Original Article

Evaluation of body weight, body mass index, and body fat percentage changes in early stages of fixed orthodontic therapy

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Abstract

Aim: The aim of this study was to evaluate and compare the changes in body weight, body mass index (BMI), and body fat percentage (BFP) during the initial stages of fixed orthodontic treatment. **Materials and Methods:** The sample for this observational prospective study included 68 individuals with fixed orthodontic appliance in the age group of 18–25 years of both the sexes (25 males and 43 females). The control group consisted of 60 individuals (24 males and 36 females). The weight, BMI, and BFP were measured using a Body Composition Monitor at three points of time "T1" initial; "T2" after 1 month; and "T2" after 3 months. The results were tabulated and analyzed with the Statistical Package for the Social Sciences software. The mean changes between different parameters in both the study and control groups and between males and females in the study group was compared by using two-tailed unpaired student's *t*-test. The statistical significance is set at $P \leq 0.05$. **Results:** There was an overall decrease in the body weight, BMI, and BFP after 1 month in the study cohort, which was statistically significant compared to the control group ($P < 0.0001$). This was followed by an increase in the parameters after the end of the 3rd month. Comparison of the parameters between the study and control group at the start of the treatment and at the end of the 3rd month had no statistical significance. There was a marked variation in the changes of these parameters between males and females of the study group, which is statistically significant (<0.0001). **Conclusion:** There is a definite reduction in the weight, BMP, and BMI at the end of the first month followed by a gain of weight, but not at the initial point by the end of the 3rd month.

Key words: *Body fat percentage, body mass index, fixed appliance, Orthodontics, weight*

INTRODUCTION

In recent decades, a high demand for orthodontic treatment has been observed. According to Baldwin,[1] 80% of adults seeking orthodontic care for themselves or their children are motivated by a desire to improve appearance, regardless of structural or functional consideration. The major option of choice for treating them is fixed orthodontic treatment.

During fixed orthodontic treatment, patients are often advised by orthodontists to follow certain dietary restrictions such as to eat soft food during the initial stages of treatment for preventing pain and discomfort

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caused by pressure sensitivity. In the absence of proper dietary charts, patients generally switch over to convenient, easy to eat food without any special attention to the nutrient values of the consumed food. A good diet plays an important role in maintaining good overall health as well as oral health.[2] Inadequate food intake in humans results in a decrease in body weight. The loss of body weight during energy restriction involves loss of variable proportions of fat.[3] A very limited number of studies have assessed the impact of fixed orthodontic treatment on weight, body mass index (BMI), and body fat percentage (BFP) due to alteration in food intake. With this in mind, an investigation to determine the effects of fixed orthodontic treatment during early stages on body weight, BMI, and BFP was conducted.

MATERIALS AND METHODS

Participants

The participants for this study were selected among the patients who were registered and due for orthodontic treatment at the Narayana Dental college, Nellore. A total of 117 young adults (age range: 18 to 35 years) who satisfied the selection criteria were selected and divided into two groups. The study group consisted of 68 individuals (25 males and 43 females) for whom the treatment was initiated. The control group consisting of 60 individuals (24 males and 36 females) included patients on nominal roll for orthodontic treatment and in whom the treatment was not started. Both the groups completed sociodemographic and food frequency questionnaires. An initial pilot study was conducted on 20 patients in order to ensure that the 95% confidence interval estimate of the parameters in patients under orthodontic treatment with five units of error of mean were selected. A minimum sample size of 62 was estimated, preferably with equal number of male and female participants. It was determined that the difference in the sample size between the treatment and control group should not exceed 20% to increase the power of the study that was set at 80%. However, in our sample, there was a difference of 23% between the study and control group. Our study population belonged to an urban population of similar socioeconomic status.

In general, inclusion criteria included participants who were medically fit with an age range of 18–35 years without any history of trauma and congenital craniofacial deformities. The exclusion criteria included patients with a history of chronic disease or chronic medication that could influence nutritional habits or body weight (e.g., anorexia nervosa, diabetes, anemia, hormonal disturbances, etc.). Subjects who would fasting at any point of the study and patients on steroid therapy, diet plans, exercise, or any other drugs were also excluded from the study. The study sample included participants in whom both the upper and lower fixed appliance was indicated with extraction of premolars in all the quadrants. Patients who required removable appliances including functional appliances were excluded from the study.

This prospective study included participants who were followed-up for the first 3 months after placement of fixed appliance treatment for the study group and without any active treatment for the control group. The body weights, BMI, and BFP of the study and control group were recorded at the baseline during the time of initiation of the treatment (T1), end of the first month (T2), end of the 3rd month (T3) at different time-periods during the treatment.

The parameters in the study and control group were listed according to time, group, and sex [Table 1]. All the parameters were measured and entered by a single observer. Height and weight were measured thrice for each participant at a particular point of time and an average reading was taken. Thus, 36 readings were taken during the entire study, as tabulated. To assess the intraexaminer and interexaminer reliability, the procedure was performed by two examiners on a trial basis on five samples of measurements taken at T1 and T2. They were blinded from the information regarding the purpose of the study. Intraexaminer reliability data demonstrated a mean percentage agreement of 98% and

Table 1: Description of the parameters in the study

Time period	Parameter	Control (C)		Study (S)	
		Male	Female	Male	Female
T1	W	CMW 1	CFW 1	SMW 1	SFW 1
	BMI	CMBMI 1	CFBMI 1	SMBMI 1	SFBMI 1
	BFP	CMBFP 1	CFBFP 1	SMBFP 1	SFBFP 1
T2	W	CMW 2	CFW 2	SMW 2	SFW 2
	BMI	CMBMI 2	CFBMI 2	SMBMI 2	SFBMI 2
	BFP	CMBFP 2	CFBFP 2	SMBFP 2	SFBFP 2
T3	W	CMW 3	CFW 3	SMW 3	SFW 3
	BMI	CMBMI 3	CFBMI 3	SMBMI 3	SFBMI 3
	BFP	CMBFP 3	CFBFP 3	SMBFP3	SFBFP 3

W=Body weight; BMI=Body Mass index; BFP=Body fat percentage. SMW=Study group Male Body weight; SMBMI=Study group Male Body Mass Index; SMBFP=Study group male Body Fat Percentage; SFW1=Study group Female Body Weight; SFBMI=Study group Female Body Mass Index; SFBFP=Study group female Body Fat Percentage; CMW=Control group Male Body Weight; CMBMI=Control group Male Body Mass Index; CMBFP=Control group Male Body Fat Percentage; CFW=Control group Female Body Weight; CFBMI=Control group Female Body Mass Index; CFBFP=Control group Female Body Fat Percentage; Sex: M=Male; F=Female; Time-period: T1=Initial; T2=end of 1st month; T3=end of 3rd month

a kappa coefficient of 0.96 indicating high reliability. In the final run, all the measurements were taken by a single observer (KV) who is a nondental (nonorthodontist) and was blind to the purpose of the study.

The difference between the T2 and T1 (T2 − T1) readings provides the mean changes in the parameters within the first month and that of the T1 and T3 gives the change in measurements at the end of 3 months (T3 − T1). The mean changes between the first month and at the end of the 3rd month can be derived from the difference in readings at T2 and T3 (T3 − T2).

The participant's height and weight were measured to calculate their BMI along with BFP. The height was measured using a stadiometer (Chasmors Limited, London, UK, 2015) [Figure 1]. Body weight and fat percentage was measured using a Karada Scan Body Composition Monitor HBF-375 (OMRON HEALTHCARE Co., Kyoto, Japan) [Figures 2 and 3]. It is more accurate for obtaining full body composition to estimate from an individual. It works under the principle of bioelectrical impedance analysis (BIA). The prediction formula gave generally good estimates of percentage of body fat (BF%).[4,5]

Body fat percentage = [Body fat Mass (Kg)/Body weight (kg)] × 100

Body mass index is defined as the individual's body mass divided by the square of his or her height. The formula universally used in medicine produce a unit of measure of kg/m^2.

BMI = Weight (kg)/[height (m)]^2

The procedures were explained to the patient and an informed consent was obtained from all the participants who voluntarily participated in the study. The study was approved by the Institutional Ethical review board.

During the course of the study, 3 patients from the study group and 10 patients from the control group were dropped and excluded from the study. During the course of the study, 10 patients (4 males and 6 females) were reluctant to take orthodontic treatments who were in the control group. In the treatment group, 2 males and 1 female joined a yoga therapy class which included restriction of diet. These subjects were excluded from the study. The final sample size analyzed includes a test group of 65 (23 males and 42 females) and control group of 50 (20 males and 30 females) [Figure 4].

RESULTS

Data collection

The data was collected and tabulated using MS Excel worksheet (MS office 2007). The readings of the control and study group were documented separately. The demographic and descriptive parameters are given in Tables 2 and 3.

Figure 1: Measuring height with stadiometer

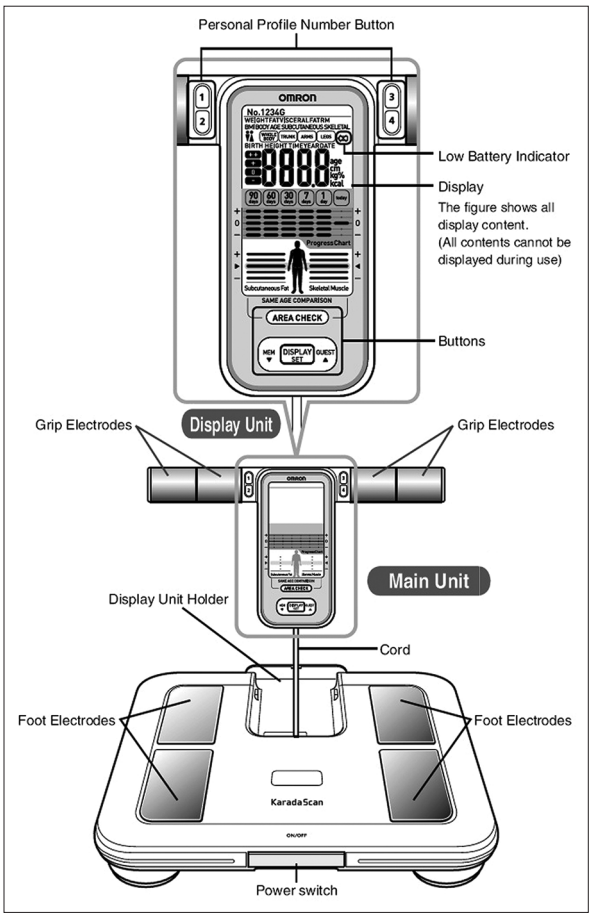


Figure 2: Karada scan body composition monitor HBF-375

Figure 3: Measuring body weight and body fat percentage

Table 2: Descriptive statistics in the study

	Study group	Control group
Total sample	*n*=65	*n*=50
Male	*n*=23	*n*=20
Female	*n*=42	*n*=30
Average age (males)	23.52±2.43	26.30±3.26
Average age (Females)	22.00±1.93	23.53±2.54

The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) V 20.0 (IBM, Newyork, USA, 2011). For continuous variables, the data values are represented as mean and standard deviation. To test the mean difference between the study and control group, a two-tailed unpaired student's *t*-test was applied [Tables 3 and 4]. To determine the change in parameters of the experimental group at different periods between males and females, independent *t*-test was applied [Tables 5 and 6]. The statistical significance was set at $P \leq 0.05$. *P* values of 0.00 generated by the software were computed as 0.01 for all practical purposes.

DISCUSSION

Diet and orthodontic treatment, being paradoxical, have a synergistic relation. Diet can affect periodontal health, oral microbe composition, and quantity; wound healing; protein synthesis; immune system function; growth; and intelligence quotient.[6] It is stated that orthodontic treatment creates a physical, physiologic, and emotional stress that in turn increases the nutrient mobilization and utilization, raising the nutritional requirements of the individual.[2] However, during orthodontic treatment it is usually recommend to eat soft food and avoid hard food due to difficulty in chewing,

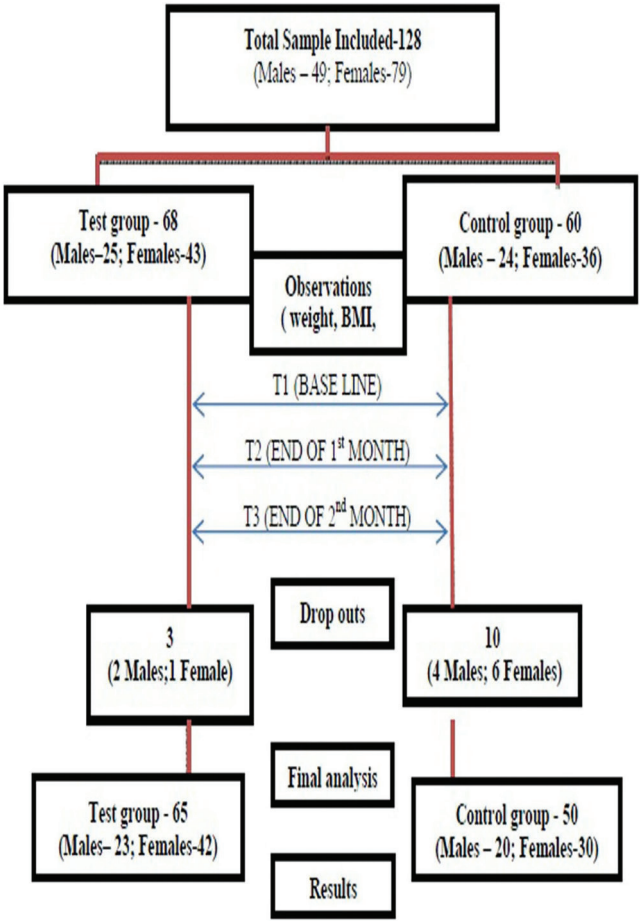


Figure 4: Flow chart of the study

risk of appliance breakage, and associated pain and discomfort. Pain and discomfort are a common sequel for many orthodontic procedures such as separator placement, archwire placement and activations, application of orthopedic forces, and debonding producing pain in patients.[7-10] A review of literature revealed there is a paucity regarding the studies on the effects of fixed orthodontic treatment on body weight, BMI, and BFP. As a result, there is a need to explore whether patients undergoing fixed orthodontic treatment are potentially at risk of general health. As an attempt to evaluate this concern, a study was designed to investigate the effects of fixed orthodontic treatment on body weight, BMI, and BFP.

The data collected from the final sample was utilized to compare the difference in changes of these parameters between the study and control group. In the second phase, the change in the parameters at time intervals of 1 and 3 months was assessed and compared within the male and female participants separately in the study group. Further, the study compared the effect of the

Table 3: The mean and standard deviation of parameters in the study group and the control group

Time period	Parameter	Study group				Control group			
		Males *n*=23		Females *n*=42		Males *n*=20		Females *n*=30	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
T1	W1	73.55	13.65	54.46	12.42	73.78	5.86	56.17	11.67
	BMI1	24.95	3.94	21.65	4.16	24.41	1.62	22.47	4.53
	BFP1	23.98	4.60	29.90	5.91	22.62	4.58	26.05	5.91
T2	W2	72.27	13.46	53.68	11.99	73.95	5.72	56.29	11.76
	BMI2	24.43	3.89	21.35	4.00	24.49	1.70	22.51	4.52
	BFP2	23.32	5.31	28.67	5.50	23.34	3.85	26.44	5.65
T3	W3	73.14	13.13	53.99	11.86	74.52	5.55	5.91	1.08
	BMI3	24.67	3.85	21.46	4.01	24.69	1.68	4.46	0.82
	BFP3	24.48	4.46	29.88	5.53	23.32	4.01	5.97	1.09

Weight in kg; BMI in kg/m²; BFP in percentage values; SD=Standard deviation

Table 4: Comparison of changes in the parameters at different time-period between study group and control group

Para meter	Time point	Mean	SD	Mean difference	*P*
Body weight (In Kg) (W)					
Males	T2-T1(S)	−1.283	1.29	−1.44	<0.0001*
	T2-T1(C)	0.165	0.71		
	T3-T2(S)	0.865	1.546	0.290	0.453
	T3-T2(C)	0.575	0.791		
	T3-T1(S)	−0.417	1.876	−0.157	0.19
	T3-T1(C)	0.740	0.970		
Females	T2-T1(S)	−0.781	1.065	−0.901	<0.0001*
	T2-T1(C)	0.120	0.673		
	T3-T2(S)	0.319	1.042	0.309	0.1395
	T3-T2(C)	0.010	0.520		
	T3-T1(S)	−0.462	1.420	−0.592	0.0333*
	T3-T1(C)	0.130	0.534		
Body mass index (kg/m²) (BMI)					
Males	T2-T1(S)	−0.513	0.520	−0.603	<0.0001*
	T2-T1(C)	0.090	0.306		
	T3-T2(S)	0.235	0.646	0.040	0.7991
	T3-T2(C)	0.195	0.270		
	T3-T1(S)	−0.278	0.670	−0.563	0.0026*
	T3-T1(C)	0.285	0.439		
Females	T2-T1(S)	−0.293	0.373	−0.326	<0.0001*
	T2-T1(C)	0.033	0.283		
	T3-T2(S)	0.107	0.485	0.110	0.2446
	T3-T2(C)	−0.003	0.204		
	T3-T1(S)	−0.186	0.555	−0.216	0.0511*
	T3-T1(C)	0.030	0.252		
Body fat % (BFP)	T2-T1(S)	−0.661	1.673	−1.386	0.005*
Males	T2-T1(C)	0.725	1.336		
	T3-T2(S)	1.157	2.361	1.177	0.0355*
	T3-T2(C)	−0.020	0.553		
	T3-T1(S)	0.496	1.997	−0.209	0.6789
	T3-T1(C)	0.705	1.097		
Females	T2-T1(S)	−1.231	1.659	−1.621	<0.0001
	T2-T1(C)	0.390	0.959		
	T3-T2(S)	1.205	2.336	1.025	0.047*
	T3-T2(C)	0.180	1.819		
	T3-T1(S)	−0.026	2.005	−0.596	0.2264

SD=Standard deviation; S=Study group; C=Control group; P values ≤0.05 are statistically significant

Table 5: The comparison of mean difference of each parameter at T1, T2, and T3 in Males (M) and Females (F) in the study group (S)

Parameter	Males				Females			
	Mean	SD	Mean	*P* value	Mean	SD	Mean	*P*
Body weight (W) (In Kg)								
W1	73.55	13.65	−1.28	<0.0001*	54.46	12.42	−0.78	<0.0001*
W2	72.27	13.46			53.68	11.98		
W2	72.27	13.46	0.87	0.014*	53.68	11.98	0.31	0.014*
W3	73.14	13.13			53.99	11.85		
W1	73.55	13.65	−0.41	0.297	54.46	12.42	−0.47	0.297
W3	73.14	13.13			53.99	11.85		
Body mass index (BMI) kg/m²								
BMI1	24.95	3.93	−0.52	<0.0001*	21.65	4.16	−0.29	<0.0001*
BMI2	24.43	3.88			21.36	4.002		
BMI2	24.43	3.88	0.24	0.09	21.36	4.002	−0.10	0.16
BMI3	24.67	3.84			21.46	4.013		
BMI1	24.95	3.93	−0.28	0.05*	21.65	4.16	−0.18	0.03
BMI3	24.67	3.84			24.67	3.84		
Body fat percentage (BFP) %								
BFP1	23.98	4.59	−0.66	0.07	29.90	5.91	-1.23	<0.0001
BFP2	23.32	5.30			28.67	5.49		
BFP2	23.32	5.30	1.16	0.02*	28.67	5.49	1.20	0.002
BFP3	24.48	4.46			29.88	5.53		
BFP1	23.98	4.59	0.5	0.24	29.90	5.91	-0.02	0.933
BFP3	24.48	4.46			29.88	5.53		

SD=Standard deviation; P values ≤0.05 are statistically significant

orthodontic treatment between the male and female patients with regard to change in this parameter.

Body weight

The findings in the present study show weight alterations in both males and females of the study group undergoing orthodontic treatment. It is observed that there is a definite weight reduction in the first 1-month period of active orthodontic treatment. Compared to the control group, the study group males showed a mean decrease in weight of 1.44 kg, and this difference was highly significant ($P < 0.0001$) [Tables 3-5]. In females also, there was a reduction of approximately 1 Kg (0.909 kg) in the first 1-month period which was highly significant ($P < 0.0001$) [Tables 6 and 7]. However, there was a gradual increase in the weight between both the males and females in the study group between the time periods T2 and T3. Thus, at the end of the 3rd month, the comparative decrease in weight was 0.15 kg in males and 0.5 kg in females, which is not statistically significant compared to the baseline point. At the end of the 3rd month, however, the original weight was not restored, which was not statistically significant.

The comparison of the weight changes at a specified interval was made within the study group [Tables 5 and 6]. The weight loss in the study group males within the first month was highly significant with a mean difference of 1.28 ($P < 0.0001$) and in females with a mean difference of 0.78 ($P < 0.0001$).

It was predicted that, with the initial archwires, there is pain in the tooth that results in avoidance of hard food that causes pain. Discomfort while eating traditional dishes and spicy food promotes to lose pleasure to eat.[11,12] There was a significant weight loss observed in females whereas males showed insignificant results from 1st to 3rd month in this study. According to Wardle *et al.*,[13] women were more likely than men to report avoiding high fat foods, eating fruit and fiber, and limiting salt. The weight loss was more expected in females. On the contrary, our findings indicate that the absolute weight loss as well as the relative proportion of the weight loss in more marked in males in the first month. It is possible that differences in food priority between genders shows changes in weight loss or gain as body weight depends on food intake.

Body mass index

The change in the weight may reflect the changes in BMI. The changes in BMI were also in tune with the changes in the body weight. [Tables 3-7]. However, at the end of the 3-month period, the overall reduction

in BMI in both the males ($P = 0.002$) and females ($P = 0.05$) in the study group was statistically significant compared to the control group. A direct comparison of the males and females in the study group with regard to change in the BMI was assessed [Tables 5 and 6]. Except for the difference in mean values in the first month (−0.22), none of the changes were statistically significant.

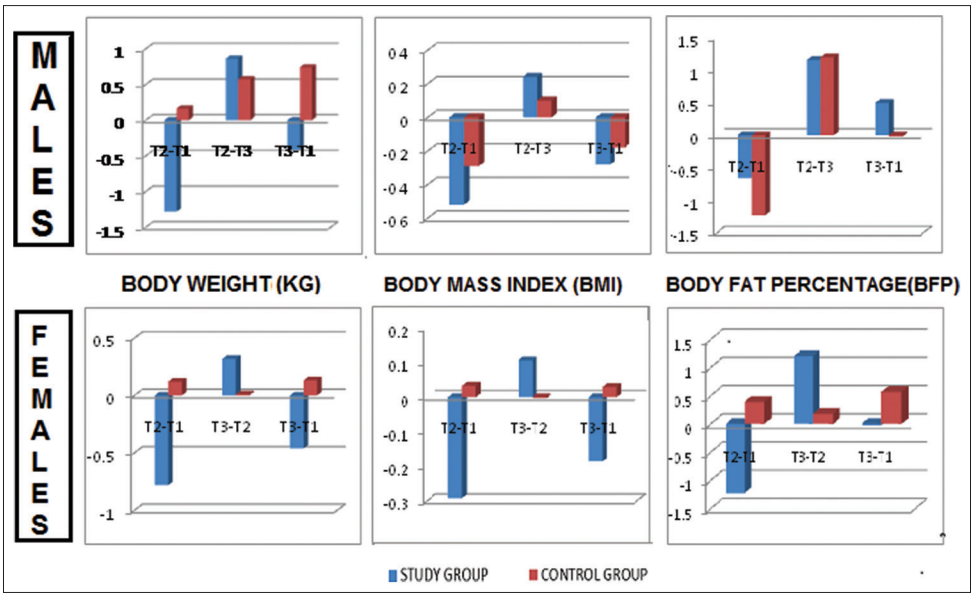
Table 6: Comparison of changes in the parameters at different time-periods between male and female in the study group

Parameters	Group Statistics				
	Sex	*N*	Mean	Std. Deviation	Std. error mean
Age	Males	23	23.52	2.428	0.506
	Females	42	22.00	1.938	0.299
Body weight (W)					
T2-T1	Males	23	73.5522	13.65237	2.84672
	Females	42	54.4571	12.42496	1.91721
T3-T2	Males	23	72.2696	13.46110	2.80683
	Females	42	53.6762	11.98533	1.84938
T3-T2	Males	23	73.1348	13.13637	2.73912
	Females	42	53.9952	11.85631	1.82947
Body Mass Index (BMI)					
T2-T1	Males	23	24.9478	3.93930	0.82140
	Females	42	21.6500	4.16139	0.64212
T3-T2	Males	23	24.4348	3.88863	0.81084
	Females	42	21.3571	4.00226	0.61756
T3-T1	Males	23	24.6696	3.84760	0.80228
	Females	42	21.4643	4.01338	0.61928
Body Fat Percentage (BFP)					
T2-T1	Males	23	23.9826	4.59927	0.95901
	Females	42	29.9024	5.91012	0.91195
T3-T2	Males	23	23.3217	5.30797	1.10679
	Females	42	28.6714	5.49946	0.84858
T3-T2	Males	23	24.4783	4.46033	0.93004
	Females	42	29.8762	5.53101	0.85345

Body fat percentage

Loss of weight may alter the percentage of fat composition in the body. This study also evaluated the effect of changes in weight on the BFP. The findings in the present research shows BFP alterations in both males and females in the study group compared to the control group [Tables 3-7]. There is a definite fall in the BFP in the first month of the start of the treatment in both the males (−0.661) and females (−1.231). The mean difference of BFP between the study and control group in males was −1.386% and that in females was −1.621%. Both these values are statistically significant at $P = 0.005$ and $P < 0.0001$, respectively [Graph 1]. There was a gradual increase in the second phase of the treatment, which resulted in no statistical difference between the control and study group at the end of the 3rd month.

The changes in the BFP in male and female participants of the study groups when assessed at different time periods revealed that the fall in BFP during the initial 1 month was statistically significant as well as its recovery during the second stage till the end of the 3rd month. In males, it was observed that at the end of the 3rd month, there was a positive balance of BFP (0.5) whereas in females



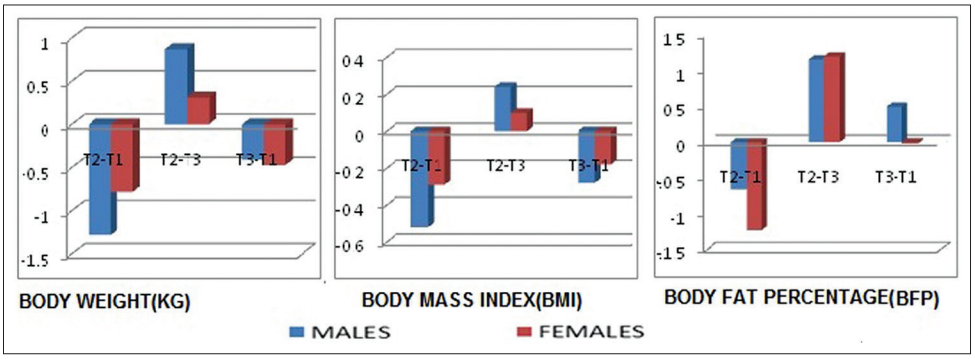
Graph 1: Comparing the changes in weight, body mass index, and body fat percentage of study group and control group

it was still the negative balance of BFP, however, it was negligible (−0.02); both are statistically not significant [Graph 2].

Neeley and Gonzales[14] reviewed BMI and influence of sedentary lifestyle and consumption of high energy foods and drinks to alter the BMI and BFP. Although no clear consensus exists, the best-accepted definition for clinically important weight loss is approximately 5% over 6–12 months.[15,16] Schott and Ludwig[17] found that the orthodontic treatment of young patients with removable appliances showed qualitative decrease in BMI over a period of 6 to 36 months.

The percentage of weight loss obtained in our study was maximum in the first month with males showing a decline of 1.7% and females exhibiting weight loss of 1.3%. However, this is not progressive as there was again a gradual increase in weight of 1.3% in males and 0.6% in females in the next 2 months. Thus, at the end of the 3rd month, the net percentage of weight loss in males was 0.4% and 0.7% in females. Thus, the study indicates the weight loss occurring during the initial stages of orthodontics is not clinically significance.

BMI[18] is the method most typically used to quantify body weight of a person in relation to their body surface.



Graph 2: Comparing the changes in weight, body mass index, and body fat percentage of males and females at different points of time study group

Table 7: Tests for equality of variances and means for the parameters between males and females in the study group

Parameter		Levene's test for equality of variances		*t*-test for equality of means				95% confidence interval	
	Assumption	F	Significance	*t*	*P*	Mean £	SEM	Lower	Upper
Body weight (W)									
T2-T1	X	0.491	0.486	5.721	<0.0001	19.09	3.34	12.43	25.76
	Y			5.564	0.000	19.09	3.43	12.16	26.02
T3-T2	X	0.789	0.378	5.725	<0.0001	18.59	3.25	12.10	25.08
	Y			5.532	0.000	18.59	3.36	11.80	25.38
T3-T1	X	0.605	0.439	5.990	<0.0001	19.13	3.19	12.75	25.52
	Y			5.811	0.000	19.13	3.29	12.49	25.78
Body Mass Index (BMI)									
T2-T1	X	0.076	0.784	3.112	0.003	3.29	1.05	1.18	5.41
	Y			3.163	0.003	3.29	1.04	1.20	5.39
T3-T2	X	0.014	0.907	2.994	0.004	3.07	1.02	1.02	5.13
	Y			3.020	0.004	3.07	1.019	1.02	5.12
T3-T2	X	0.087	0.769	3.123	0.003	3.20	1.026	1.15	5.25
	Y			3.163	0.003	3.20	1.01	1.16	5.24
Body Fat Percentage (BFP)									
T2-T1	X	1.963	0.166	−4.158	<0.0001	−5.91	1.42	−8.76	−3.07
	Y			−4.473	0.000	−5.91	1.32	−8.57	−3.26
T3-T2	X	0.123	0.727	−3.796	<0.0001	−5.34	1.40	−8.16	−2.53
	Y			−3.836	0.000	−5.34	1.39	−8.15	−2.54
T3-T2	X	1.076	0.304	−4.015	<0.0001	−5.39	1.34	−8.08	−2.71
	Y			−4.276	0.000	−5.39	1.26	−7.92	−2.86

X=Equal variances assumed; Y=Equal variances not assumed; Mean £=Mean difference; SEM=Standard error of mean; N=23 for Males group and N=42 for females group; P≤0.05 are statistically significant

It is a numerical index used to classify a person's weight in relation to "normal," and is typically defined as the weight in kilograms divided by the square of height in meters. Although BMI is an accepted measurement for categorizing obesity, it does not distinguish between lean and fatty tissues.[19] BIA is a noninvasive method and it has been applied in epidemiological studies;[20] the method was used in this study.

Unfortunately, there are no prior studies available to compare the results of our study. One of the main limitation of the present study is that it did not consider the examination of patients into categories based on their initial BMI and BFP. The loss of weight observed in this study may be attributed to a multitude of factors such as soft tissue irritation due to the appliance itself, psychological stress, and baseline dietary habits of the participants. Patients do not consider suggestions given by the practitioner regarding food intake and follow their own pattern of food intake.[21] This study can be further investigated with inclusion of other variables such as qualitative parameters in a questionnaire format regarding type of food (hard, medium soft, soft diet) nature of food (high calorie or low calorie), mode of intake (liquid or solid), intensity and quantity of intake, oral hygiene, pain, discomfort, and among different geographical locations to make it more valid. Further studies are warranted with increased sample size and inclusion of other variables.

However, it is important to know the negative consequences of such side effects to produce evidence of the quality of care orthodontists deliver to patients. Understanding patient's experiences during treatment may help to improve patient attitudes toward the treatment and allow them to cope and adapt to potential side effects.[22] It will also help shape the process of informed consent and provide patients with realistic expectations on what they may experience during the course of the treatment.

CONCLUSION

- There were definite changes in the weight, BMI, and BFP in the patients undergoing orthodontic treatment
- The changes were more pronounced at the end of 1 month and there was definite loss in weight, BMI, and total BFP
- Restoration toward normalcy was noted after 1 month but full regain of the original parameters was not noted even after three months.

Further studies are warranted with an increased sample size and inclusion of other variables.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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