# Investigating Osteoporosis-related Nutritional Behaviors: The theory of Planned Behavior

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## Abstract

*Background:* Osteoporosis is one of the most common problems in health systems and a hidden epidemic in the modern world. The aim of the present study was to investigate osteoporosis-related nutritional behaviors based on the theory of planned behavior (TPB) in adolescent girls in Sari, Iran.

*Methods:* This cross-sectional study was performed on 341 12-16-year high school students who were selected by multi-stage random sampling method in Sari, Iran. Data collection was carried out using a TPB-based researcher-made questionnaire consisting of three parts; part A included questions on demographic characteristics and osteoporosis-related diseases, part B discussed osteoporosis nutritional behaviors based on TPB constructs, including behavioral attitudes, subjective norm, perceived behavioral control, and intention, and part C was the Food frequency questionnaire (FFQ). Part A and B were completed by students and part C was completed through an interview, taking into account the number of food units based on the recommended standards of the Food Pyramid. Data analysis was also performed using regression analysis, Pearson correlation and ANOVA in SPSS ver. 20.

*Results:* The present study demonstrated a significant relationship between perceived behavioral control and osteoporosis predisposing nutritional behaviors (P<0.05). Also, among TPB constructs, subjective norm (β=0.138) and intention (β=0.136) were the main determinants of osteoporosis-preventive behaviors; and subjective norm (β=0.182) and knowledge (β=0.155) played the most important roles in determining osteoporosis-predisposing nutritional behaviors.

*Conclusion:* Based on the results, there is a significant relationship between TPB constructs and osteoporosis-related nutritional behaviors. Considering the role of TPB constructs and lower consumption of the osteoporosis-preventing group, there is a need for educational interventions among adolescents, parents and other people influencing adolescents.

*Key Words:* Adolescent, Nutritional behavior, Osteoporosis, Theory of planned behavior.

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## 1- INTRODUCTION

Osteoporosis is one of the most common problems in health systems and a hidden epidemic in the modern world (1). According to the international osteoporosis foundation at the fourth international symposium in 1993, osteoporosis refers to a widespread bone disease characterized by a decrease in bone mass and a change in the microscopic structure of its tissue (2). Osteoporosis is called a silent disease because bone loss occurs asymptomatically until pain and fractures are seen in advanced stages (3). More than 200 million people are currently suffering from this disease worldwide. The osteoporosis prevalence is estimated 15% among women aged 50 to 60 years and 45% among those over 70 years, but its prevalence is lower in men aged 50 to 60 years (2.4%) and aged over 70 years (17%) (4). In Iran, almost 34,000 years of useful life is lost due to osteoporosis and one in every three women and one in every twelve men get osteoporosis (5).

In addition to physical problems, osteoporosis imposes great financial costs on the individual and society (6). The risk of osteoporosis-related death in women is equal to the risk of breast cancer death and about four times more than the risk of uterine cancer death (7).

Osteoporosis risk factors include inactivity, low calcium and vitamin D intake, high-protein and high-phosphorus diet, smoking, high caffeine intake, menopause followed by estrogen decline, race, body mass index (BMI), hyperthyroidism, parathyroidism, and family history of osteoporosis. Optimal calcium intake is an important factor in the development and maintenance of a healthy skeleton. Phosphorus, magnesium and vitamin D also play an essential role in the development and maintenance of bone tissue (8, 9). Studies show that adequate protein and potassium contribute to bone health (10).

This disease is preventable and the easiest and cheapest solution is to improve lifestyle (nutrition and physical activity) and gain maximum bone mass. The skeletal system grows rapidly during childhood and late adolescence (11-13). Approximately, 60% of bone growth occurs during adolescence, therefore, this is the best time to invest in bone health (14).

A healthy nutritional pattern is one of the factors affecting bone restoration, bone density, and bone health, so that eating vegetables, fruits, and fish together will have a synergistic effect on bone density. Moreover, an omega-3-rich diet has positive effects on joints and bones (15). The results showed that consuming 3 glasses of low-fat milk a day, vegetables and fruits 5 times a day, drinking high-calcium mineral water, and receiving adequate vitamin D through fish, liver and milk, and vitamins C and K are essential for osteoporosis prevention (16). Results of a study also showed that having a poor diet (rich in processed foods) or consuming foods lacking protein and other important nutrients is a risk factor for bone health (17).

According to the above mentioned risk factors, one of the prevention methods is the optimization of eating habits and other osteoporosis-related behaviors. For this reason, it is necessary to study such behaviors in a proper framework (12). Theory of planned behavior (TPB) is used to identify and understand individual and environmental factors affecting behavior and can measure a person's behavior and intention (18, 19). It is also one of the important food choice theories in which a person processes information before performing a behavior. Factors influencing food choices include self-efficacy, attitude, and subjective norm. TPB refers to intention to perform a behavior as the most important predictor of performing that behavior (20).
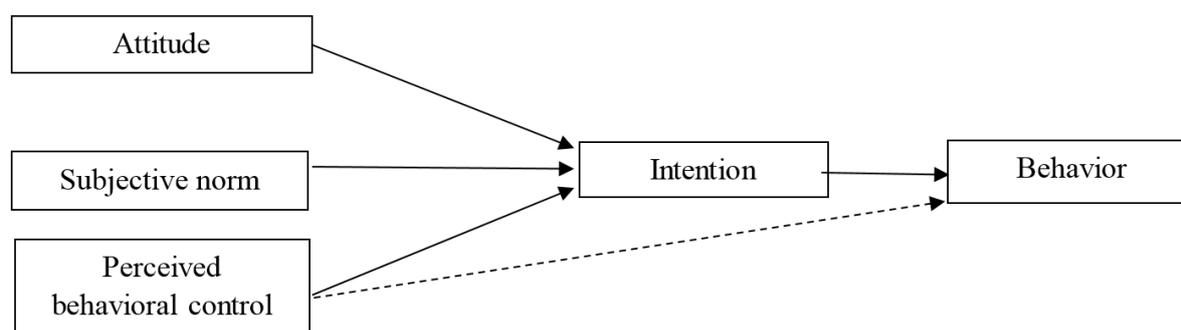
**Fig. 1:** Theory of planned behavior (19).

Girls' diet has permanent effects on their own health and that of their infants, children and future families. Due to the role of girls as future mothers, osteoporosis prevention is of higher importance among girls than boys; and since women can be attributed to the higher incidence of the disease, their eating habits in adolescence is of paramount importance (21). According to the above studies, childhood and adolescence is the best time to increase bone mass. It should be noted that osteoporosis is irreversible and leads to disability. Considering that there are few studies on osteoporosis nutritional behaviors among adolescent girls in the city of Sari, the present study aimed at determining the osteoporosis nutritional behaviors using the theory of planned behavior (TPB).

## 2- MATERIALS AND METHODS

### 2-1. Study design and population

This is a descriptive-analytical cross-sectional study and the study population included 12-16-year-old female high school students in Sari in 2019. The sample size was estimated as 341 people according to the results of the study by Hemmati et al (6) using the sample size formula.

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} \cdot P(1-P)}{d^2} = \frac{(1.96)^2(0.32)(0.68)}{(0.05)^2} = 334$$

### 2-2. Methods

In order to select the samples, a multi-stage random sampling method was used. To this end, the researcher first randomly selected 7 schools from all schools of the two educational districts of the city, and then referred to the schools after introducing himself and observing all considerations. According to the school population and the total sample size, students were randomly selected from the first, second, and third grades of high school based on the list of names prepared by the school office.

### 2-3. Measuring tools: validity and reliability

A researcher-made questionnaire was used in the present study that consisted of 3 parts. The first part of the questionnaire included 14 questions related to demographic characteristics and osteoporosis-related diseases. The second part discussed osteoporosis nutritional behaviors based on TPB constructs, including 11 questions on behavioral attitudes, 8 questions on subjective norm, 6 questions on perceived behavioral control, and 7 questions on intention. The scale of these constructs was designed based on a 5-point Likert (Strongly disagree, Disagree, Natural, Agree, Strongly agree). The possible score range was 0 (the worst state) to 5 (the most desirable state). In this part, students' knowledge about osteoporosis preventive behaviors is also

evaluated and the correct and neutral answers are scored 1 and 0, respectively; the possible score range is 0-14 (22). The validity of the questionnaire was confirmed by a content validity method with a panel of nutritionists and health educators. Reliability was also estimated using Cronbach's alpha test ($\alpha=0.75$). In the third part, a food frequency questionnaire (FFQ) with acceptable validity and reliability was used to measure the consumption of osteoporosis preventive foods (23). 35 items from FFQ 164 food items related to osteoporosis prevention and predisposing behaviors were analyzed. Intake of bread and cereals, milk and dairy products, fruits and vegetables, plant and animal proteins, nuts, etc. in adolescent girls was evaluated taking into account the number of food units based on the recommended standards set by United States Department of Agriculture (USDA) Food Pyramid. Based on the literature review and the recommended food pyramid for adolescents, the foods were divided into two categories: osteoporosis preventive foods (including milk and dairy products, plant protein, animal protein, fruits, vegetables and nuts), and osteoporosis predisposing foods (including bread, cereals, and miscellaneous nutriments). Participants were asked to indicate the frequency of consuming and non-consuming foods specified by food units on a daily, weekly, monthly, and yearly basis. This part of the questionnaire was completed through an interview. The frequency of osteoporosis preventive behaviors was classified at three levels: excellent (>18 units), good (11-18 units), and bad (< 11 units). The frequency of osteoporosis predisposing behaviors was also classified at three levels: excellent (< 6 units), good (6-11 units), and bad (>11 units) by adding up the minimum and maximum food units of osteoporosis preventive and predisposing food groups (9). Students' weight was measured using Seca standard scale with 100g precision while they were wearing light clothing and no shoes. Students' height was also measured in a standing position while they were wearing no shoes, and heels, legs, buttocks, shoulders, and head touched the height meter (0.5 cm precision) and the head was kept completely straight. Then a ruler was placed on the person's head and the point where head and height meter were interacted was considered as students' height. Body mass index (BMI)-for-age was calculated by the researcher, based on the 2000 CDC growth chart. BMI-for-age of 5-85%, 85-95%, and above 95% indicate underweight, normal weight, overweight, and obesity, respectively (percentile of $< 0.05$) (24).

## 2-4. Ethical consideration

A written approval was obtained from the Education Center of Sari and Mazandaran University of Medical Sciences prior to the study (ID-code: IR.MAZUMS.REC.1398.326), and then the students' consent to participate in the study was obtained.

## 2-5. Inclusion and exclusion criteria

Inclusion criteria for high school first year students of selected schools in Sari included informed and voluntary consent to participate in the study, no chronic diseases, no bone-related diseases, and no use of bone disease drugs.

## 2-6. Data Analyses

Data analysis was carried out using descriptive and inferential statistical tests through SPSS 20.0 software package. The results were expressed as percentages, means $\pm$ standard deviation (SD) or median. To determine the relationship between variables, the Pearson correlation test was used. Other tests included regression analysis and ANOVA. The significance level was considered as P $<0.05$.

## 3- RESULTS

Three hundred and forty-one female high school students from Sari city participated in this study. The results showed that the mean ± standard deviation of students' age was 13.80 ± 1.013 years and most students (83.8%) lived in families with one or two children. The education level of most mothers (47.5%) and fathers (54.5%) was higher than the diploma; most mothers (68.6%) were housewives and half of the fathers (49.9%) were self-employed. With regard to place of residence, 92.4% of students lived in the city. Also, 61.9% of students used dietary supplements, of which 61.9% consumed vitamin D and 15.2% consumed iron. **Table 1** shows the demographic characteristics and BMI-for-age of students, according to which 67.7% of students have normal weight and there was no significant relationship between BMI-for-age and other demographic characteristics.

**Table-1:** Distribution of demographic characteristics of the adolescent participants

| Demographic variables | Variable levels | Number (Percent) |
|---|---|---|
| Mother's education | Under Diploma | 35 (10.2) |
| | Diploma | 134 (39.3) |
| | University | 162 (47.5) |
| Father's education | Under Diploma | 23 (6.7) |
| | Diploma | 121 (35.5) |
| | University | 186 (54.5) |
| Mother's occupation | Housewife | 234 (68.6) |
| | Employee | 75 (22) |
| | Free | 32 (9.4) |
| Father's occupation | Worker | 25 (7.3) |
| | Employee | 131 (38.4) |
| | Free | 170 (49.9) |
| | Retired | 14 (4.1) |
| BMI for age | Underweight | 12 (3.5) |
| | Healthy weight | 231 (67.7) |
| | overweight | 66 (19.4) |
| | obese | 31 (9.1) |

**Table 2** describes the amount of food groups and the osteoporosis predisposing and preventive factors. According to this table, the intake of most food groups among adolescents was less than the recommended standard. According to the USDA recommendation, the highest intake belonged to dairy products (45%) and the lowest consumption to the vegetables group. The frequency of osteoporosis-preventive behavior was excellent, good, and bad among 249 (73%), 79(23.2%), and 13(3.8%) of adolescents, respectively. Also, the frequency of osteoporosis-predisposing behavior was excellent, good, and bad among 102(20.2%), 190(55.7%), and 48(14.1%) adolescents, respectively. With regard to the miscellaneous food group, 38% of adolescents had tea once a day, 23.4% had coffee two to four times a week, 24.3% had soda 2-4 times a week, 67.9% had one teaspoon of salt per day.

**Table 3** shows the means and standard deviations of TPB constructs in different BMI-for-age groups; the results of ANOVA showed no significant

relationship between the TPB constructs and BMI-for-age.

**Table-2:** Intake of food groups as predisposing and preventing behaviors of osteoporosis in adolescents [†]

| Food groups | Serving [††] | Number (Percent) |
|---|---|---|
| Bread and cereals | 6> | 227 (66.6) |
| | 6-11 | 108 (31.7) |
| | 11< | 6 (1.8) |
| Milk and Dairy | 2> | 77 (22.6) |
| | 2-3 | 154 (45.2) |
| | 3< | 110 (32.3) |
| Animal proteins | 2> | 288 (84.7) |
| | 2-3 | 42 (12.4) |
| | 3< | 10 ((2.9) |
| plant proteins | 2> | 310 (90.9) |
| | 2-3 | 20 (5.9) |
| | 3< | 11 (3.2) |
| Fruit | 2> | 116 (34) |
| | 2-4 | 115 (33.7) |
| | 4< | (32.3)110 |
| Vegetables | 3> | 329 (96.5) |
| | 3-5 | 11 (3.2) |
| | 5< | 1 (0.3) |
| Nuts | 2> | 287 (84.9) |
| | 2-3 | 37 (10.9) |
| | 3< | 14 (4.1) |

[†]Number of food group servings per day
[††]Sample servings (25):
1 grain serving (whole and refined) = 1 slice bread, 1 cup dry cereal, 1/2 cup cooked rice, pasta, or cereal
1 dairy serving = 1 cup milk/yogurt, 1.5 oz. natural/2.0 oz. processed cheese;
1 meat serving = 1 oz. lean meat, fish or poultry, 1/2 cup dry cooked beans, 1 egg, or 2 Tbs. peanut butter;
1 fruit serving = 1 medium fruit (e.g., apple), 1/2 cup chopped, cooked, or canned fruit or 3/4 c. juice;
1 vegetable serving = 1 c. raw leafy vegetable, 1/2 c. raw/cooked other vegetables or 3/4 c. vegetable juice;

**Table-3:** The relationship between BMI for age and constructs of the theory of planned behavior

| Subjects | Percentiles | Knowledge | Attitude | Subjective norms | Perceived behavioral control | Intention | preventing behaviors | predisposing behaviors |
|---|---|---|---|---|---|---|---|---|
| BMI for age | 5> | 4.4±7.6 | 5.6±38.3 | 4.6±28.9 | 5.6±22.5 | 7.1±23.0 | 2.1±8.9 | 2.0±7.8 |
| | 85-5 | 3.4±8.1 | 4.8±37.3 | 6.3±28.3 | 5.0±22.6 | 5.2±238 | 4.3±9.3 | 3.0±8.2 |
| | 95-85 | 3.44±7.7 | 4.6±36.9 | 6.5±27.2 | 5.1±21.9 | 5.9±23.1 | 4.4±8.5 | 2.7±8.1 |
| | 95< | 3.1±8.1 | 4.1±37.4 | 7.5±27.3 | 4.9±22.0 | 5.5±22.5 | 3.2±8.4 | 1.8±8.0 |
| P-value | | 0.8 | 0.2 | 0.7 | 0.6 | 0.3 | 0.3 | 0.9 |

Mean ± S.D.

ANOVA showed that among the TPB constructs, perceived behavioral control and intention had a significant relationship with osteoporosis-preventing nutritional behavior. There was a significant relationship between the subjective norm and perceived behavioral control with osteoporosis-predisposing behaviors (**Table 4** ؛P-value<0.05). There was also a significant relationship between attitude (P=0.039) and intention (P=0.042) with the father's level of education (P=0.042).

**Table-4:** The relationship between the structures of planned behavior theory and nutritional behaviors related to osteoporosis

| Constructs | preventing behaviors | | predisposing behaviors | |
|---|---|---|---|---|
| | P | F | P | F |
| Attitude | 0.24 | 1.16 | 0.76 | 0.79 |
| Subjective norms | 0.44 | 1.02 | 0.004 | 1.96 |
| Perceived behavioral control | 0.02 | 1.56 | 0.007 | 2.44 |
| Intention | 0.02 | 1.59 | 0.078 | 1.44 |

Regression analysis showed that the TPB constructs predicted 5.7% of osteoporosis-preventing behaviors among students. Among the constructs, subjective norm and intention had the highest prediction rates. TPB constructs also predicted 5.5% of osteoporosis-predisposing behaviors, with subjective norm and knowledge having the highest prediction rates. Regarding the subjective norm, parents have the highest expectations about consummation of calcium-rich foods. The Pearson analysis test also showed a positive correlation between intention and osteoporosis-preventive behavior (r=0.12, P=0.036).

**Table-5:** Regression of constructs of the theory of planned behavior in predicting nutritional behaviors associated with osteoporosis

| Independent variable | R2 | β | *P-Value | Dependent variable |
|---|---|---|---|---|
| Subjective norms Intention | 5.7 | 0.138 0.136 | 0.04 0.07 | preventing behaviors |
| Subjective norms Knowledge | 5.5 | 1.82 -0.155 | 0.008 0.018 | Predisposing behaviors |

*P-value < 0.05

## 4- DISCUSSION

The present study investigated osteoporosis nutritional behaviors among female adolescents in Sari based on the theory of planned behavior. The findings of the study showed that most of the students (67.7%) had a normal BMI and 9.1% of students were obese. However, Jafari-rad et al. showed in another study on girls aged 14 to 18 years in Sari that 79.6% of them had a normal weight (26). In another study in Zanjan, Ahmadnia et al. showed that approximately 82% of students had a normal BMI (12). This difference in anthropometric indicators (WHO 2007, CDC2000, NHANESI) can be due to differences in age group, cultural and social characteristics, economic conditions or differences in the definition of indicators based on different criteria, and even differences in evaluation time. The present study also showed no

significant correlation between BMI-for-age and TPB constructs. In a study on American girls and boys aged 9 to 18 years, Fila found no significant relationship between BMI and intention for healthy nutritional behavior (27). Ickes et al. also found no significant relationship between BMI and general nutritional behaviors in students (28), which was consistent with the results of the present study. This can be due to adolescents' lack of knowledge of the effect of BMI on osteoporosis and increasing attention to the physical form of the body instead of paying attention to healthy nutritional behaviors.

In the present study, the average daily intake of fruits among one third of the adolescents was equal to the recommended amount and the average daily intake of vegetables was less than the recommended standard among more than 90% of them. Arshi et al. reported lower than the recommended standard for the average daily intake of fruits among more than 50% of the girls in Tehran and vegetables among about half of them (29). Studies of the nutritional status of adolescents in countries such as Syria, Turkey, and Kuwait have shown insufficient daily intake of fruits and vegetables among adolescent girls (30). In a study of American adolescent girls, Moor found that more than 90% of girls failed to eat the recommended amount of fruits and vegetables (31). In a study of 12-15-year-old students in Gonabad, Meshki et al. found that 27.9% of adolescents had fruits and vegetables twice and three times a day (32), respectively, which was consistent with the results of the present study. Diets rich in fruits and vegetables reduce urinary calcium levels by creating an alkaline environment (15). Research has shown that some of the micronutrients in fruits and vegetables, such as potassium, magnesium, vitamin C, carotenoids, and quercetin significantly increase bone density and decrease the risk of osteoporosis (33). The

main reasons for inadequate fruit and vegetable consumption among adolescents include the poor economic status of the family, lack of knowledge and unfavorable attitude towards their taste, low enjoyment of fruit and vegetable consumption, hard access to fruits and vegetables at home, and increasing TV watching hours (20, 34, 35).

In the present study, the average daily intake of plant and animal proteins among more than three-quarters of groups and nuts is less than the recommended amount. Meshki's study revealed that only 12% of adolescents consumed proteins such as meat, eggs, and legumes twice a day (32). Moore's study showed inadequate meat intake among 75% of American adolescent girls (31), which was consistent with the results of the present study reflecting an intake pattern similar to that of American adolescents. In a HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study on adolescents from ten regions of Europe and research conducted in Germany and Spain, Diethelm et al. indicated excessive consumption of meat and processed meats among adolescents in European regions (36). This discrepancy can be due to the high meat consumption in the Western diet. Excessive consumption of animal or plant proteins can be detrimental to bone health. On the other hand, it increases urinary calcium levels, and an increase in osteoporotic fractures has often been attributed to an increase in dietary animal protein. These protein-related effects can be moderated by other food nutrients and the whole diet so that high potassium levels in plant protein foods such as legumes reduce urinary calcium levels (37). Nonetheless it is considerable that meat, animal fats, fish, and eggs are important sources of vitamin D (38).

In this study, more than two-third of adolescents consume more than two units of dairy products per day. In Arshi et al.'s

study, the average daily intake of milk and dairy products was lower than the recommended amount, and almost half of the girls had an adequate intake of dairy products (29). A total of 29% of participants in Meshki's study consumed dairy products twice a day (32), and more than 90% of girls in Moore's study didn't have adequate intake of dairy products (31). These studies were inconsistent with the results of the present study. This discrepancy could be due to differences in socio-economic conditions, parents' employment status, hatred or food intolerance, etc. High calcium content of milk and dairy products compensate for the loss of urinary calcium due to milk protein (37).

In the present study, more than two-third of adolescents consumed cereals less than the recommended amount. In Meshki's study, 14.9% consumed cereals six times a day (32). Diethelm et al. proposed that according to HELENA study and some previous research studies in Germany and Spain, adolescents in these regions consumed cereals less than the recommended amount (36), which can be due to eating habits, level of knowledge, family socioeconomic status, fear of gaining weight, adolescents' food interests or hatreds. Phytate in cereals has a high ability to combine with calcium and thereby declining its bioavailability by forming highly insoluble salts (39). On the other hand, high potassium concentration in cereals reduces urinary calcium level and reduces the incidence of osteoporosis (37, 40). Studies show that 6-11 units/day of cereals prevents osteoporosis and more than 11 units/day of cereals predispose people to osteoporosis (9).

In the present study, the average daily intake of osteoporosis predisposing and preventing foods was good and excellent, respectively. Kholdi et al. showed that the performance of adolescent girls was relatively good in terms of frequency of consumption of calcium sources and inappropriate in terms of consumption of substances reducing calcium absorption (41). In Moore's study, the majority of girls had inadequate calcium, magnesium, potassium, vitamins D and E at any age (31). This discrepancy in the consumption of calcium-rich foods can be due to differences in the knowledge of and appropriate access to calcium-rich foods and food sources that reduce calcium absorption, and socio-economic conditions; or because they prefer ready meals and think that healthy foods such as dairy products, fruits and vegetables are not delicious (35).

Findings of the present study showed that subjective norm and behavioral intention were the main determinants of osteoporosis-preventive behaviors and subjective norm and knowledge played the greatest role in determining osteoporosis-predisposing behaviors among adolescents. Also, parents, as the people who have the most influence on adolescents, expected them to have the highest intake of calcium-rich foods. As revealed in the study by Babazadeh et al., approximately 39% of fruit and vegetable consumption was predicted by the TPB constructs and the subjective norm was the strongest predictor, which is consistent with the results of the present study (34). This consistency can be due to the effect of subjective norm on increasing social support and access to vegetables, and improved consumption rate. In a study on American adolescent boys, Kassem showed that attitudes, subjective norm, and perceived behavioral control were significant predictors of intention to drink low-fat milk (42). In Meshki's study, all TPB constructs predicted 92.6% of the intention to healthy nutrition, and attitude was strongly related with intention and was the next predictor of the perceived behavior control (32). The different prediction rates in TPB constructs can be

attributed to differences in age, gender, socio-economic/cultural conditions, and different characteristics of the sample groups. Furthermore, according to the results of the present study and other studies, it can be said that TPB constructs give a relatively good explanation of adolescent nutritional behaviors.

The results of the present study showed a significant relationship between perceived behavioral control and intention with osteoporosis preventing nutritional behavior. There was also a significant relationship between subjective norm and perceived behavioral control with osteoporosis predisposing behaviors. Rahimi et al. demonstrated that intention and perceived behavioral control were determinants of milk consumption among students (43). In a study of middle-aged people, Pakyar et al. found a statistically significant relationship between osteoporosis prevention behaviors and subjective norm, perceived behavioral control, and behavioral intention (44). In another study, Khani jeyhoni et al. used the health belief model along with the cognitive and social theory; and found a significant relationship between nutritional performance with perceived sensitivity and self-regulation of osteoporosis-preventive behaviors (45). The differences in results may be due to differences in age, gender, sample size, questionnaire, etc.

The present study revealed a significant relationship between attitude and intention with the father's level of education. Panahi et al. reported a significant relationship between the mother's level of education and the adoption of osteoporosis preventive behaviors (P<0.05) (7). Monshadi et al. proposed that osteoporosis-related knowledge, attitude and practice score increases with higher parental educational level (46). According to the results of studies, there is a need for health education and raising the

educational level of young people as future parents.

The present study revealed a positive correlation between behavioral intention and osteoporosis preventive behavior. In other words, the stronger the student's behavioral intention, the more likely osteoporosis preventive behavior will occur. In the same line, Moeini et al. found a positive and significant correlation between behavioral intention (P<0.001) and subjective norm (P<0.05) with fruit and vegetable consumption (20). In yet another study, Babazadeh et al. observed a significant positive correlation between subjective norm and attitude with fruit and vegetable consumption (34). The present study, however, showed no correlation between intention and behavior. This discrepancy can be due to age, gender, and socio-cultural differences of the participants.

## 4-1. Study Limitation

Some of the limitations of the present study include non-cooperation of schools, non-inclusion of parents in the study, lack of evaluation of physical activity, and the studied age group, which can affect the accuracy of the findings.

## 5- CONCLUSION

According to the findings of the present study, the consumption of vegetables, cereals, as well as the animal and vegetable proteins were less than the recommended amount. Moreover, consumption of dairy products in most adolescents was equal or greater than the recommended amount and fruit consumption among one-third of the adolescents was equal to the recommended amount. Therefore, further research on dietary intake of other factors influencing osteoporosis-related behaviors is recommended. The present study demonstrated a significant relationship between perceived behavioral control and osteoporosis predisposing nutritional

behavior. The results also revealed that subjective norm and behavioral intention were the main determinants of osteoporosis preventing behaviors; and subjective norm and knowledge played the greatest role in determining osteoporosis predisposing behaviors.

One of the strengths of the present study is the simultaneous evaluation of TPB and the frequency of quantitative-qualitative food consumption in comparison to other similar articles. According to the results of implementing TPB-based programs for parents and adolescents, it is recommended to use the mass media such as radio, television, newspapers and social networks to teach about osteoporosis and the preventive role of nutrition.

## 6- CONFLICT OF INTEREST: None.

## 7- ACKNOWLEDGMENT

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