

# Statistical Evaluation of Anthropometric Measures and Oral Health Status in Terms of Diet, Smoking and Brushing Habits

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**How to cite this paper:** Dagalp, R., Aka, S.P., Aydintug, I. and Iper, D. (2019) Statistical Evaluation of Anthropometric Measures and Oral Health Status in Terms of Diet, Smoking and Brushing Habits. *Health*, 11, 391-405.

<https://doi.org/10.4236/health.2019.114035>

**Received:** March 25, 2019

**Accepted:** April 25, 2019

**Published:** April 28, 2019

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## Abstract

**Introduction and Objective:** The aim of this research was to find out the interaction of anthropometric measurements particularly body mass and oral health status of Turkish young adult nationals regionally, depending on the effects of diet (food and fluid consumption), smoking and tooth brushing habits, which were determined by using the body mass index (BMI) and dental health index (DMFT). **Material and Methods:** The BMI and DMFT of 202 cases, with an age average 22.5 years, were recorded through physical and clinical examinations. Statistical evaluation of the data was checked by Cronbach's Alpha Reliability Scale and performed by analysis of variance, Somer's d and Pearson Chi-Square statistics, Poisson Regression and Odds Ratio analysis. **Results:** The results showed that the mean of BMI was at the optimum level (21.52) for all cases. The DMFT was higher for underweight females and for overweight males. The mean of DMFT according to sexes seemingly had no significant difference; however, females had 8.6% more DMFT than males. When the risk factors of dental caries were evaluated, the DMFT was found as 19.3% more for cases consuming high carbohydrate foods, 4.5% more for high beverage consumption and 18% more for smokers. **Conclusions:** In conclusion, tooth brushing 3 or more times a day is necessary to decrease the DMFT and tooth brushing 3 times a day as opposed to 1 or 2 times shows significant difference regarding oral health.

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## Keywords

Anthropometric Measures (BMI), Dental Index (DMFT), Oral Health, Diet, Smoking, Tooth Brushing

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## 1. Introduction

### 1.1. The Body Mass Status

The sanity of human health is interdependent of a myriad of factors. It has been reported that deterioration of oral health is a risk factor which generally effects the overall health and quality of life [1] [2]. Diet habits also have an influence on the general health, especially on the body mass index (BMI) or Quetelet Index (QI), which can be calculated by the ratio of body weight in kilograms to square of the height in meters and serves as a measure for the state of general health and an acceptable tool for the estimation of deviations from optimum body mass index [3]. The relationship concerning anthropometric measures (height, weight, and BMI), the dental health of a person and diet habits, are well documented [4] [5] [6]. According to BMI classification, scores below 18.5 are regarded as underweight, between 18.5 - 25 as optimum, between 25 - 30 as overweight and above 30 kg/m<sup>2</sup> as obesity [7].

### 1.2. Oral Health Status

Diet, smoking and poor tooth brushing habits are influential risk factors regarding oral health. The state of oral health can be indicated by recording the number of decayed (D), missing (M) and filled (F) or restored teeth, known as the DMFT index for permanent teeth (T), which is a world-wide accepted and used system of diagnosis in the field of oral health, and also the most important indicator of dental health. DMFT index numerically shows the total number of **D**ecayed, **M**issing and **F**illed permanent **T**eeth of a case. The main component is the dental decay which is a chronic irreversible disease of dental hard tissue that creates a need for restoration or at the stage beyond repair, an extraction of the tooth may be required. In case the third molar teeth are excluded, the score of DMFT ranges between 0 - 28, otherwise 0 - 32. This score must be written in lower case letters for primary teeth as “dmft” where the scores range from 0 - 20.

A research concerning the oral health diseases among 658 young adolescents, aged 10 - 14 years was conducted at Addis Ababa, Ethiopia, through interview and oral examinations, where prevalence of dental caries was found 47.4%, which was associated with risk factors as: age, sweets intake, tooth cleaning, poor oral hygiene and being from a poor household [8]. In another research it was stated that the proportion of teeth that were decayed, missing, or filled, nearly doubled between ages 15 and 26 years [9]. Essentially the primary cause of dental caries—demineralization of the tooth hard tissue—is the activity of *Streptococcus mutans*’ bacterial metabolism, which alters the homeostasis of the oral

cavity by releasing acidic by-products and reducing the pH in the oral cavity below 5.5 (under normal conditions the pH of oral cavity is between 6.75 - 7.25) by the fermentation of dietary carbohydrates and sugar-containing drinks that predisposes a media for dental caries [10] [11] [12]. Additionally it is stated that, the metabolic activity of *Streptococcus mutans* bacterium propagates with the intake of nicotine [13].

This research is principally based on the factors such as diet and cigarette habits that are accepted among the major factors affecting the colonization of this specific *Streptococcus mutans* bacteria and formation of dental caries; however the effects of microorganism activities remain beyond the scope of this research. In addition, the extent of the effect of the tooth brushing factor on the prevention of tooth decay has also been assessed. The aim of this research was to investigate the interaction among BMI and DMFT status of Turkish young adult nationals regionally, depending on the effects of diet (carbohydrate and beverage consumption), smoking and effectiveness of tooth brushing habits.

## 2. Materials and Methods

The data of this study were obtained from the volunteer participation of the faculty students in to the health screening and questionnaire, under the permission of Medical Director of Dentistry Hospital of Ankara University Faculty of Dentistry, dated November 07, 2018. The study was carried out in accordance with the principles of the Declaration of Helsinki.

In this research, body mass and oral health status of 202 cases (100 male, 102 female) with an average age of 22.5 years (range 20 - 25) were recorded through physical and clinical examinations carried out by the second author who is a qualified dental professional and had undergone standardization and measurement training. The sample size was calculated at least for 156 cases depending on a statistical power of 85% and  $\alpha$ -error of 5%. The effective size for the lowest odds-ratio 1.045 was required for 174 cases as sample size, conversely effective size for the highest odds-ratio 1.398 was required for 156 cases as sample size. However, in this study the sample size was taken as 202 cases for a more reliable result. These cases were from the five regions of Turkey which were; 17.8% West, 8.5% East, 19.3% North, 16.3% South and 38.1% from the Center.

During the clinical survey, anamneses were taken from each individual; showing their food and drinking preferences, the amount of cigarettes they smoke if they are a smoker and the frequency of their tooth brushing. Afterwards, the height and weight of the individuals were measured in physical examination and recorded. During the physical examinations, the BMI index was calculated by dividing the body weight in kilograms to the square of the body height in meters for young adult subjects of both sexes. To numerically identify the oral health status for each individual, the total number of DMFT index were recorded according to regions of Turkey. Third molars 18, 28, 38 and 48 were excluded from this research due to the excessive variations of these teeth, therefore the survey was conducted on the 28 permanent teeth of each in-

dividual. The limitations of this method appear for dentition where there are congenital absence or impact status of any tooth, where the examination of such tooth requires radiographs for accurate assessment of missing tooth.

In this research, the factors associated with dental health such as the groups of food (carbohydrate-rich foods versus protein and fiber-rich foods) and fluid consumption preferences (beverage, fruit juice other than water versus bottled natural mineral water which originates from natural or underground sources such as an underground reservoir or spring) [14], smoking habits (smoking versus non-smokers) and brushing habits (1 or 2 times a day versus 3 or more times a day) were recorded and the dataset was statistically evaluated. Statistical analysis methods used for this research were Pearson Chi-squared test, Student's t test and odds-ratios used for comparison of proportions according to different groups.

### 3. Results

The reliability of this research was tested according to the Cronbach's Alpha Reliability Scale and intraclass correlation, which define the strong relation of variables with each other in the dataset. These scales gave a reliability coefficient of 78.7%, that presents high internal consistency among the variables (*minimum acceptable value is considered to be 70%*) [15]. Additionally, DMFT index was fitted by Poisson Regression on the variables; sex, region, food, drinking, smoking and brushing habits, where the model was found significant ( $p$  value = 0.009 < 0.05).

#### 3.1. The Body Mass Status

The result of physical examinations of this research performed on 202 subjects, with an age range of 20 - 25, showed that the BMI was; minimum 16.33, maximum 29.71 where the mean was 21.52 which falls in to the optimum level (**Table 1**). The frequency of sex and BMI in total cases showed that, 79.7% of cases were within the confines of normal BMI range, and the frequency of BMI due to sexes showed that, females were more in the underweight group whereas males were more in the overweight group (**Table 2**). According to analysis of variance, Somer's d and Pearson Chi-Square statistics, BMI was statistically significant for sexes ( $p$  value < 0.05), where the difference stems especially from the underweight group. When the distribution of DMFT was examined, for the relation among BMI and sexes due to regions by cross tabulation, it is found that there was a statistical significance for underweight and overweight groups ( $p$  value < 0.05). The maximum DMFT percentage for underweight female cases were at West (30.1%) and for overweight male cases were at East (18.4%), however the maximum optimal normal weight cases took place at the Center for both sexes (female cases 23.0%, male cases 18.3%) (**Table 3**).

#### 3.2. Oral Health Status

In this research, during the clinical examination it was found that, out of 5656

teeth, 1201 teeth were in the scope of DMFT; where 579 were decayed, 80 were missing and 542 were filled. There was no significant difference between average DMFT according to sexes ( $p$  value  $> 0.05$ ). As a control group intact tooth was taken to determine the Odds Ratios (OR), which is a measure of association between the variable of interest (*taken as an exposure*) and an outcome [16]. According to OR, the tooth DMFT was 8.6% more for females than males (Table 4). The designated factors that affect oral health status which are; diet (food and fluid consumption), smoking and tooth brushing were examined and the statistical results are given below.

### 3.2.1. Diet Habits (Food and Fluid Consumption)

This research revealed that the DMFT of cases were 19.3% more for individuals consuming high carbohydrate food diet, compared to diets with protein and fibrous food. According to daily beverage consumption; DMFT was found as 4.5% more for individuals who prefer to consume juice, for their need for water, rather than drinking mineral water (Table 5). The frequency of DMFT according to the regions and diet habits showed that the diet of the subjects was generally based on the Carbohydrate rich foods and the DMFT for people who consume protein and fiber rich foods, showed a decrease up to 19.8, 5.9, 5.4, 29.3 and 9.5 times respectively for West, East, North, South and Central regions of Turkey, when compared to cases consuming carbohydrate rich foods (Table 6). The caries' prevalence DMFT due to the regions and drinking habits also indicate decrease up to 7.0, 3.3, 8.1, 2.2 and 8.9 times respectively for West, East, North, South and Central regions of Turkey, for people consuming mineral water, compared to high consumption of beverages (Table 7).

### 3.2.2. Smoking Habits

In this study smoking habit was determined as another factor increasing DMFT which was found as 18% more for smokers than non-smokers as seen in Table 5. Among the subjects 70 individuals were smokers, 25.7% of which were females, who were smoking average 9 cigarettes daily and 74.3% of them were males who smoke average 10.9 cigarettes daily (minimum 1 to maximum 30 cigarettes daily, mean 10.41 std. 6712). The maximum percentage of smokers of both sexes were seen at the Central region (41.4%).

### 3.2.3. Tooth Brushing Habits

The DMFT was found 18.5% more when tooth brushing was done 1 or 2 times as opposed to 3 or more times, in addition to brushing 1 or 2 times per day, DMFT was increased by 39.8% when the diet mainly includes carbohydrates and in the case where the diet includes beverages DMFT was increased by 24.7% seen in Table 5. The decrease rate of DMFT for the cases who brush their teeth 3 or more times instead of 1 or 2 times a day were as follows; for non-smokers it was 7.5%, for people who smoke 1 - 10 cigarettes a day it was 4.7%, for the last group who smoke more than 11 cigarettes a day it was 23.4% (Table 8). The frequency of DMFT according to the regions and brushing habits present decrease up to

4.1, 6.5, 82.3, 14.4 and 4.8 times respectively for West, East, North, South and Central regions of Turkey, for people who brush their teeth 3 or more times a day, compared to 1 or 2 times a day (**Table 9**). After eliminating the effects of high carbohydrate foods, beverages and cigarette consumption, the results showed that daily 3 or more times brushing decreases the DMFT by 31.0% (**Table 10**).

**Table 1.** Descriptive statistics of young adults' body mass index (BMI) for 202 cases (102 female, 100 male).

| Variables                        | Minimum | Maximum | Mean   | Std. Deviation |
|----------------------------------|---------|---------|--------|----------------|
| Age (Year)                       | 20      | 25      | 22.51  | 1.22           |
| Stature (cm)                     | 151     | 190     | 170.40 | 8.54           |
| Body Weight (Kg)                 | 44      | 96      | 62.90  | 11.55          |
| BMI (Kg/cm <sup>2</sup> )        | 16.33   | 29.71   | 21.52  | 2.67           |
| Female BMI (Kg/cm <sup>2</sup> ) | 16.33   | 29.71   | 20.27  | 2.25           |
| Male BMI (Kg/cm <sup>2</sup> )   | 16.72   | 29.35   | 22.80  | 2.45           |

**Table 2.** Frequency of sex and BMI among total cases.

| Sex  | BMI            |                 |               | Sex % in Total |
|--|----------------|-----------------|---------------|----------------|
|  | Under weight % | Normal weight % | Over weigh t% |                |
| Female   | 17.6           | 78.4            | 3.9           | 50.5           |
| Male   | 3              | 81              | 16            | 49.5           |
| <b>BMI % in Total</b><br>(Kg/cm <sup>2</sup> ) | 10.4           | 79.7            | 9.9           | 100            |

**Table 3.** Frequency of BMI and DMFT indexes according to the sex and regions.

| Region | Sex    | Under weight |              |           | Normal weight |              |           | Over weight |              |           |
|--------|--------|--------------|--------------|-----------|---------------|--------------|-----------|-------------|--------------|-----------|
|        |        | % of N       | Mean of DMFT | % of DMFT | % of N        | Mean of DMFT | % of DMFT | % of N      | Mean of DMFT | % of DMFT |
| West   | Female | 23.8         | 7.6          | 30.1      | 7.5           | 5.3          | 7.2       | 0.0         | 0*           | 0.0       |
|        | Male   | 4.8          | 7.0          | 4.9       | 9.9           | 5.5          | 8.8       | 10.0        | 3.5          | 7.0       |
|        | Total  | 28.6         | 7.5          | 35.0      | 17.4          | 5.4          | 16.0      | 10.0        | 3.5          | 7.0       |
| East   | Female | 0.0          | 0            | 0.0       | 1.9           | 7.0          | 2.0       | 0.0         | 0            | 0.0       |
|        | Male   | 0.0          | 0            | 0.0       | 7.5           | 3.8          | 5.3       | 10.0        | 9.5          | 18.4      |
|        | Total  | 0.0          | 0            | 0.0       | 9.3           | 4.5          | 7.3       | 10.0        | 9.5          | 18.4      |
| North  | Female | 14.3         | 6.7          | 15.4      | 11.2          | 5.5          | 11.0      | 10.0        | 8.0          | 14.0      |
|        | Male   | 4.8          | 10           | 7.0       | 7.5           | 6.5          | 8.7       | 15.0        | 6.7          | 17.5      |
|        | Total  | 19.0         | 7.5          | 22.4      | 18.6          | 5.9          | 19.7      | 25.0        | 7.2          | 31.6      |
| South  | Female | 14.3         | 5.7          | 11.2      | 7.5           | 5.8          | 7.5       | 0.0         | 0            | 0.0       |
|        | Male   | 0.0          | 0            | 0.0       | 8.7           | 5.4          | 8.2       | 20.0        | 3.3          | 17.5      |
|        | Total  | 14.3         | 5.7          | 11.2      | 16.1          | 5.5          | 15.7      | 20.0        | 3.3          | 17.5      |

## Continued

|        |        |       |     |       |       |     |       |       |     |       |
|--------|--------|-------|-----|-------|-------|-----|-------|-------|-----|-------|
|        | Female | 33.3  | 5.4 | 28.0  | 21.7  | 6.0 | 23.0  | 10.0  | 4.5 | 8.8   |
| Center | Male   | 4.8   | 5.0 | 3.5   | 16.8  | 6.3 | 18.3  | 25.0  | 3.6 | 16.7  |
|        | Total  | 38.1  | 5.4 | 31.5  | 38.5  | 6.2 | 41.3  | 35.0  | 3.9 | 25.4  |
|        | Female | 85.7  | 6.3 | 84.6  | 49.7  | 5.8 | 50.7  | 20.0  | 6.3 | 22.8  |
| Total  | Male   | 14.3  | 7.3 | 15.4  | 50.3  | 5.7 | 49.3  | 80.0  | 4.8 | 77.2  |
|        | Total  | 100.0 | 6.4 | 100.0 | 100.0 | 5.7 | 100.0 | 100.0 | 5.1 | 100.0 |

\*0 means no cases present at this region.

**Table 4.** Frequency of DMFT versus intact tooth among total number of tooth examined for both sexes (Odds Ratio = 1.086, DMFT was 8.6% more for females than males).

| Sex    | DMFT | Intact Tooth | Total Tooth |
|--------|------|--------------|-------------|
| Female | 626  | 2230         | 2856        |
| Male   | 575  | 2225         | 2800        |
| Total  | 1201 | 4455         | 5656        |

**Table 5.** Frequency of DMFT for food, drinking, smoking and brushing habits.

| Habits   | Preference              | N of DMFT | N of Intact Tooth | N of Total Tooth | Odds Ratios |
|--|-------------------------|-----------|-------------------|------------------|-------------|
|  | <i>Carbohydrate RF*</i> | 1046      | 4106              | 5152             |             |
| Food Consumption   | Protein and Fiber RF    | 112       | 392               | 504              | 1.193       |
|  | Total                   | 1158      | 4498              | 5656             |             |
|  | Beverages               | 1022      | 3766              | 4788             |             |
| Drinking Consumption   | Mineral Water           | 179       | 689               | 868              | 1.045       |
|  | Total                   | 1201      | 4455              | 5656             |             |
| Smoking Habit**<br>[For 70 smoker and<br>randomly chosen 70<br>Non-smoker] | Smoker                  | 388       | 1572              | 1960             |             |
|  | Non-smoker              | 339       | 1621              | 1960             | 1.180       |
|  | Total                   | 727       | 3193              | 3920             |             |
|  | 1 or 2                  | 1053      | 3819              | 4872             |             |
| Brushing   | 3 or more               | 148       | 636               | 784              | 1.185       |
|  | Total                   | 1201      | 4455              | 5656             |             |
| Daily brushing habit<br>for cases consuming<br>preferably                  | 1 or 2                  | 969       | 3383              | 4352             |             |
|  | 3 or more               | 119       | 581               | 700              | 1.398       |
|  | <i>Carbohydrate RF</i>  | Total     | 1088              | 3964             | 5052        |
| Daily brushing habit<br>for cases consuming<br>preferably beverages        | 1 or 2                  | 899       | 3217              | 4116             |             |
|  | 3 or more               | 123       | 549               | 672              | 1.247       |
|  | Total                   | 1022      | 3766              | 4788             |             |

\*RF: Rich Food, \*\* Smoking Habit was not homogenous for the young adults (number of non-smokers were 65%, smokers were 35%), therefore randomly equal number of cases (70 for each) were selected.

**Table 6.** Frequency of DMFT according to the regions and diet habits.

| Region | Diet Habit                  | N of Tooth | N of DMFT | % of DMFT out of Total | % of DMFT within Region | Amount of Decrease Rate |
|--------|-----------------------------|------------|-----------|------------------------|-------------------------|-------------------------|
| West   | <i>Carbohydrate RF*</i>     | 952        | 199       | 16.6                   | 95.2                    | 19.8                    |
|        | Protein and fiber <i>RF</i> | 56         | 10        | 0.8                    | 4.8                     |                         |
|        | Total                       | 1008       | 209       | 17.4                   | 100                     |                         |
| East   | <i>Carbohydrate RF</i>      | 392        | 77        | 6.4                    | 85.6                    | 5.9                     |
|        | Protein and fiber <i>RF</i> | 84         | 13        | 1.1                    | 14.4                    |                         |
|        | Total                       | 476        | 90        | 7.5                    | 100                     |                         |
| North  | <i>Carbohydrate RF</i>      | 952        | 214       | 17.8                   | 84.3                    | 5.4                     |
|        | Protein and fiber <i>RF</i> | 140        | 40        | 3.3                    | 15.7                    |                         |
|        | Total                       | 1092       | 254       | 21.1                   | 100                     |                         |
| South  | <i>Carbohydrate RF</i>      | 868        | 178       | 14.8                   | 96.7                    | 29.3                    |
|        | Protein and fiber <i>RF</i> | 56         | 6         | 0.5                    | 3.3                     |                         |
|        | Total                       | 924        | 184       | 15.3                   | 100                     |                         |
| Center | <i>Carbohydrate RF</i>      | 1988       | 420       | 35.0                   | 90.5                    | 9.5                     |
|        | Protein and fiber <i>RF</i> | 168        | 44        | 3.7                    | 9.5                     |                         |
|        | Total                       | 2156       | 464       | 38.6                   | 100                     |                         |
| Total  | <i>Carbohydrate RF</i>      | 5152       | 1088      | 90.6                   | 90.6                    | 9.6                     |
|        | Protein and fiber <i>RF</i> | 504        | 113       | 9.4                    | 9.4                     |                         |
|        | Total                       | 5656       | 1201      | 100.0                  | 100.0                   |                         |

\*RF: Rich Food.

**Table 7.** Frequency of DMFT according to regions and drinking habits.

| Region | Drink Variety | N of Cases | N of DMFT | % of DMF out of Total DMFT | % of DMFT within Region | Amount of Decrease Rate |
|--------|---------------|------------|-----------|----------------------------|-------------------------|-------------------------|
| West   | Beverages     | 896        | 183       | 15.2                       | 87.6                    | 7.0                     |
|        | Mineral water | 112        | 26        | 2.2                        | 12.4                    |                         |
|        | Total         | 1008       | 209       | 17.4                       | 100                     |                         |
| East   | Beverages     | 364        | 69        | 5.7                        | 76.7                    | 3.3                     |
|        | Mineral water | 112        | 21        | 1.7                        | 23.3                    |                         |
|        | Total         | 476        | 90        | 7.5                        | 100                     |                         |
| North  | Beverages     | 952        | 226       | 18.8                       | 89                      | 8.1                     |
|        | Mineral water | 140        | 28        | 2.3                        | 11                      |                         |
|        | Total         | 1092       | 254       | 21.1                       | 100                     |                         |
| South  | Beverages     | 644        | 127       | 10.6                       | 69                      | 2.2                     |
|        | Mineral water | 280        | 57        | 4.7                        | 31                      |                         |
|        | Total         | 924        | 184       | 15.3                       | 100                     |                         |
| Center | Beverages     | 1932       | 417       | 34.7                       | 89.9                    | 8.9                     |
|        | Mineral water | 224        | 47        | 3.9                        | 10.1                    |                         |
|        | Total         | 2156       | 464       | 38.6                       | 100                     |                         |
| Total  | Beverages     | 4788       | 1022      | 85.1                       | 85.1                    | 5.7                     |
|        | Mineral water | 868        | 179       | 14.9                       | 14.9                    |                         |
|        | Total         | 5656       | 1201      | 100.0                      | 100                     |                         |



**Table 8.** Frequency of DMFT for smoking and brushing habits.

| Smoking Habit               | Daily Brushing Habit | N of Tooth | N of DMFT | % of DMFT out of Total | % of DMFT within Region | Amount of Decrease Rate |
|-----------------------------|----------------------|------------|-----------|------------------------|-------------------------|-------------------------|
| Non-smoker                  | 1 or 2               | 3136       | 717       | 59.7                   | 88.2                    |                         |
|                             | 3 or more            | 560        | 96        | 8.0                    | 11.8                    | 7.5                     |
|                             | Total                | 3696       | 813       | 67.7                   | 100                     |                         |
| 1 - 10 cigarettes/day       | 1 or 2               | 1036       | 219       | 18.2                   | 82.3                    |                         |
|                             | 3 or more            | 196        | 47        | 3.9                    | 17.7                    | 4.7                     |
|                             | Total                | 1232       | 266       | 22.1                   | 100                     |                         |
| More than 11 cigarettes/day | 1 or 2               | 700        | 117       | 9.7                    | 95.9                    |                         |
|                             | 3 or more            | 28         | 5         | 0.4                    | 4.1                     | 23.4                    |
|                             | Total                | 728        | 122       | 10.2                   | 100                     |                         |
| Total                       | 1 or 2               | 4872       | 1053      | 87.7                   | 87.7                    |                         |
|                             | 3 or more            | 784        | 148       | 12.3                   | 12.3                    | 7.1                     |
|                             | Total                | 5656       | 1201      | 100.0                  | 100                     |                         |

**Table 9.** Descriptive analysis of DMF according to regions and brushing habits.

| Region | Brushing Habit/Times a Day | N of Cases | N of DMF | of DMF out of Total DMF | of DMF within Region | Amount of Decrease Rate |
|--------|----------------------------|------------|----------|-------------------------|----------------------|-------------------------|
| West   | 1 or 2                     | 840        | 168      | 14.0                    | 80.4                 |                         |
|        | 3 or more                  | 168        | 41       | 3.4                     | 19.6                 | 4.1                     |
|        | Total                      | 1008       | 209      | 17.4                    | 100                  |                         |
| East   | 1 or 2                     | 392        | 78       | 6.5                     | 86.7                 |                         |
|        | 3 or more                  | 84         | 12       | 1.0                     | 13.3                 | 6.5                     |
|        | Total                      | 476        | 90       | 7.5                     | 100                  |                         |
| North  | 1 or 2                     | 1036       | 251      | 20.9                    | 98.8                 |                         |
|        | 3 or more                  | 56         | 3        | 0.2                     | 1.2                  | 82.3                    |
|        | Total                      | 1092       | 254      | 21.1                    | 100                  |                         |
| South  | 1 or 2                     | 812        | 172      | 14.3                    | 93.5                 |                         |
|        | 3 or more                  | 112        | 12       | 1.0                     | 6.5                  | 14.4                    |
|        | Total                      | 924        | 184      | 15.3                    | 100                  |                         |
| Center | 1 or 2                     | 1792       | 384      | 32.0                    | 82.8                 |                         |
|        | 3 or more                  | 364        | 80       | 6.7                     | 17.2                 | 4.8                     |
|        | Total                      | 2156       | 464      | 38.6                    | 100                  |                         |
| Total  | 1 or 2                     | 4872       | 1053     | 87.7                    | 87.7                 |                         |
|        | 3 or more                  | 784        | 148      | 12.3                    | 12.3                 | 7.1                     |
|        | Total                      | 5656       | 1201     | 100.0                   | 100.0                |                         |

**Table 10.** The effect of tooth brushing on DMFT versus intact tooth among total number of tooth for the cases who consume high carbohydrate food, beverages and smoke.

| Brushing Habit /Times a Day | DMFT | Intact Tooth | Total Tooth |
|-----------------------------|------|--------------|-------------|
| 1 or 2                      | 247  | 985          | 1232        |
| 3 or more                   | 18   | 94           | 112         |
| Total                       | 265  | 1079         | 1344        |

(Odds Ratio = 1.310, DMFT was 31.0% more for cases who brush their teeth 1 or 2 times than 3 or more).

#### 4. Discussion

In this research the association between anthropometric measures (BMI) and dental caries has been evaluated for 202 cases, with a mean age of 22.51 and significant results were obtained for the relation of BMI, sex and region due to DMFT ( $p$  value < 0.05). The frequency of sex and BMI in total cases showed that, 17.6% of females were in the underweight group where and 16% of the males were in the over weight group (**Table 1** and **Table 2**). The results of this research showed that within the BMI groups, maximum DMFT percentage was observed for underweight female cases at West, overweight male cases at East and optimal cases at the Center for both sexes (**Table 3**). Plus, the mean of DMFT was 8.6% more for females than males according to OR as seen in (**Table 4**). Even though these results depend on the inhomogeneous distribution of the cases within the regions, the maximum consumption rates of all the factors were at the Center. This outcome not only shows the association of BMI, DMFT, carbohydrates, beverages and cigarettes, but also the interactions of these factors according to selected regions. This outcome not only shows the association of BMI, DMFT, carbohydrates, beverages and cigarettes, but also the interactions of these factors according to selected regions. These findings support a similar study that found that, tooth decay was associated with high and low body mass indexes [4]. Additionally a research conducted in India revealed that there was a significant association between the indexes of anthropometric measures and dental caries for the 15 - 19 year age group (caries scores of overweight males and females were higher), whereas there were no relation found for the age group of 12 - 14 years [5]. These findings seem natural, as teeth at this age have recently erupted. A longitudinal investigation realized at Dunedin, New Zealand following cases in the age range of 5 - 26 years proved that the number of decayed, missing, or filled teeth would be twofold between the ages 15 and 26 years [9].

A research conducted in Abu Dhabi on children with an age range from 18 months to 4 years showed that the frequent use of carbohydrate foods and high-sugar beverages was directly proportional with the DMFT which disclosed 41% dental caries for this age group [17]. Fluid intake data also had been analyzed for 2 - 10-year-old 5985 children and there was remarkably more dental caries detected in children who consume high carbonated drinks as opposed to

children who consume; milk, water or juices, therefore accepted as a risk factor for dental caries for primary teeth [18]. A four-year study showed positive relation between consuming sugar sweetened beverages and dental caries among adults where DMFT was 33% more for cases who drink beverages more than 3 times a day as compared to the control group [19]. A review of the literature, to find out the relationship between sucrose and dental caries, from years 1856 to 2007 revealed that, it is not the sugar amount, but its frequency which has a moderate significant relation with dental caries [20]. This research showed that, consuming carbohydrate rich foods rather than protein and fibrous food increases the risk for dental caries occurrence 19.3%, preferring beverages and fruit juices instead of water increases caries formation rate as 4.5% (Table 5). On the contrary the % of DMFT shows a decrease rate of totally 9.6 for people consuming protein and fiber rich foods and 5.7 for cases preferring mineral water (Table 6 and Table 7).

It is also found that not only food and drink intake, but also smoking may affect the oral health and sufficient daily tooth brushing is a major factor in decreasing the DMFT. In this study the ratio of smoking habits for females was one third of males which may be sourced culturally. However, the average number of cigarettes were approximate for both sexes. The results showed that; smoking habits were a factor, increasing the dental decay which caused 18% more tooth decay for smokers than non-smokers as seen in Table 5. The destructive effects of cigarette have not been fully observed for people who smoke a few cigarettes, since the average age of the individuals was 22.5, however it provides a prediction that smoking may have an effect at the older ages. It is also shown that adequate daily tooth brushing especially 3 or more, significantly decrease the value of DMFT index. The highest prevalence of dental loss was seen for smokers who smoke more than 11 cigarettes/day 95.9% for cases who brush their teeth 1 or 2 times a day, conversely the decrease rate was 23.4 times when the subjects brush their teeth 3 or more times a day (Table 8). This result shows that the caries prevention effect of tooth brushing is much more evident for heavy smokers. These findings supported another research, where the effect of daily cigarette smoking factor on the increase of dental decay was examined on 955 adults by a 4-year clinical study, which proved that smokers had 1.7 times more decayed teeth than non-smokers where the rate for heavy smokers was twice as much. It is stated that tooth brushing frequency, sugar intake frequency and dental attendance explains only 20% of the effect of daily smoking on caries development [21].

It has been reported that, prevention of dental diseases is possible by; high quality foods coupled with healthy dietary modifications and personal hygiene measures such as, effective and daily regular brushing. It has to be noted however that ineffective tooth brushing has been shown as a factor associated with dental caries, although the frequency of brushing is adequate [22] [23] [24]. Another research conducted on oral hygiene practices of 12 - 13 years old school children supported our findings, DMFT was higher for cases who brush their

teeth irregularly than cases who brush their teeth once or twice a day [25]. In a cross-sectional study performed on a sample of 658 children, aged 10 - 14 years, the frequency of tooth cleaning was shown as; 19.3% once a week, 38.5 few times a week, 32.6 once a day, other 9.6 where the prevalence of dental caries was 47.4%. This study emphasized on public oral health education program [8].

It is clearly proved that, for all cases when tooth brushing was done 1 or 2 times as opposed to 3 or more times, DMFT was found 18.5% more, additionally for cases who mostly consume carbohydrate rich foods DMFT was 39.8% more, and for cases who consume beverages than mineral water the DMFT was 24.7% more (Table 5). The results also showed that; the decrease rates of DMFT were respectively; 7.5, 4.7, and 23.4 for non-smokers, for smokers who smoke 1 - 10 cigarettes/day, and for smokers who smoke more than 11 cigarettes/day, for individuals who brush their tooth 3 or more times in a day versus 1 or 2 times (Table 8). Plus, the frequency of DMFT according to the regions and brushing habits present decrease up to 4.1, 6.5, 82.3, 14.4 and 4.8 times respectively for West, East, North, South and Central regions of Turkey (Table 9), and the results showed 31.0% decrease of DMFT, when the effects of high carbohydrate food, beverages and cigarette consumption were eliminated for cases, who daily brushed their teeth 3 or more times a day (Table 10). The statistical descriptive analysis of dental health status due to regions and brushing habits according to DMFT index shows that, tooth brushing must be done at least 3 times a day especially after each meal.

## 5. Conclusions

The following facts are derived from this research:

- 1) The average of body mass index (BMI) was 21.52% and 79.7% of the cases were within the confines of normal BMI range (18.5 - 25) for the adults, with an age average of 22.5 years.
- 2) Tooth decay was associated with high and low body mass indices. DMFT was slightly lower for individuals having optimal body index.
- 3) The mean of DMFT according to sexes showed 8.6% more DMFT for females than males.
- 4) DMFT was found as 19.3% more for high carbohydrate food consuming diets and, 4.5% more for high beverage consuming diets.
- 5) The DMFT was found 18.5% more when tooth brushing was done 1 or 2 times as opposed to 3 or more times. In addition to brushing 1 or 2 times per day, DMFT was increased by 39.8% when the diet mainly consumes carbohydrates. As for the case of the diet that includes drinking beverages, when tooth brushing frequency was 1 or 2 times per day, the DMFT was 24.7%.
- 6) Smokers showed 18% more DMFT than non-smokers. The highest prevalence of dental loss was detected for smokers who smoke more than 11 cigarettes/day but, it was found that smokers who brush their teeth 3 or more times a day showed a decrease rate of DMFT 23.4 times. It is evident that 3 or

more times tooth brushing reduces the DMFT; therefore attention must be given to oral health measures such as tooth brushing after each meal.

- 7) The results showed that daily, 3 or more times tooth brushing decreases the DMFT by 31.0% when the effects of high carbohydrate food, beverages and smoke consumption were eliminated.

As expressed by the Bard hundreds of years ago, toothache is an excruciatingly painful thing to suffer, enough to break the most stoic of philosophers. The importance of taking good care of dental health, for children and adults alike, cannot be overstated.

*“I pray thee, peace. I will be flesh and blood;  
For there was never yet philosopher  
That could endure the toothache patiently,  
However they have writ the style of gods  
And made a push at chance and sufferance”.* (Shakespeare W) [26]

#### **Further research is recommended for the following subjects:**

- 1) In this research the mean DMFT was slightly lower for individuals having optimal body index. This relation between body mass and dental caries should also be investigated for older age groups.
- 2) Dental health problems were found more for smokers than nonsmokers. However, the effects of smoking in this age group were not significant, as they are young and have been smoking for a few years yet. Therefore, such research for older ages should be conducted longitudinally for each decade.

### **Acknowledgements**

As the authors of this research, would like to give our special thanks for the voluntary participation of our contributors, for the information they provide during their anamnesis records and clinical oral examinations. We also gratefully thank Bahar Aka MSc., for her sincere support during the study.

### **Statement of Disclosure**

The authors of this study published the article in a consensus. There is no conflict of interest among the authors.

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