The Relationship Between Dietary Diversity with General and Abdominal Obesity in Female Amateur Athletes of Mazandaran University of Medical Sciences

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Abstract

**Background:** The prevalence of obesity in the world shows the impact of environmental factors such as sex, marital status, and changes in eating patterns as well as the replacement of high-fat diets rather than healthy diets.

**Objectives:** The aim of this study was to investigate the relationship between dietary diversity score, general obesity, and abdominal obesity among female athlete students of Mazandaran University of Medical Science.

**Methods:** In this cross-sectional study, 143 healthy amateur athletes aged 18 to 28 years old were randomly selected as female students. The usual food intake was evaluated using a 24-hour recall questionnaire for three consecutive days. Dietary scores were calculated based on scores of five food groups. Weight, height, waist circumference, and hip circumference were measured based on standard methods. Data were analyzed using descriptive statistics and inferential statistics. Pearson correlation coefficient and linear regression were used.

**Results:** There was an inverse and significant relationship between the dietary diversity score and general and abdominal obesity in amateur female students (P ≤ 0.05).

**Conclusions:** There is an inverse and significant relationship between the adherence to a high-diversity diet and obesity patterns. Finding dietary patterns associated with obesity can help obesity prevention and provide a healthy diet for controlling this epidemic in the community.

**Keywords:** Dietary Diversity Score, Dietary Diversity, Dietary Diversity, Abdominal Obesity

1. Background

Obesity, as a multifactorial disease, is strongly associated with genetics, however, environmental factors are very effective on the prevalence of obesity throughout the world. These factors include the socio-economic status, sex, marital status, educational level, physical activity, changes in eating style, and replacing a high-fat diet rich in refined carbohydrates and low in fiber with a healthy diet (1). In Iran, 67% of women and 32% of men aged 20 years old suffer from abdominal obesity (2).

Obesity is associated with the risk of many chronic diseases. Many researchers have suggested that both general obesity and the distribution of fat in the body should be paid attention to (3). They believe that abdominal obesity increased the risk of other chronic diseases, such as metabolic syndrome, type 2 diabetes, cardiovascular disease, and mortality (4-6). Waist circumference (WC) and waist-hip ratio (WHR) are two important indicators in estimating abdominal obesity; most researchers use World health organization (WHO) standards or adult treatment panel 3 to estimate belly fat. Therefore, a waist circumference of 102 centimeters (40 inches) or more in men, or 88 centimeters (35 inches) or more in women, is associated with belly fat. The prevalence of abdominal obesity is increasing throughout the world (7).

Studies have shown that a healthy lifestyle and nutrition help the physical, intellectual, and social health of the individual, improve the quality of life, and reduce the cost of socio-healthy cares (8). According to the WHO, more than 80% of obesity-related illnesses can be treated by improving the quality of life and physical activity (9).

On the other hand, various dietary and non-diary factors are associated with general obesity and abdominal
obesity (10). Among the dietary factors, the consumption of many nutrients and foods are associated with this problem (11). Given the Iranian consumption pattern, the variety of food items made from whole meal flour in Iran is very limited and thus, the choice of individuals from such foods (12). Whereas, grains are the main diet of Iranian people, which, in turn, is associated with reduced fiber consumption, a high glycemic index, increased WC, and hypertriglyceridemic (13). Consumption of vegetables, fruits, whole grains, and low-fat dairy products have the lowest risk of obesity in the Iranian population, and enough calcium and vitamin intake reduce the risk of abdominal obesity in Iranians (14).

The assessment of food intake is important for several reasons, it is due to the fact that monitoring diet and dietary intake can reflect the health status of the community and clarify the dietary effect on health and disease (11). Dietary diversity score (DDS) is an indicator for assessing the entire diet (15). A diverse diet can prevent either high or low intake of a nutrient (16). It is also combined with more consumption of micronutrients and macronutrients, as well as nutritional adequacy and quality (15). According to the US Department of Agriculture (USDA) and Food Guide Pyramid, one of the characteristics of healthy diets is dietary diversity (15). Dietary diversity is the number of different foods consumed in a given time period, or the selection of different foods from different food groups (such as bread, cereals, fruits, vegetables, etc.), as well as the selection of different foods within each dietary group (such as rice, wheat, barley, oats, corn, etc.) (16).

Multiple studies showed the reverse significant relationship between obesity and the dietary diverse pattern of high fiber, low-fat dairy products, whole grains, unsaturated fatty acids, and finally the use of high-density food patterns (12). Dietary patterns associated with obesity can be used for prevention as well as provision of a healthy dietary pattern for controlling obesity in the community. However, there are still significant uncertainties regarding the relationship between the dietary diversity score, general obesity, and abdominal obesity. So far, it has not been clear exactly whether diets with a higher diversity are associated with general obesity and abdominal obesity. Can this indicator be used to prevent obesity in amateur athletes?

2. Objectives

A cross-sectional study was conducted to clarify the relationship between dietary diversity and obesity in female amateur athletes of Mazandaran University of Medical Sciences.

3. Methods

This cross-sectional study was conducted on 143 female amateur athletes in Mazandaran University of Medical Sciences in the second semester of 2012 - 2013. According to the Morgan table formula, female amateur athletes were selected randomly by multi-stage cluster sampling method in different academic fields. The usual food intake was evaluated using a 24-hour recall questionnaire for three consecutive days (one holiday and two working days). Then, each food was converted to grams using the Household Scale Manual, conversion factors and food percentages (17), and the daily consumed elements were coded according to the program N4 (18), which evaluated the amount of energy and nutrients. The results were converted into an Excel file. The method of Kant et al. (19) was used to score dietary diversity. A total of five groups of cereals, vegetables, fruits, dairy products, and meat were used according to the food guide pyramid standards. The main groups were divided into 23 subgroups, which show dietary diversity among the pyramid groups. Bread and cereal were divided into seven subgroups of white bread, refined grains, whole wheat baked, pasta, whole breads, cereals, rice, and flour. The fruit was divided into two subgroups: Berries and citrus, other fruits, and juices. Vegetables include seven sub-groups of vegetable, potato, tomato, other starchy vegetables, legumes, yellow vegetables, and other green vegetables. Meat included four subgroups of red meat, fish, poultry, and eggs. Finally, the dairy group was divided into three subgroups of milk, yogurt and Doogh (a savory yogurt-based beverage), cheese, and Kashk (used in cuisines of Iranian). According to the food guide pyramid, the individual must use at least 1.2 servings of food within three days. The final score is 10, and each group has two points out of 10 points. These two points were calculated as the number of subgroups consumed per person divided by the total number of subgroups and then multiplied by two. To assess anthropometry, weight, dressed lightly with no shoes, was measured using a digital scale with a precision of 100 g. The height of the subjects was measured using a tape measure without any pressure on the body with an accuracy of 0.1 cm. Since the thinnest waist is not possible to be determined due to excessive abdominal fat or excessive thinness, WC was measured precisely after the last rib. The measurements were performed by one person to minimize errors. To measure BMI of subjects, body weight (kg) was divided by the square of height in meters. The WHR was calculated by dividing WC by hip circumference. To understand the socio-economic status of people, a demographic questionnaire including age, sex, education level, occupation, smoking, medical history, drug use, marital status,
parents’ obesity history, parental education, home ownership, etc. was used. The daily physical activity of individuals was calculated over three days and was expressed as Met-h/wk (metabolic equivalent hours/week) (20). To prevent any problem, a written informed consent was provided for the subjects before the research steps. General obesity was defined as BMI $\geq 30$ and abdominal obesity was defined as WC more than 88 cm.

3.1. Statistical Methods

Data was analyzed by descriptive and inferential statistics. Mean, standard deviation, tables, and charts were used at the descriptive level. In the inferential level, the KS test was firstly used to determine the normality of the variables, then, Pearson correlation coefficient was used to determine the relationship between dependent and independent variables. Linear regression was used to determine the effect of two independent variables on a dependent variable.

4. Results

Dietary diversity has a significant and inverse relationship with general obesity in female amateur athletes of Mazandaran University of Medical Sciences. In addition, dietary diversity has a significant and inverse relationship with abdominal obesity in female amateur athletes of Mazandaran University of Medical Sciences. The following table and figure describe the individual characteristics of the research subjects and results (Figures 1-4) and (Tables 1-5).

5. Discussion

Statistical analysis showed that dietary diversity had a reverse relationship with general and abdominal obesity (P $\leq 0.05$), which is consistent with the results of Samadi et al. (21), Azadbakht et al. (22), Rezazadeh et al. (23), and Abedi et al. (24). The studies showed that a healthy dietary pattern is followed by a dietary diversity with high fiber, low-fat dairy products, whole grains, unsaturated oils, and ultimately the use of a high-density dietary pattern, which is associated with the reduction of obesity. Regarding the role of low-fat dairy products in reducing obesity and being overweight, studies have highlighted the role of calcium in dairy products for weight loss. Several hypotheses have suggested that calcium is effective in reducing fat mass. Generally, the hypotheses and mechanisms suggest that receiving a dairy diet when combined with healthy dietary choices can result in better oxidation of fat, reduced fat intake, increased apoptosis of adipocytes and increased fullness, as well as reduced energy intake (12, 25).

Reverse relationship between healthy diet and overweight or obesity can be attributed to the high consumption of low-fat foods with low energy and low glycemic index. Consumption of low-fat foods reduces the energy density of the diet and, consequently, prevents energy imbalances, which is the main cause of being overweight and obese. In addition, low-fat diets are often associated with a greater sense of fullness due to the fact that they typically contain higher amounts of complex carbohydrates (26). On the other hand, high consumption of foods with a low glycemic index can also play an important role in weight control by reducing insulin secretion after food, maintaining insulin sensitivity, inhibiting the synthesis of lipids, and exacerbating their oxidation (27, 28).

Jayawardena et al. studied the relationship between dietary diversity and obesity in young people in Sri Lanka (29). However, it is not consistent with the present study, due to the fact that it was conducted on 600 young individuals over the age of 18 and found that there was a significant positive correlation between high dietary diversity and general obesity. This means that they consumed a large amount of diverse foods not necessarily from all food groups, however, only from those traditionally used in their food culture. General obesity and abdominal obesity were also associated with alcohol consumption. A study was conducted by Raynor et al. as well (30). The results indicated a direct correlation between obesity and dietary diversity. In a study of 3393 people in Brazil, Bezerra and Sichieri showed that high dietary diversity had a reverse correlation with weight loss and a significant positive correlation with weight gain. This high diversity has been highlighted by the increasing diversity of unhealthy foods such as sweets, cakes, and beverages, and they stated that it was essential to consume more diverse foods in low amounts to prevent obesity (31).

According to researches, the positive relationship be-
Table 1. Descriptive Information About Height, Weight, and BMI of the Athletes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Upper Bound</th>
<th>Bound Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>143</td>
<td>1.6239</td>
<td>0.067</td>
<td>1.74</td>
<td>1.060</td>
</tr>
<tr>
<td>Weight</td>
<td>143</td>
<td>59.860</td>
<td>8.193</td>
<td>79.990</td>
<td>27.08</td>
</tr>
<tr>
<td>Age</td>
<td>143</td>
<td>19.986</td>
<td>1.486</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td>Waist</td>
<td>143</td>
<td>77.028</td>
<td>9.939</td>
<td>112</td>
<td>48</td>
</tr>
<tr>
<td>Hip circumference</td>
<td>143</td>
<td>99.17</td>
<td>13.71</td>
<td>164.71</td>
<td>62.34</td>
</tr>
</tbody>
</table>

The results suggest that increasing dietary diversity is not always associated with weight gain, due to the fact that different types of healthy food groups, such as vegetables, whole grains, and fruits can increase this index. A previ-
Table 2. Descriptive Information Obtained from Nutritional Analysis of Female Athletes of Mazandaran University of Medical Sciences

<table>
<thead>
<tr>
<th>Variable</th>
<th>Athlete Average</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>60.991</td>
<td>11.88</td>
</tr>
<tr>
<td>Fat</td>
<td>79.67</td>
<td>18.34</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>79.83</td>
<td>18.64</td>
</tr>
<tr>
<td>kilo calories</td>
<td>191.0</td>
<td>280.4</td>
</tr>
<tr>
<td>carbohydrate</td>
<td>244.45</td>
<td>37.48</td>
</tr>
<tr>
<td>Calcium</td>
<td>556.2</td>
<td>42.68</td>
</tr>
<tr>
<td>Fiber</td>
<td>15.624</td>
<td>3.710</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>22.246</td>
<td>5.996</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>93.44</td>
<td>78.93</td>
</tr>
<tr>
<td>Zinc</td>
<td>7.819</td>
<td>1.575</td>
</tr>
<tr>
<td>Iron</td>
<td>11.603</td>
<td>2.649</td>
</tr>
<tr>
<td>Sodium</td>
<td>947.4</td>
<td>74.3</td>
</tr>
<tr>
<td>Thiamine B1</td>
<td>1.4277</td>
<td>0.2903</td>
</tr>
<tr>
<td>Niacin B3</td>
<td>18.973</td>
<td>3.705</td>
</tr>
<tr>
<td>potassium</td>
<td>198.0</td>
<td>434.1</td>
</tr>
<tr>
<td>Vitamin B2</td>
<td>0.9635</td>
<td>0.2883</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>1.4788</td>
<td>0.4143</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>2.0028</td>
<td>0.7421</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>2.82</td>
<td>14.42</td>
</tr>
</tbody>
</table>

Table 4. Descriptive Information on Dietary Diversity, Abdominal Obesity, and General Obesity of Individuals

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dietary diversity</td>
<td>6.6565</td>
<td>1.097</td>
</tr>
<tr>
<td>Abdominal obesity</td>
<td>0.8099</td>
<td>0.0675</td>
</tr>
<tr>
<td>General obesity</td>
<td>22.657</td>
<td>2.51</td>
</tr>
</tbody>
</table>

vegetable and fruit (33). Therefore, increasing the dietary diversity in Iran is mainly due to the increasing diversity of vegetables or fruits. On the other hand, cereal consumption also has a positive and significant relationship with metabolic syndrome (obesity is one of its important components) (34). Previously, there was a direct correlation between dietary diversity and obesity (34). However, information regarding dietary characteristics and abdominal obesity is very low. There is no information available on the nutrition of female amateur athletes in Iran. The results of the present study suggest that increasing dietary diversity is not always associated with weight gain, which is due to the fact that consumption of different types of healthy food groups, such as vegetables, whole grains, and fruits, can also increase this index (35). In fact, vegetables and fruits are very diverse in Iran, however, the unrefined cereals are limited. The previous study on the status of dietary diversity among Iranians also showed that the grains had the lowest dietary diversity score and the highest score belonged to the group of vegetables and fruits (34). Therefore, increasing dietary diversity in Iran is mainly due to increased diversity of vegetables or fruits (22). In this study, students with higher DDS consumed more vegetables, cereals, and fruits, which may be associated with lower obesity as well as abdominal obesity. On the other hand, people with higher dietary diversity consumed the lowest amount of ready-to-eat foods. Ready-to-eat foods are one...
of the most important sources of trans fat and is associated with abdominal obesity (22). There were some limitations in this study. The data used in this study were cross-sectional. Therefore, further studies should be conducted to prove these relationships. The error in grouping of the subjects is one of the concerns of this study, which is due to the use of the questionnaire. Another confounding factor is excessive and low reporting of interviewees.

**Supplementary Material**

Supplementary material(s) is available [here](#). [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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**References**


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**FOOTNOTES**

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