were recorded in 1 electronic spreadsheet.

Statistical analysis

The data was analyzed by STATISTICA 10 for Windows Software (StatSoft Inc., Tulsa, USA). Continuous variables were reported using descriptive statistics like mean and standard deviation. For continuous variables, differences between two independent samples (boys and girls) were tested by nonparametric Mann-Whitney U test. To compare three independent groups (OW, OB, NW) we used nonparametric Kruskal-Wallis test. P value < 0.05 was considered statistically significant. The intra-rater reliability for dental age and skeletal maturity assessment was estimated with intra-class correlation coefficients with 95% confidence intervals. Intra-rater reliability was proved to be high both for dental age (0.93) and CVM method (0.92).

Results

Characteristics of weight, height and BMI percentile

In total, 109 patients at the age ranging from 6 to 16 years divided into three groups met the inclusion criteria. The OW (overweight) group comprised 34 patients (16 girls, 18 boys), the OB (obese) group included 23 individuals (10 girls, 13 boys) and the NW (normal weight) group consisted of 52 normal weight subjects (27 girls, 25 boys). The mean BMI percentile accounted for 42.81 ± 21.05 in the NW group, 87.75 ± 12.72 in the OW group and 97.51 ± 1.32 in the OB group. Statistical analysis revealed significant differences in the mean BMI percentile between three examined groups (H=130.7671; P=0.0001). Multiple comparisons revealed a significantly higher BMI percentile in the OW group than in the NW group (z=7.3197), in the OB group than in the NW group (z=10.5268) and in the OB group then in the NW group (z=3.4494). Statistical analysis did not reveal any significant difference in the mean BMI percentile between boys and girls in any of the studied groups (Table 1).

Characteristics of chronological age, dental age and skeletal age

As shown in Table 2, the mean chronological age accounted for 10,2 ± 1.81 in the NW group, 10.91 ± 2.43 in the OW group and 10.67 ± 2.54 in the OB group. Statistical analysis did not reveal any significant difference in the mean chronological age between three examined groups (P=0.3267). The comparison of the mean chronological age between boys and girls did not show any significant difference in any of the examined groups. The mean dental age accounted for 10.58 ± 2.28 in the NW group, 12.7 ± 2.72 in the OW group and 12.55 ± 2.76 in the OB group. Statistical analysis revealed a significant difference in dental age between three studied groups (H=22.0038; P=0.0001). Multiple comparisons showed a significantly higher dental age in OW group than in the NW group (z=4.0735) and in the OB group than in the NW group (z=3.4111). No significant difference was found in dental age between OW group and OB group (z=0.2366). The mean dental age acceleration accounted for as a difference between dental age and chronological age was 0.38 ± 1.13 in the NW group, 1,79 ± 0.96 in the OW group and 1.88 ± 0.75 in the OB group. Statistical analysis revealed a significant difference in dental age acceleration between the studied groups (H=59.4897; P=0.0001). Dental age acceleration was significantly greater in the OW group in comparison with the NW group (z=6.3603) and in the OB group in comparison with the NW group (z=6.0251). No significant difference in dental age acceleration between OW group and OB group was found (z=0.2464) (Fig. 1). In all the studied groups girls presented a significantly greater dental age acceleration than boys (P<0.05).

As presented in Table 2, the mean Cervical Vertebral Maturation (CVM) score accounted for 2.01 ± 1.16 in the NW group, 2.95 ± 1.47 in the OW group and 2.97 ± 1.49 in the OB group. Statistical analysis revealed a significant difference in the CVM score between the examined groups (H=18,8409; P=0.0001). The mean CVM score was significantly greater in the OW group than in the NW group (z=3.5218)) and in the OB group than in the NW group (z=3.2233), but the comparison of the mean CVM score between OW group and OB group did not reveal any significant difference (z=0.0369). Statistical analysis showed that normal weight girls presented significantly higher mean CVM score than obese boys (P=0.0391).

Discussion

Nutrition is an important regulator of the rate of human growth and obesity and overweight are usually associated with taller childhood stature and an earlier onset of puberty [15]. Tanner observed in the Harvard Growth Study that early maturation, based on age at peak height velocity, was positively associated with a higher weight/height ratio [16]. Frisch and Revelle suggested a critical weight of 48 kg, or 22% body fat, had to be achieved to allow puberty to progress [17]. This critical weight hypothesis was controversial, but the discovery of leptin in 1994 provided a candidate hormone that might sense body fat levels and feed back to the brain to activate central gonadotrophin secretion [18]. Several observations in rodents promoted the theory that leptin may be the major trigger of the puberty [19]. In humans, a longitudinal study of children during adolescence reported a small peak in leptin levels just before the onset of puberty, therefore, suggesting that leptin might have an active role in pubertal development in humans [20].

There are numerous methods which have been described to assess the degree of maturity. In a growing patient dental development and skeletal maturity are commonly used to determine the timing of orthodontic treatment and to select appropriate treatment method.

Association between obesity or overweight and precocious skeletal maturation is a controversial subject in the literature. In our study we used cervical vertebrae maturation (CVM) method proposed by Baccetti et al., which is widely recommended to assess skeletal maturity of the patients in orthodontics and dentofacial orthopaedics [21]. The study revealed accelerated skeletal maturity in overweight and obese children and adolescents in comparison with the normal weight individuals. The mean CVM (cervical vertebrae maturation) score accounted for 2.01 ± 1.16 in the NW group, 2.95 ± 1.47 in the OW group and 2.97 ± 1.49 in the OB group and was significantly greater in the OW and OB group than in the NW group (P<0.05).

In the study of Giuca et al. skeletal maturity assessed on hand-wrist and lateral cephalometric radiographs was significantly different in the obese and normal weight individuals. In accordance with the carpal analysis, the obese subjects showed precocious skeletal maturation in relation to the normal weight individuals. In contrast, the normal weight subjects showed a slightly delayed skeletal maturation in relation to their chronologic age. Furthermore, obese individuals had a higher mean cervical vertebral maturation score in comparison with the normal weight subjects pointing to the earlier skeletal maturation. In the following study, the skeletal age of both obese boys and girls at a mean age of 9.8 years was reported to be 12 months ahead of the chronologic age, however no significant difference in skeletal age between both sexes was found [21]. In the study of Mack et al. an increase in the BMI percentile appeared to be correlated with an acceleration of skeletal maturation [22].

Dentition development and eruption are an integral part of a child′s development and are an important measure of general maturity of a paediatric patient. Only a few authors assessed the relationship between dental development and weight status of growing patients. Our study revealed accelerated dentition development in overweight and obese children and adolescents in comparison with the normal weight patients. The mean dental age acceleration accounted for 0.38 ± 1.13 in the NW (normal weight) group, 1,79 ± 0.96 in the OW (overweight) group and 1.88 ± 0.75 in the OB (obese) group and was significantly greater in the OW and OB group than in the NW group ($P<0.05$). Mack et al. found that for every 1 percentile of increase in BMI percentile for age, there was a 0.005-year increase in dental age. The study conducted by Mack et al. revealed that there was a significant relationship between weight status defined by BMI percentile and dental age [22]. In the study of Hilgers et al. conducted in the obese children the mean dental age difference for all individuals was 0.98 years [23]. Those findings were in agreement with Eid et al., who also found a significant correlation between dental development and BMI [24]. Hilgers et al. found that girls had a significantly greater difference between dental age and chronologic age compared to boys. The mean dental age advancement ranged from - 0.09 to 2.38 years in boys, depending on age and the BMI index, whereas in girls it ranged from 0.72 to 3.33 years [23].

The study comparing dental age of Polish girls and boys aged 6-12 years using Demirjian method revealed that the mean difference between chronologic age and dental age was 8.5 months for girls and 3.5 months for boys [25]. Fudalej et al. assessing dental age of Polish children at the age of 9.5 – 11.5 years found out that the acceleration of dental age in relation to the chronological age accounted for 1.49-1.83 years for girls and 1.06-1.37 years for boys [26]. An acceleration of dental age was also observed in children from Central Poland in the study conducted by Różyło-Kalinowska et al. [27], which was confirmed in further research of the authors [10].

Conclusions

The study revealed accelerated skeletal maturity and dentition development in overweight and obese children and adolescents in comparison with the normal weight individuals. BMI percentile is an important parameter that healthcare professionals should thoroughly consider in the context of growth and development assessment in paediatric patients.

References

1. World Health Organization: Report of the commission on ending childhood obesity. WHO, Geneva 2016.
2. Ng M, Fleming T, Robinson M. Global, regional and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014; 384(9945): 766-781. doi:10.1016/S0140-6736(14)60460-8.
3. Bentham J, Bilano V, Bixby H. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet 2017; 390(10113): 2627-2642.
4. Żukiewicz-Sobczak W, Wróblewska P, Zwoliński J. Obesity and poverty paradox in developed countries. Ann Agric Environ Med 2014; 21(3): 590–594. doi: 10.5604/12321966.1120608.
5. Garcia EG, Lopez MAV, Martinez RG. Prevalence of overweight and obesity in children and adolescents aged 2-16 years. Endocrinol Nutr 2013; 60(3): 121-126. doi:10.1016/j.endonu.2012.09.014.
6. Bac A, Woźniacka R, Matusik S. Prevalence of overweight and obesity in children aged 6-13 years – alarming increase in obesity in Cracow, Poland. Eur J Pediatr 2012; 171; 245-251. doi: 10.1007/s00431-011-1519-1.

7. Mazur A, Klimek K, Telega G. Ten-year secular trend of overweight and obesity in school children in South-Eastern Poland. Ann Agric Environ Med 2014; 21(3): 634–638. doi: 10.5604/12321966.1120616.
8. Gnacińska M, Małgorzewicz S, Guzek M. Adipose tissue activity in relation to overweight or obesity. Pol J Endocrinol 2010; 61 (2): 160–168.
9. Sandhu J, Ben-Shlomo Y, Cole TJ. The impact of childhood body mass index on timing of puberty, adult stature and obesity: a follow-up study based on adolescent anthropometry recorded at Christ's Hospital. Int J Obesity 2006; 30: 14-22. doi: 10.1038/sj.ijo.0803156.
10. Różyło-Kalinowska I, Kolasa-Rączka A, Kalinowski P. Relationship between dental age according to Demirjian and cervical vertebrae maturity in Polish children. Eur J Orthod 2011; 33: 75-83. doi:10.1093/ejo/cjq031.
11. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z. 2000 CDC growth charts for the United States: methods and development. Vital Health Stat 2002; 246: 1-190.
12. Palczewska I, Szilagyi-Pągowska I. Assessment of somatic development of children and adolescents. Med Prakt Ped 2002; 3: 1–7 (in Polish).
13. Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. Hum Biol 1973; 45: 211–227.
14. Baccetti T, Franchi L, McNamara Jr JA. The cervical vertebral maturation (CVM) method for the assessment of optimal treatment timing in dentofacial orthopedics. Semin Orthod 2005; 11: 119-129. doi: 10.1053/j.sodo.2005.04.005.
15. Dunger DB, Ahmed ML, Ong KK. Effects of obesity on growth and puberty. Best Pract Res Clin Endocrinol Metab 2005; 19(3): 375-390. doi:10.1016/j.beem.2005.04.005.
16. Tanner J: Growth at Adolescence. Blackwell Scientific Publications, 1st ed., Oxford, 1955.
17. Frisch RE, Revelle R. Height and weight at menarche and a hypothesis of critical body weights and adolescent events. Science 1970; 69: 397–399.
18. Zhang Y, Proenca R, Maffei M. Positional cloning of the mouse obese gene and its human homologue. Nature 1994; 372: 425–432.
19. Ahima RS, Dushay J, Flier SN. Leptin accelerates the onset of puberty in normal female mice. J Clin Invest. 1997; 99: 391–395. doi:10.1172/JCI119172.

20. Ahmed ML, Ong KK, Morrell DJ. Longitudinal study of leptin concentrations during puberty: sex differences and relationships to changes in body composition. J Clin Endocr Metab. 1999; 84: 899–905. doi:10.1210/jcem.84.3.5559.
21. Giuca MR, Pasini M, Tecco S. Skeletal maturation in obese patients. Am J Orthod Dentofacial Orthop 2012; 142: 774-9. doi: 10.1016/j.ajodo.2012.07.011.
22. Mack K, Philips C, Jain N. Relationship between body mass index percentile and skeletal maturation and dental development in orthodontic patients. Am J Orthod Dentofac Orthop 2013; 143: 228-234. doi: 10.1016/j.ajodo.2012.09.015.
23. Hilgers KK, Akridge M, Scheetz JP. Childhood obesity and dental development. Pediatr Dent 2006; 28: 18-22.
24. Eid RM, Simi R, Friggi MN. Assessment of dental maturity of Brazilian children aged 6 to 14 years using Demirjian's method. Int J Paediatr Dent 2002; 12: 423-428. doi: 10.1046/j.1365-263X.2002.00403.x.
25. Zatylna N, Rogowska K, Kozanecka A. Comparison of 6-12 year old girls' and boys' dental age using Demirijan method. Dent Med Probl 2013; 50(1): 64-70.
26. Fudalej P, Chrostowska E, Maciejewska A. Validity of Nolla's and Demirjian's method of dental age assessment in children with a normal craniofacial structure. Czas Stomatol 2007; 11: 744–751.
27. Różyło-Kalinowska I, Kiworkowa-Rączkowska E, Kalinowski P. Dental age in Central Poland. Forensic Sci Int 2008; 174: 207–216. doi:10.1016/j.forsciint.2007.04.219.

Table 1. The mean weight, height and BMI percentile in the NW (normal weight) group, OW (overweight) group and OB (obese) group.

Group	sex	n	Weight		Height		BMI percentile	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
NW	Girls	27	34,01	7,49	1,41	0,12	41,47	20,32
	Boys	25	34,57	9,83	1,41	0,13	45,00	22,33
	Total	52	**34,23**	**8,41**	**1,41**	**0,12**	**42,81**	**21,05**
OW	Girls	16	52,67	10,09	1,53	0,12	89,71	4,07
	Boys	18	52,06	11,59	1,54	0,11	85,96	17,15
	Total	34	**52,38**	**10,47**	**1,54**	**0,11**	**87,75**	**12,72**
OB	Girls	10	48,50	10,98	1,42	0,12	97,44	1,46
	Boys	13	52,12	21,96	1,44	0,17	97,59	1,23
	Total	23	**50,43**	**17,21**	**1,43**	**0,15**	**97,51**	**1,32**

Table 2. The mean chronological age, dental age, dental age acceleration and CVM (Cervical Vertebrae Maturation) stage in NW (normal weight) group, OW (overweight) group and OB (obese) group.

Group	**Sex**	**Chronological age**		**Dental age**		**Dental age acceleration**		**CVM stage**	
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
NW	Girls	10,37	1,72	10,83	2,31	0,46	1,23	2,14	1,09
	Boys	9,92	1,93	10,18	2,21	0,26	0,96	1,80	1,25
	Total	**10,20**	**1,81**	**10,58**	**2,28**	**0,38**	**1,13**	**2,01**	**1,16**
OW	Girls	10,52	2,08	12,53	2,22	2,02	0,65	2,85	1,35
	Boys	11,27	2,70	12,86	3,15	1,59	1,15	3,04	1,61
	Total	**10,91**	**2,43**	**12,70**	**2,72**	**1,79**	**0,96**	**2,95**	**1,47**
OB	Girls	11,08	2,69	13,22	2,77	2,14	0,86	3,37	1,45
	Boys	10,28	2,41	11,92	2,69	1,64	0,57	2,59	1,46
	Total	**10,67**	**2,54**	**12,55**	**2,76**	**1,88**	**0,75**	**2,97**	**1,49**

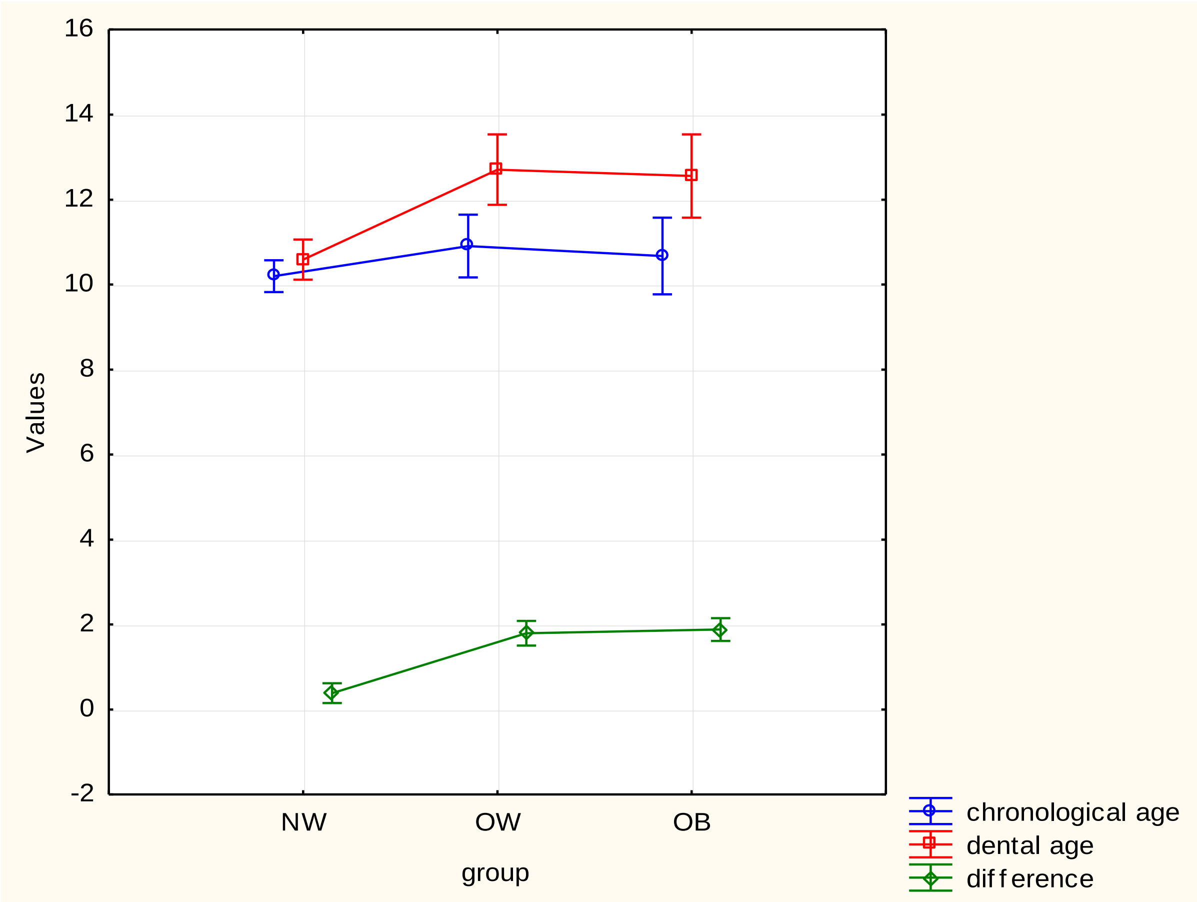

Figure 1. The mean weight, height and BMI percentile in the NW (normal weight) group, OW (overweight) group and OB (obese) group.