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Relationship of body mass index and skeletal maturation using cervical maturation staging in orthodontics patients

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Abstract

Introduction: Rate of obesity is escalating abnormally across the globe affecting all age ranges of people, gender, racial ethnic groups, and educational level. Increase Body mass index BMI has direct influence on growth. The purpose of this study was to determine the relationship between BMI and skeletal maturations using CVM staging.

Material and methods: Sample size consisted of 53 subjects 40 females (75%) and 13 males (25%) with mean age11.8±1.3 and 12.9 ±1.3 respectively BMI was calculated by measuring weight and height while Skeletal maturation was determined by using CVM staging on Digital Lateral cephalograms.

Results: Weak but significant correlation was found between BMI and CVM stages. However, no correlation was found among BMI percentile, CVM stages and gender.

Conclusions: There was a weak correlation between BMI and CVM while there is no correlation among BMI percentile, CVM and Gender. There was significant correlation between BMI and height.

Keywords: Body mass index; cervical Vertebral Maturation stages; weight

Introduction

Rate of obesity is escalating abnormally across the globe affecting all age ranges of people, gender, racial ethnic groups, and educational level. Children adopting sedentary lifestyle are more prone to obesity.[1] Apart from sedentary lifestyle there are other etiological factors which contribute to increased obesity, like urbanization, increase energy intake and modern lifestyle.[2-3]

Many methods have been adopted to assess the obesity, like waist circumference, skinfold thickness, biomass impedance, Body Mass index (BMI), age, weight & sex related BMI percentile.[2,4] Body Mass Index is the measure of Height and weight. Calculating BMI score merely based on height and weight in growing individual is of no use due to age and gender related growth pattern.[4] Sex and gender related Body Mass Index percentile is an efficient, fast, noninvasive, & easily accessible way to determine child's weight status. BMI less 5th percentile is considered as underweight and above 95th as obese. A BMI percentile between 85th and 95th is overweight and a BMI percentile between 5th and 85th is deemed as a normal weight.[5]

Apart from causing many medical conditions, obesity also strongly affects individual growth pattern.[6] It has been documented those individuals having increased BMI have early onset of puberty.[7] Literature shows that individuals with high BMI have increased

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maxillary and mandibular lengths. In biphasic orthodontic treatment, orthodontists rely on patients' own growth and take advantage of growth potential, to prevent patient from invasive procedure in the future. Hence, it is of utmost importance for clinician to consider BMI when treating children for growth modification.[8-9]

Some previous studies found no correlation between BMI and skeletal.[1-3] However, Mack et al concluded that the cervical vertebral maturation stages and dental ages were higher in subjects with increased BMI percentiles.[4] Conversely, Duplesis et al found that there is weak correlation between BMI percentile and skeletal maturation. Moreover, there is little evidence regarding the relationship of BMI with skeletal maturation in Pakistani population. Hence, the purpose of this study was to explore the relationship between BMI and skeletal maturation stages. The results of the study would be an additional and important diagnostic tool for determining skeletal maturation.

Material and Methods

This retrospective cross-sectional study was conducted in the Department of Orthodontics, Rehman College of Dentistry Peshawar from February 2020 to February 2021. Ethical approval from institute ethical committee (reference no 2020-10-035) was sought prior to the study. Written informed consent was taken at time of data collection, patients were also briefed about potential benefits of the study. Sample size consisted of 53 patients 40 females (75%) and 13 males (25%) with mean age 12.9±1.3 and 11.8±1.3, respectively.

The standardized Digital Lateral Cephalograms used for this study were collected from the Orthodontic Department records. Lateral cephalograms were taken with CARE STREAM CS 9000 having the following parameters of exposure (64 kV, 15 mA and 0.0400 s).

Inclusion criteria of study were patients with the age range 9 to 14 years, having no significant medical history that could affect the physical growth status adequate diagnostic quality Lateral cephalograms, with clearly visible 2nd 3rd and 4th Cervical vertebrae. Those patients were excluded from the study whose 2nd 3rd & 4th cervical vertebrae were not visible or congenitally abnormal.

Weight was calculated of all the patients participating in the study, in Camry Analog weight scale (model BR2017)[Figure 1]. Height was measured in feet using measuring tape. The patients were asked to stand in a natural head position, to confirm Natural Head Position (NHP) patients were requested to look into the mirror. BMI was calculated using Center of disease control (CDC) BMI calculator.[11] All patients were categorized according to age and gender related BMI percentile i.e., obese having BMI percentile of 95th. Overweight having BMI percentile of between 85th and 95th, normal having BMI percentile between 5th and 85th and underweight having percentile of less than 5th.[7]

Lateral cephalograms were placed on the illuminator, cervical vertebrae maturation stages were noted by checking the 2nd 3rd and 4th vertebrae, and accordingly categorized as CVM 1 ,2,3 4 5and 6 based on Baccetti method [Figure 2].[10]

Figure 1: Camry Analog weight scale

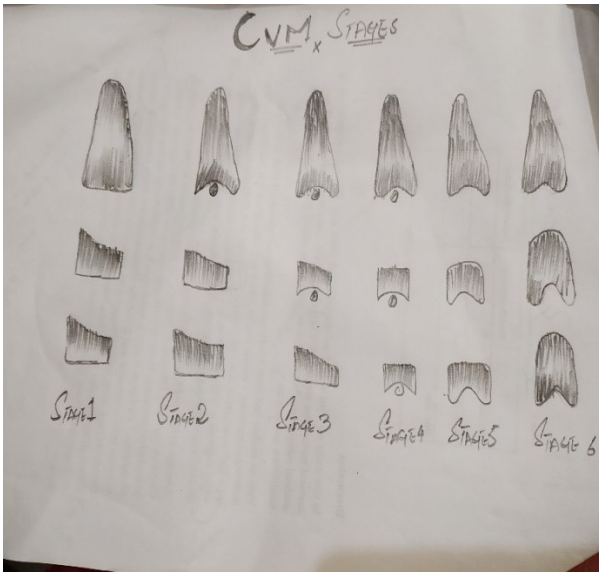

Figure 2: Cervical vertebrae maturation (CVM) stages.

Statistical Analysis

Data were analyzed in IBM SPSS version 22.0. Shapiro wilk test was used to check normality of the data. Spearman rank correlation was used for finding correlation between BMI and CVM stages. Odds ratio was calculated for BMI and CVM stages. P value of 0.05 or less was considered significant.

Result

The sample consisted of 53 patients, which comprised of 40(75%) female and 13(25%) male subjects. Mean age of the sample was 12.57 + 1.46 years. Base line data are given in [Table I]. Demographics, with gender-based comparisons are given in [Table II].

Correlations among BMI, BMI percentile and CVM are shown in [Table III]. Weak but significant correlation(r=0.33) between BMI and CVM was found (p=0.016). Insignificant correlation found between BMI percentile and CVM stages

Cross tabulation of BMI vs CVM resulted in Odds ratio of 4 which was significant. [Table IV]. However, insignificant association between BMI percentile and CVM was found, with Odds ratio of 1.1.

Table I: Baseline statistics

	Height	Weight	CVM	Age	BMI	Percentile
Mean	4.93	43.66	2.92	12.57	17.46	38.34
S.D	.512	10.5	.997	1.4	3.86	30.2
Mode	5.1	41	3	12	17	31

Table II: Demographic and gender wise comparison

Gender	Height	Weight	CVM	Age	BMI	Percentile
Male						
Mean	4.56	37	2.15	11.85	15.8	43.23
S.D	.394	4.14	.801	1.068	2.85	24.96
Median	4.79	36	2	12	16	45.00
Female						
Mean	5.06	45.83	3.18	12.18	18	36.75
S.D	.490	11.096	.931	1.506	4.026	31.8
Median	5.10	43.5	3	13	17	22.5

Table III: Correlation between BMI, BMI percentile and CVM stages

Correlation	BMI	Percentile	CVM
BMI correlation coefficient Sig. (2-tailed)	1.000	.637*** .000	.330* 0.016
Percentile correlation coefficient Sig.(2-tailed)	.637*** .000	1.000	0.10 0.946
CVM correlation coefficient Sig-(2tailed)	0.330* 0.016	0.10 0.946	1.00

Table IV Odds ratios of BMI and CVM

	CVM stages Growth potential +	CVM Growth potential -
BMI low	28	7
BMI high	9	9
Odd ratio		4

Discussion

In this study, we tried to find out correlation of BMI index and skeletal maturation using cervical maturation staging, (CVM), results yielded correlation between BMI and skeletal maturation stages, but no correlation among BMI percentile, skeletal maturation, and gender.

Various studies have been conducted regarding correlation of BMI & skeletal maturation stages showing variable results. Mack et al concluded the individuals having high BMI percentiles might have progressed dental age and Cervical vertebral stages.[4] While Duplesis et al found a weak correlation among BMI percentile skeletal and dental maturation,[5] which is consistent with our study results. Danze et al [12,17,18] found significant correlation between BMI percentile and CVM stages and dental maturation which is in agreement with our result.

Guica et al [13] studied skeletal maturation in obese people, his results show that obese people are skeletally advanced as compared to normal people, the results are in agreement in with our study although he used both hand wrist and latera cephalogram for assessing skeletal maturation. Another study by Ke et al concluded that accelerated skeletal maturation in individual with increase BMI, for skeletal maturation he used hand and wrist radiographs.[14,15,16]

Akridge et al found that the Body mass index percentile is not related with Cervical Vertebral Maturation stages.[1] T. sezen erhama et al concluded Body Mass Index percentile is not reliable and explanatory variable for Cervical Vertebral Maturation.[2] Hedayati Z et al also found no correlation between BMI percentile and CVM stages.[3]

The difference in the result may be due to BMI percentile they used, while we used both BMI and BMI percentile. Small sample and accuracy to determine CVM stages on lateral cephalograms may be other contributing factors to the difference in the result. However, in our study there was a positive correlation between skeletal maturation and height.

Limitation of our study is small sample size, further in our department we lacked initial patient records like weight, & height etc. Therefore, in future, further studies can be conducted with a larger sample size. The literature is scarce in correlations studies between Height and CVM staging so, in future this can also be investigated.

Conclusions

1) There is weak correlation between BMI and skeletal maturation.
2) While there is no correlation among BMI percentile, CVM staging and Gender.
3) There is a positive correlation between skeletal maturation and height.

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