



## Role of BMI in Fixed Orthodontic Treatment Course

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### Abstract

Orthodontic treatment is becoming a choice of treatment for many individuals to bring about changes in their dentofacial features. It helps to improve esthetics and self-esteem hence bringing about a change in behaviour and personality of an individual.

India is a big country undergoing transitions drastically in the economic field and hence facing many diseases associated with it like obesity. Presently we are dealing with the problem of obesity in our society which is becoming more and more prevalent. The aim of this study was to show association of BMI of patients undergoing fixed orthodontic treatment with different aspects of treatment like overall cooperation of the patient, missed appointments, duration time etc. The total sample of 42 patients, consisted of 18 male and 24 females, in the age group of 11 to 30 years who had come for the orthodontic treatment. BMI was calculated and accordingly they were divided into normal weight, overweight and obese patients. Statistical analysis was done, and it was concluded that obese patients showed poor overall compliance with more missed appointments and longer treatment time. The overweight BMI patients showed overall bad compliance, more missed appointments than normal BMI patients but greater percentage of them finishing treatment in lesser time. The normal BMI patients showed overall compliance as good with less missed appointments and lesser treatment duration time. Though none of the results were significant but differences were seen. Hence during orthodontic treatment there is a need for certain efforts to be made in patients with higher BMI to bring the treatment outcome to comparable level.

**Keywords:** BMI; Orthodontic Treatment; Obesity

### Introduction

Obesity is a disease of economically developed countries found not only in adults but in children and adolescents also. The World Health Organisation considers childhood obesity as one of the serious public health problem of 21st century [1]. Obesity can lead to different diseases like Type 2 diabetes mellitus, cardiovascular and, gastrointestinal disorders, obstructive sleep apnoea, social exclusion, depression, orthopaedic problems etc [2-4]. India is one such developing country which is progressing rapidly and facing certain related health issues like obesity. From dental point of view studies have shown association between obesity and periodontal diseases leading to oral morbidity and association with increased carious lesions [5-6].

The Body Mass Index (BMI, Kg/m<sup>2</sup>) is a convenient index of weight adjusted for height that can be used to broadly categorize bodyweight, within population groups as normal, overweight or obese. Recommendations for BMI generally present a range of BMIs that are considered healthy because they have been associated with desirable health outcomes [7].

In India 50% of adults have a BMI < 18.5 Kg/m<sup>2</sup>. BMI values were similar in men and women with women (6.6%) being more overweight/obese with BMI  $\geq$  25 Kg/m<sup>2</sup> than men (3.5%). In India prevalence of overweight adolescents varies between 10% and 30% [8,9].

There is a need to understand the existence of differences if any in behaviour pattern of normal weight and overweight/obese patients undergoing orthodontic treatment to analyse whether it has any effect on treatment outcome which would make the orthodontist changes in his treatment plan in treating patients with different BMIs [10]. Studies show that overweight adolescents show less cooperation in comparison to their normal weight peers undergoing orthodontic treatment, but not affecting the treatment outcome in two groups. The difference was accountable due to hormonal changes and bone metabolism in different BMI groups [11,12].

The aim of this study was to compare the responses of patient of different BMI groups (normal, overweight and obese) undergoing fixed orthodontic treatment with respect to following parameters.

1. Overall compliance which included different parameters of oral hygiene maintenance, punctuality in keeping appointments, breakage of brackets/ bands, chairside cooperation, following instructions.
2. Missed appointments.
3. Total duration time.

This study also aimed to find any differences in overall compliance and total duration time of patients according to their gender also.

### Material and Methods

The study was done on a sample of 42 patients who had come to the Department of Orthodontics and Dentofacial Orthopaedics, HPGDC, Shimla, for orthodontic treatment. The males were 18 in number and females were 24 in number with the age range of 11 to 30 years. Fixed orthodontic treatment with multibracket appliances was planned for these patients.

Weight was measured using bathroom scales accurate up to 0.5 Kg with patient standing bare feet and normal clothing. Height was measured to the nearest cm. Individual BMI percentile was calculated according to age (< 20 years) and sex of the patient. BMI was calculated as Weight / Height x Height in Kg/m<sup>2</sup> and was classified as normal weight (normal BMI), overweight (BMI > 90<sup>th</sup> percentile) or obese (BMI > 97<sup>th</sup> percentile) [13]. BMI was calculated before the start of the treatment (pre-treatment BMI) and at the end of the treatment (post treatment BMI). To record overall compliance different parameters included in it were recorded as positive remark (+) or negative remark (-) and overall grade was given on the basis of number of negative remarks as 0 - 1 good; 2 - 4 bad; > = 5 poor [14]. Total duration time of each patient was calculated in months and number of missed appointments was also noted. At the end of the treatment statistical analysis of recordings was done using IBM SPSS statistics (version 22.0). Chi square tests were done to compare the results and p < 0.05 taken as significant.

### Results

The study consisted of sample of 42 patients, of which 24 were females and 18 were males. Pre-treatment weight and height were measured to calculate BMI and accordingly were divided into normal weight group (71.4%), overweight group (23.8%) and obese group (4.8%). Similarly, at the end of the treatment BMI was calculated and was found to be as 78.6%, 19% and 2.4% respectively.

McNemar - Bowker Test showed no statistical significant difference in pre-treatment BMI and post treatment BMI and hence pre-treatment BMI was taken as a standard for further statistical analysis (Table 1).

| Categories of BMI | Pre treatment |            | Post treatment |            | P value |
|-------------------|---------------|------------|----------------|------------|---------|
|                   | Number        | Percentage | Number         | Percentage |         |
| Normal            | 30            | 71.4       | 33             | 78.6       | 0.435   |
| Over-weight       | 10            | 23.8       | 8              | 19.0       |         |
| Obese             | 2             | 4.8        | 1              | 2.4        |         |
| Total             | 42            | 100        | 42             | 100        |         |

**Table 1:** Comparing number of subjects in pre and post treatment groups according to different categories of BMI. McNemar-Bowker Test; \*P < 0.05 (significant).

Gender comparison was done among different BMI group patients and it was found that 83.3% of male patients had normal BMI as compared to 62.5% of females. Similarly, in obese group males were higher in percentage (5.6%) in comparison to females (4.2%). Whereas in overweight BMI group females were more in number (33.3%) as compared to males (11.1%). However, none of the differences were statistically significant and hence they were comparable in all the three groups of BMIs (Table 2).

| Categories of BMI | Total | Gender   |          | P value |
|-------------------|-------|----------|----------|---------|
|                   |       | Male     | Female   |         |
| Normal            | 30    | 15 (50%) | 15 (50%) | 0.247   |
| Overweight        | 10    | 2 (20%)  | 8 (80%)  |         |
| Obese             | 2     | 1 (50%)  | 1 (50%)  |         |

**Table 2:** BMI according to gender. Chi square test; \*P < 0.05 (significant).

On evaluation of Overall Patient Compliance, it was found out that more females (61.1% had good grade in comparison to males (38.9%) whereas males were more in number (60%) as compared to females (40% with poor grade. However, In the bad grade the females were slightly more (57.9%) than males (44.4%). However, these differences were statistically not significant (Table 3).

| Overall Grade | Total | Gender    |            | P value |
|---------------|-------|-----------|------------|---------|
|               |       | Male      | Female     |         |
| Good          | 18    | 7 (38.9%) | 11 (61.1%) | 0.698   |
| Bad           | 19    | 8 (44.4%) | 11 (57.9%) |         |
| Poor          | 5     | 3 (60%)   | 2 (40%)    |         |

**Table 3:** Overall patient compliance according to gender. Chi square test; \*P < 0.05 (significant).

**Treatment duration:** The average treatment duration of male patient was 20.94 months which was shorter than that of female patient which was 21.71 months. However, this difference was not significant statistically (Table 4).

| Gender | Total | Mean duration of treatment in months | Standard deviation | P value |
|--------|-------|--------------------------------------|--------------------|---------|
| Male   | 18    | 20.9                                 | 4.09               | 0.543   |
| Female | 24    | 21.7                                 | 3.91               |         |
| Total  | 42    | 21.3                                 | 3.9                |         |

**Table 4:** Treatment duration according to gender.

T test; \*P < 0.05 (significant).

On comparing the mean treatment duration according to BMI, it was found that for normal weight (56.7%) and overweight group (60%), more patients finished the treatment in less than 20 months in comparison to patients who took more than 20 months in contrast to the obese group (100%) who took more than 20 months to finish their treatment. However, this difference was not significant statistically (Table 5).

| BMI        | Treatment Duration |             | Total     | P value |
|------------|--------------------|-------------|-----------|---------|
|            | < or = 20 months   | > 20 months |           |         |
| Normal     | 17 (56.7%)         | 13 (43.3%)  | 30 (100%) | 0.276   |
| Overweight | 6 (60.0%)          | 4 (40.0%)   | 10 (100%) |         |
| Obese      | 0                  | 2 (100%)    | 2 (100%)  |         |
| Total      | 23 (54.8%)         | 19 (45.2%)  | 42 (100%) |         |

**Table 5:** Treatment Duration according to BMI.

Chi square test; \*P < 0.05 (significant).

**Overall Patient compliance (Grade):** It was found out that according to BMI normal weight patients had overall grade in the order of good (46.7%) > bad (40%) > poor (13.3%); overweight patients had grading as bad (70%) > good (30%) and obese patients had same grading of good (50%) and poor (50%). However, these differences were not statistically significant (Table 6).

| BMI        | Overall grade |            |           | Total     | P value |
|------------|---------------|------------|-----------|-----------|---------|
|            | Good          | Bad        | Poor      |           |         |
| Normal     | 14 (46.7%)    | 12 (40%)   | 4 (13.3%) | 30 (100%) | 0.157   |
| Overweight | 3 (30%)       | 7 (70%)    | 0         | 10 (100%) |         |
| Obese      | 1 (50%)       | 0          | 1 (50%)   | 2 (100%)  |         |
| Total      | 18 (42.9%)    | 19 (45.2%) | 5 (11.9%) | 42 (100%) |         |

**Table 6:** Overall Patient compliance according to BMI.

Chi square test; \*P < 0.05 (significant).

**Number of missed appointments:** The mean of missed appointments of obese group (7.50) was more than that of overweight patients (5.10) which was in turn more than that of normal weight patients (4.17) but the difference was not statistically significant (Table 7).

| BMI        | Number of Subjects | Mean of missed appointments | Standard Deviation | P value |
|------------|--------------------|-----------------------------|--------------------|---------|
| Normal     | 30                 | 4.17                        | 2.183              | 0.137   |
| Overweight | 10                 | 5.10                        | 2.09               |         |
| Obese      | 2                  | 7.50                        | 3.53               |         |

**Table 7:** Showing Missed appointments according to BMI.

NPar test; \*P < 0.05 (significant).

**Overall compliance (Grade):** was analysed using different parameters of oral hygiene maintenance, Breakage of brackets/bands, Insufficient wearing of elastics, Punctuality, Chairside cooperation, Following instructions (Table 8).

It was found that oral hygiene maintenance in overweight (50%) and obese BMI patients (50%) was less than that of normal weight BMI patients (56.7%). Breakage of bands/brackets was seen most in obese BMI patients (100%) followed by normal BMI (90%) and overweight BMI patients (80%). Insufficient wearing of elastics was seen the most in obese BMI patients (50%), followed by normal BMI (26.7%) patients. In punctuality obese BMI patients showed least punctuality (50%) whereas overweight BMI patients were the most punctual (70%). Chairside cooperation was seen the most in obese (100%) and overweight BMI groups (100%) in comparison to lesser cooperation seen in normal weight BMI group (86.7%) and last but not the least instructions were followed the most by normal weight BMI group (76.7%) to be followed by overweight BMI (70%) and Obese BMI group (50%).

**Discussion**

Patients seek orthodontic treatment to improve facial and dental aesthetics. Bodyweight is often used to assess health status and health risks both in clinical settings and in epidemiological analysis. Globally an estimated 10% of school aged children between 5 and 17 years of age are overweight or obese. In India the prevalence of overweight among adolescents varies between 10% and 30% [11]. This study was done to understand the differences if any in patients with different BMI undergoing orthodontic treatment.

The differences in pre-treatment BMI and post treatment BMI were not significant in our study. The change if any may not be necessarily accountable to orthodontic treatment but may be due to physiological parameters like growth and development of an individual, dietary changes, exercise schedule etc.

| Category                         | BMI        | No (-) ve entry |       | (-)ve entry present |       | Chi-square tests |    |                       |
|----------------------------------|------------|-----------------|-------|---------------------|-------|------------------|----|-----------------------|
|                                  |            | Count           | %age  | Count               | %age  | Value            | df | Asymp. Sig. (2-sided) |
| Oral Hygiene maintenance         | Normal     | 17              | 56.7% | 13                  | 43.3% | .154             | 2  | .926                  |
|                                  | Overweight | 5               | 50.0% | 5                   | 50.0% |                  |    |                       |
|                                  | Obese      | 1               | 50.0% | 1                   | 50.0% |                  |    |                       |
| Breakage of brackets / bands     | Normal     | 3               | 10%   | 27                  | 90%   | .999             | 2  | .607                  |
|                                  | Overweight | 2               | 20%   | 8                   | 80%   |                  |    |                       |
|                                  | Obese      | 0               | .0%   | 2                   | 100%  |                  |    |                       |
| Insufficient wearing of elastics | Normal     | 22              | 73.3% | 8                   | 26.7% | 4.186            | 2  | .123                  |
|                                  | Overweight | 10              | 100%  | 0                   | .0%   |                  |    |                       |
|                                  | Obese      | 1               | 50%   | 1                   | 50%   |                  |    |                       |
| Punctuality                      | Normal     | 19              | 63.3% | 11                  | 36.7% | .332             | 2  | .847                  |
|                                  | Overweight | 7               | 70%   | 3                   | 30%   |                  |    |                       |
|                                  | Obese      | 1               | 50%   | 1                   | 50%   |                  |    |                       |
| Chairside cooperation            | Normal     | 26              | 86.7% | 4                   | 13.3% | 1.768            | 2  | .413                  |
|                                  | Overweight | 10              | 100%  | 0                   | .0%   |                  |    |                       |
|                                  | Obese      | 2               | 100%  | 0                   | .0%   |                  |    |                       |
| Following instructions           | Normal     | 23              | 76.7% | 7                   | 23.3% | .788             | 2  | .674                  |
|                                  | Overweight | 7               | 70%   | 3                   | 30%   |                  |    |                       |
|                                  | Obese      | 1               | 50%   | 1                   | 50%   |                  |    |                       |

**Table 8:** Different parameters of Overall compliance of patients determining the resultant Grade.

\*P < 0.05 (significant), df = 1.

**Gender:** In our study the ratio of Female: Male was 4:3, which is in accordance with other studies which have concluded that females are more concerned about their esthetics as compared to their male counterparts. When we compared male and female according to their BMI, it was found that percentage of males (83.3%) was more in normal weight and obese categories (5.6%) in comparison to females which was (62.5%) and (4.2%) respectively. However, the overweight category showed greater percentage of females (33.3%) in comparison to males (11.1%) but none of it was statistically significant. However, another study concluded that in normal BMI group females were in a higher percentage than males whereas in overweight and obese BMI groups the males were in a higher percentage [14].

Our study also showed that according to gender, when overall compliance was graded based on different factors, there were more of females in comparison to males in both good and bad grade. On the other hand, more of males had poor grade in comparison to females.

Our study showed that more of normal weight and overweight patients finished their treatment in less than 20 months whereas all obese patients had their treatment duration of more than 20 months. Longer duration time results due to cumulative effect of non-cooperation, missing appointments and not following orthodontist’s instructions. Another study showed treatment duration of overweight patients took slightly longer (21.4 months) and required more appointments (19.9 months) in comparison to normal

weight patients (18.9 months, 18.1 appointments) which was due to more number of missed appointments by patients with higher BMI [11].

Physiologically the reasoning has been attributed to high bone density in obese patients making tooth movement difficult [15]. Also, there is increased amount of adipose tissue in such patients, which secretes leptin hormone a known inhibitor of bone formation and resorption due to decreased expression of RANK and RANKL [16]. Obese patients show decreased level of adiponectin which is responsible for osteoblast growth and inhibition of osteoclast genesis. This accounts for slow tooth movement in obese patients. On the other hand, several authors have reported that hormones lead to loss of bone quality in overweight patients making tooth movement easier [17]. A study has reported that cooperation level of overweight patients was not good in comparison to their normal weight peers and had a longer treatment duration [11]. Studies show that overweight adolescents show less cooperation in comparison to their normal weight peers undergoing orthodontic treatment, but not affecting the treatment outcome in two groups.

**Missed appointments:** Our study showed that mean of missed appointments was the most for obese patients, followed by overweight and normal weight BMI group patients. This is in accordance with another study which showed that due to more number of missed appointments by patients with higher BMI [11], the

treatment duration of overweight patients took slightly longer in comparison to normal weight patients.

**Overall compliance (Grade):** Our study showed that overweight BMI patients had more of bad grade than good grade whereas obese group showed same percentage of poor and good grade. However, the normal weight patients had more of good grade. Similarly, another study reported that where as much as 51.7% of normal weight BMI cooperated sufficiently, only 25% of overweight patients exhibited acceptable cooperation [11]. The number of patients with bad or poor cooperation was significantly higher in overweight BMI than in Normal BMI group. Reason for non-cooperation of obese patients could be due to obesity related factors like sleep disordered breathing, OSA, poor self-esteem etc [18,19].

Individual parameters determining overall compliance were also studied and it was found that with respect to oral hygiene in normal weight BMI patients (56.7%) oral hygiene was better followed in comparison to overweight (50%) and obese patients (50%). This is in accordance to another study which showed that after fixed orthodontic treatment 79.4% of normal weight patients had gingivitis in comparison to 79.5% of overweight and 93.3% of obese patients due to poor oral hygiene [14]. Another study showed that 73% of adolescent patients were good compliers with oral hygiene when evaluated at the 5<sup>th</sup> month of orthodontic treatment but in this study the BMI was not considered [20]. The physiological reason for poor oral hygiene in overweight patients could be due to higher levels of pro inflammatory cytokines (TNF -  $\alpha$ , IL - 1, IL - 6) which are responsible for progression of periodontitis. Another study reported that poor compliance is common in low status families which could be due to insufficient support from home [21]. However, our study did not take socioeconomic status of the patient into consideration.

**Breakage of brackets and or bands:** Our study concluded that only 10% of normal weight patients showed breakage in comparison to breakage seen in 20% of overweight patients. This is in accordance with another study which showed that number of appliance breakage was more in overweight patients in comparison to normal weight group, though equally good results were obtained in both groups [22].

**Insufficient wearing of elastics:** Our study showed that 50% of obese BMI patients showed insufficient wearing of elastics in comparison to 26.7% of normal weight patients. Similar results were seen in another study which showed behaviour pattern of obese patients as being discontinuous in not wearing removable appliances on some days and then trying to compensate by wearing for extra time on other days [23]. In contrast another study concluded that BMI did not influence wear time of removable appliances amongst different groups [22].

**Chairside cooperation:** Our study showed that 86.7% of normal weight patients showed chairside cooperation whereas 100% cooperation was seen by overweight and obese patients. In contrast another study [22] has shown that children with higher BMI did not cooperate as well as normal weight children. The difference was accountable due to hormonal changes and bone metabolism in different BMI groups [11,12].

**Following instructions:** Our study showed that 76.7% of normal weight BMI patients followed instructions in comparison to 70% of overweight and 50% of obese patients. Another study reported that majority of obese patients achieved the median wear time and adherence level in comparison to non-obese patients, hence not needing to be treated differently [23].

**Punctuality:** Our study showed that 63.3% of normal weight patients and 50% of obese patients were punctual whereas overweight patients had the highest percentage in punctuality (70%). This also reflects the motivation of patients towards treatment. It is well known that most of the patients coming for orthodontic treatment want improvement in their facial appearance along with obtaining a better occlusion [24]. It is also known that physically not so attractive people have a lower self-esteem in comparison to attractive people. This may be the reason why overweight patients are more motivated for orthodontic treatment in comparison to normal weight patients as has been shown in our study.

There are certain limitations of our study as it is preferable to have different groups in similar number to have better comparison but in our study the sample size was small in overweight and obese category. Though there were differences between the groups, but statistically significant P value could not be determined. We cannot deny the relationship of BMI with oral health problems, we need to determine the necessity of BMI to be included as an important determinant of treatment planning and treatment outcome with fixed orthodontic appliances.

## Conclusion

The response of normal, overweight and obese patients undergoing fixed orthodontic treatment with respect to different factors considered in our study were not statistically significant.

1. In overall compliance the more overweight BMI patients had bad grade whereas more of normal weight patients had good grade and obese patients had equal poor and good grade.
2. The treatment duration of more of normal weight and overweight BMI patients was less than 20 months whereas of all obese patients it was more than 20 months.
3. The mean of missed appointments was the most for obese patients, followed by overweight and normal weight BMI group patients.

Hence need for certain efforts to be made in patients with higher BMI in order to have a successful treatment outcome.

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