Clin Nutr Res. 2017 Oct;6(4):247-255
https://doi.org/10.7762/cnr.2017.6.4.247
pISSN 2287-3732·eISSN 2287-3740

CLINICAL NUTRITION RESEARCH

Original Article

Check for updates

# Dietary Diversity Score and Its Related Factors among Employees of Kermanshah University of Medical Sciences

**Seyed Mostafa Nachvak** [1] **Hadi Abdollahzad** [1] **Roghayeh Mostafai** [2] **Shima Moradi** [2] **Yahya Pasdar** [1] **Mansour Rezaei** [3] **Soudabeh Esksndari** [4]

[1]Nutritional Sciences Department, School of Nutritional Sciences and Food Technology, Kermanshah University of Medical Sciences, Kermanshah, Iran
[2]Student Research Committee, School of Nutritional Sciences and Food Technology, Kermanshah University of Medical Sciences, Kermanshah, Iran
[3]Department of Biostatistics, Faculty of Health, Communing Developmental and Health Promotion Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran
[4]Research Center for Environmental Determinants of Health (RCEDH), School of Public Health, Kermanshah University of Medical Sciences, Kermanshah, Iran



**Received:** Jul 10, 2017
**Revised:** Aug 31, 2017
**Accepted:** Oct 18, 2017

**Correspondence to**
**Shima Moradi**
Student Research Committee, School of Nutritional Sciences and Food Technology, Kermanshah University of Medical Sciences, Kermanshah, Iran.
Tel: +98-9186803376
Fax: +98-8338281990
E-mail: shimamoradi21@yahoo.com

**Hadi Abdollahzad**
Nutritional Sciences Department, School of Nutritional Sciences and Food Technology, Kermanshah University of Medical Sciences, Kermanshah, Iran.
Tel: +98-9122549078
Fax: +98-8338281990
E-mail: Hadi_nut@yahoo.com



## ABSTRACT

Dietary diversity score (DDS) is known as an indicator of food quality. Dietary diversity can promote health status. The aim of this study was determined DDS and its related factors in Kermanshah University of Medical Sciences (KUMS) employees. This cross-sectional study was conducted on 190 employees of KUMS in 2015. According to the population of KUMS centers which were selected randomly (Paramedical, Public Health faculties, Imam Reza Hospital and province health center), subjects were selected by convenience sampling method. Food frequency questionnaire (FFQ) was used to calculate DDS. Foods were divided into 5 main groups: grains, vegetables, fruits, meat, and dairy products. The main groups had 23 subgroups. Total DDS divided to 4 quartiles: less than 3.0, 3.0–5.5, 5.6–8.5, and more than 8.5. Anthropometric parameters including: weight, height, waist circumference (WC), and hip circumference were measured. Data were analyzed by Kolmogorov-Smirnov test, $\chi^2$ test, and analysis of variance (ANOVA) test with SPSS 20 software (IBM Corp., Chicago, IL, USA). The mean ± standard deviation of DDS and body mass index (BMI) were 5.68 ± 1.73 and 25.1 ± 3.42 kg/m$^2$, respectively. The average of the waist-to-hip ratio (WHR) in men and women was 0.92 ± 0.04 and 0.86 ± 0.06, respectively. There was statistically significant difference between DDS and self-reported economic status ($p < 0.022$). No significant difference was observed between DDS and BMI or WC. However, significant negative correlation was observed between DDS and WHR in men ($p < 0.019$). This study showed that DDS had a negative correlation with the WHR. Therefore, dietary diversity may improve health status by effect on fat distribution in body.

**Keywords:** Food quality; Waist to hip ratio; Waist circumference

**ORCID iDs**
Seyed Mostafa Nachvak
https://orcid.org/0000-0002-7265-3495
Hadi Abdollahzad
https://orcid.org/0000-0003-2367-9573
Roghayeh Mostafai
https://orcid.org/0000-0002-1383-9409
Shima Moradi
https://orcid.org/0000-0002-6507-7928
Yahya Pasdar
https://orcid.org/0000-0001-8682-5721
Mansour Rezaei
https://orcid.org/0000-0002-6446-7289
Soudabeh Esksndari
https://orcid.org/0000-0002-8031-9497

**Funding**
This study was funded by Research Council of Kermanshah University of Medical Sciences (No. 95484).

**Conflict of Interest**
The authors have declared no conflict of interest.

## INTRODUCTION

Food diversity has been considered as one of the hallmarks of healthy diet [1]. A diverse diet which contains all the food groups (vegetables, fruits, grains, meat, and dairy product) is necessary for achieving a nutrient adequacy and optimal growth and development [2]. Dietary diversity has been defined as "the number of different foods or food groups consumed over a given reference period" [3]. An omnivorous diet with adequate macro- and micronutrients, could improve appetite especially among children and decrease prevalence of chronic diseases such as cardiovascular diseases (CVDs), diabetes mellitus, metabolic syndrome and cancers [4]. Dietary diversity score (DDS) has been considered as an indicator of diet quality associated inversely with risk of chronic diseases [5].

DDS is used widely in large studies and surveys (such as the Demographic and Healthy Survey), to assess dietary quality [6]. Evaluating dietary quality is an expensive and time-consuming method which requires a complicated methodology, whereas DDS might be used as a simple and an inexpensive index for assessing the diet quality [1]. Steyn et al. [7] concluded that DDS could be considered as a convenience and fast indicator of dietary diversity assessment. In the National Health and Nutrition Examination Survey (NHANES) which conducted among US adults to assessment of dietary diversity on body adiposity, it has been observed that increase dietary diversity is associated with improved diet quality [8].

DDS is associated with various factors such as anthropometric and socioeconomic status (SES) [9-11]. Many studies have evaluated the association between dietary diversity and anthropometric status but their results have been conflicting [2,5,11]. It has been observed that high dietary diversity may adversely contribute to weight gain and obesity. However, it has been accepted that having more dietary diversity through intake of energy-poor, nutrient-dense foods provides a low-calorie diet which is useful to combat the development of adipose tissue [8]. Poor dietary quality could cause inadequate intake of essential nutrients and consequently malnutrition, especially in childhood, which requires sufficient nutrient intake for optimal growth and development [12].

On the other hand, some studies demonstrated that appropriate food choice depends on income levels and nutritional knowledge [9,10,12,13]. In fact, people who have a higher SES are more likely to consume healthy foods such as whole grains, lean meats, fish, low-fat dairy products, and fruit and vegetables, whereas people with low SES tend to consume more fat and less fiber [14]. Renting, lower education and social class were independently associated with lower diversity in consumption of fruit and vegetable [10].

Given the beneficial outcomes of dietary diversity and the importance of DDS for determining quality of diet, this study was conducted to determine DDS and its difference with some factors including SES, body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR) in Kermanshah University of Medical Sciences (KUMS) employees.

## MATERIALS AND METHODS

This cross-sectional study was conducted on 190 of KUMS employees in 2015. From among the 6 colleges of KUMS, Paramedical and Public Health faculties, among 5 medical education hospitals of KUMS, Imam Reza Hospital and from among health centers in Kermanshah

 https://doi.org/10.7762/cnr.2017.6.4.247 

province, Kermanshah province health center were selected randomly for sampling subjects. Sample size was calculated based on the total population of KUMS employees with a confidence of 95% and a study power of 90%. Finally, according to the population of each of the mentioned centers, subjects were selected by convenience sampling method.

A sample size of 190 from Paramedical and Public Health faculties, City Health Center and Emam Reza Hospital. Inclusion criteria were employment in KUMS and consent to participate in the study. Subjects who had chronic and metabolic disease such as diabetes, CVDs and any kind of cancer were excluded from the study.

Demographic and SES information including: age, gender, educational levels, marital and economic status along with anthropometric indices, i.e., weight, height, WC, and HC were collected.

Data about demographic characteristics and SES were collected by a self-administered questionnaire. In this study based on monthly income we classified economic status to 3 groups (good, medium, and weak).

Weight was measured by digital scale (CAMRY, model: EB9171 max; Camry Scale Store, City Industry, CA, USA) to the nearest 0.1 kg. Height was measured by a fixed tape meter to the wall with an accuracy of 1 cm in the standard position without shoes while the shoulders, heels and buttocks were in contact with the wall.

BMI was calculated as weight in kg divided by height in meter squared. BMI classification was based on the World Health Organization (WHO) criteria specifically for the Asian population as follows: BMI < 18.5 kg/m$^2$, underweight; 18.5–24.9 kg/m$^2$, normal range; 25.0–29.9 kg/m$^2$, overweight; and ≥ 30 kg/m$^2$, obese.

WC was measured at the narrowest area between the last rib and the iliac crest. Values ≥ 102 cm in men and ≥ 88 cm in women, were considered to be high. For measurement of head circumference (HC), the meter placed in the maximum position of HC. It was also noticed that there was an obstacle, such as wallet, belt, and so on. WHR was calculated as WC divided by hip-circumference. Values ≥ 1 and ≥ 0.8 in men and women, respectively, were accounted as high [15]. All of the anthropometric measures collected by an expert dietitian.

Dietary intakes were assessed using a semi quantitative food frequency questionnaire (FFQ) with 168 items and a standard portion size. The FFQ had been translated and standardized for Iranian population. Also, its reliability and validity had been confirmed previously [16]. To determine DDS, we divided foods into 5 main groups: grains, vegetables, fruits, meats, and dairy products. The main groups had 23 subgroups. These subgroups were:

1. Grains group with 7 subgroups: white bread (pita bread), wholegrain biscuits, pasta, whole grain breads (Sangak bread), noodle, rice, barley.
2. Fruits were divided into 2 subgroups: berries and citrus, other fruits and juices.
3. Vegetables group with 7 subgroups: vegetables, potatoes, tomatoes, other starchy vegetables (corn, pea, eggplant, squash), legumes (pease, beans, mung beans, split peas, lentils), yellow vegetables (carrots and pumpkin), and other green vegetables (bell peppers, all kinds of cabbage, broccoli, celery, cucumbers, garlic, onion, green beans, zucchini, leeks, parsley, lettuce, radish, spinach, rhubarb, turnips).


https://doi.org/10.7762/cnr.2017.6.4.247

4. Meats group was divided into 4 subgroups: red meat (cattle and sheep), poultry (hen and chicken), fish, and eggs.
5. Dairy group was divided into 3 subgroups: milk (low-fat and full-fat), yogurt (low-fat and full-fat), cheese or curd.

To be considered as a consumer of a food group, it is necessary that at least a half-serving of that food group should be consumed per day by the individuals. Each food group had 2 scores. This 2 scores was divided among the subgroups. Total DDS was 10 and then it was divided to 4 quartiles: less than 3.0, 3.0–5.5, 5.6–8.5, and more than 8.5. This method at first was used by Kant et al. [17] then it was modified in a study in Iran [4]. In this study we used modified version of DDS. Classification of DDS is based on Food Guide Pyramid [18].

### Statistical analysis

Data were analyzed using SPSS version 20 (IBM Corp., Chicago, IL, USA). Kolmogorov-Smirnov test was used to test normality of variables separately in both sexes. The impact of gender on DDS was evaluated by $\chi^2$ test in each of the quartiles of DDS. Descriptive statistics were used to report characteristics of the studied subjects. The quantitative data are presented as mean ± standard deviation and the qualitative variables were reported as frequency graph and tables. To determine the difference between SES and DDS, Mann-Whitney U and Kruskal-Wallis tests were used and also, the difference between DDS and anthropometric indices was performed using analysis of variance (ANOVA). p values less than 0.05 were considered to be significant.

### Ethics statement

This study was given ethical approval by the Ethics Committee of Research Council of Kermanshah University of Medical Sciences (ethic number: KUMS.REC.94025). To collect data, after explaining the aims of the study, participants signed an informed written consent.

## RESULTS

From 190 participants, 85 of them were men. The means of age in men and women were 40.03 ± 9.30 and 34.80 ± 9.29 years, respectively (p = 0.756). The mean of DDS was 5.62 ± 1.82 in men and 5.69 ± 1.62 in women (p = 0.375). There was a statistically significant difference between economic status and DDS but it was not observed statistically significant difference between educational level and marital status with DDS (**Table 1**).

**Table 1.** Differences of DDS in SES of KUMS employees

| Characteristics | Category | No. (%) | Mean of DDS | p* |
|---|---|---|---|---|
| Sex | Male | 85 (44.7) | 5.62 ± 1.82 | 0.375 |
| | Female | 105 (55.3) | 5.69 ± 1.62 | |
| Marital status | Married | 57 (30.2) | 5.33 ± 1.51 | 0.805 |
| | Single | 128 (67.7) | 6.11 ± 1.73 | |
| | Separated/widow | 4 (2.1) | 5.98 ± 1.71 | |
| Self-reported of economic status | Good | 29 (15.5) | 5.47 ± 1.72 | 0.022 |
| | Medium | 139 (74.3) | 5.79 ± 1.74 | |
| | Weak | 19 (10.2) | 4.90 ± 1.42 | |
| Educational level | Less than diploma and diploma | 34 (17.9) | 5.31 ± 2.4 | 0.123 |
| | Associate degree and bachelor | 124 (65.3) | 5.76 ± 1.54 | |
| | Master and PhD | 31 (16.3) | 5.62 ± 1.45 | |

DDS, dietary diversity score; SES, socioeconomic status; KUMS, Kermanshah University of Medical Sciences.
*p value was calculated using Mann-Whitney U and Kruskal-Wallis test.

Table 2. Differences of consumed food servings among quartiles of DDS in KUMS employees

| Food group (serving/day) | Quartiles of DDS | | | | p* |
|---|---|---|---|---|---|
| | $Q_1$ (< 3.0) | $Q_2$ (3.0–5.5) | $Q_3$ (5.6–8.5) | $Q_4$ (> 8.5) | |
| No. of employees | 8 | 79 | 91 | 12 | - |
| Grains | 0.18 ± 0.27 | 1.51 ± 0.84 | 1.57 ± 0.97 | 1.76 ± 1.08 | 0.001 |
| Vegetables | 2.37 ± 2.48 | 3.22 ± 2.02 | 3.89 ± 2.32 | 4.95 ± 3.62 | 0.006 |
| Fruits | 2.72 ± 4.24 | 2.14 ± 1.39 | 3.28 ± 2.69 | 6.78 ± 3.98 | 0.001 |
| Meat and cereals | 0.12 ± 0.35 | 1.10 ± 0.55 | 1.44 ± 0.90 | 1.72 ± 0.75 | 0.001 |
| Dairy product | 0.01 ± 0.04 | 1.03 ± 0.76 | 1.40 ± 0.96 | 2.07 ± 1.11 | 0.001 |

Values are presented as mean ± standard deviation.
DDS, dietary diversity score; KUMS, Kermanshah University of Medical Sciences.
*p value was calculated using analysis of variance and Kruskal-Wallis test.

In this study, it was observed that statistically significant difference between economic status and anthropometric indices including weight (p = 0.002), WC (p = 0.003), HC (p = 0.004), and BMI (p = 0.001) except WHR (p = 0.332). Also, there was significant difference between economic status and consumption of bread and cereals (p = 0.034), vegetable (p = 0.029), and meat (p = 0.027).

In this study only 6.3% of subjects (12 persons) had DDS > 8.5. Analysis of FFQ data showed that 99.3% of subjects consumed less than 6 servings of grains per day and only 0.7% consumed 6–11 servings. Our finding showed that subjects who had DDS > 8.5, consumed more fruits and vegetables. difference of consumed food servings with DDS has been shown in **Table 2**.

Mean of BMI were 26.32 ± 2.87 kg/m$^2$ in men and 24.12 ± 3.50 kg/m$^2$ in women (p = 0.038). In overall 54.2% of participants were overweight or obese. As shown in **Figure 1** woman with normal BMI had more DDS, but this difference was not significant in any quartiles of the DDS in both sex (p = 0.459).

Anthropometric parameters and their association with DDS have been presented in **Table 3**. The mean of WHR was 0.92 ± 0.04 in men and 0.86 ± 0.06 in women. There was a significant negative difference between WHR and DDS in men (p = 0.019); However, the difference between WC and DDS was not significant (**Table 3**).

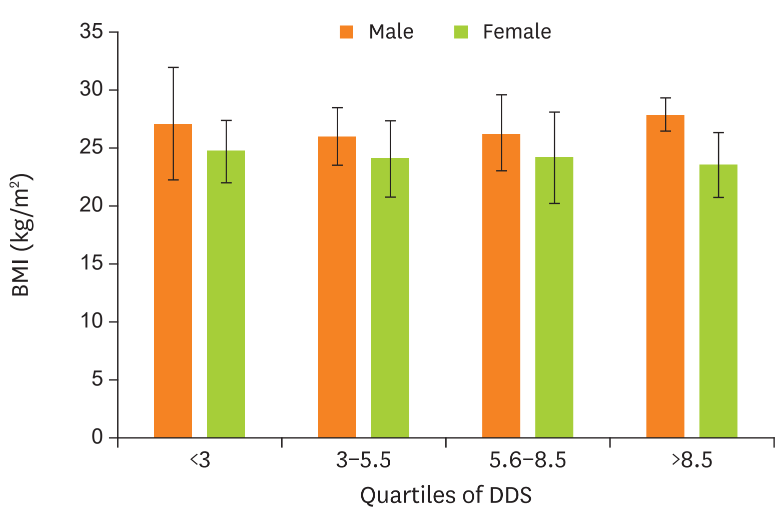


Figure 1. BMI and quartiles of DDS in KUMS employees.
BMI, body mass index; DDS, dietary diversity score; KUMS, Kermanshah University of Medical Sciences.


https://doi.org/10.7762/cnr.2017.6.4.247

**Table 3.** Differences of anthropometric parameters among quartiles of DDS in KUMS employees

| Anthropometric parameters | Sex | Quartiles of DDS | | | | p* |
|---|---|---|---|---|---|---|
| | | $Q_1$ (< 3.0) | $Q_2$ (3.0–5.5) | $Q_3$ (5.6–8.5) | $Q_4$ (> 8.5) | |
| Height (cm) | Male (85) | 179.00 ± 8.08 | 174.76 ± 7.89 | 176.95 ± 6.50 | 180.67 ± 4.96 | 0.191 |
| | Female (105) | 164.00 ± 8.28 | 162.31 ± 5.73 | 162.69 ± 5.07 | 161.00 ± 7.77 | 0.860 |
| Weight (kg) | Male (85) | 87.65 ± 21.21 | 79.65 ± 10.19 | 82.48 ± 11.80 | 90.80 ± 4.30 | 0.106 |
| | Female (105) | 66.30 ± 7.10 | 63.26 ± 8.89 | 63.90 ± 9.44 | 60.84 ± 6.00 | 0.815 |
| BMI (kg/m²) | Male (85) | 27.12 ± 4.82 | 26.02 ± 2.42 | 26.28 ± 3.22 | 27.83 ± 1.37 | 0.506 |
| | Female (105) | 24.70 ± 2.64 | 24.04 ± 3.33 | 24.19 ± 3.83 | 23.54 ± 2.72 | 0.963 |
| WC (cm) | Male (85) | 95.75 ± 3.86 | 96.16 ± 8.20 | 95.50 ± 8.12 | 90.16 ± 11.05 | 0.439 |
| | Female (105) | 78.00 ± 10.86 | 83.53 ± 9.60 | 86.55 ± 11.55 | 89.60 ± 7.30 | 0.214 |
| HC (cm) | Male (85) | 103.75 ± 1.25 | 104.29 ± 8.33 | 102.68 ± 7.00 | 104.66 ± 7.17 | 0.800 |
| | Female (105) | 93.50 ± 7.85 | 98.04 ± 9.00 | 99.37 ± 10.18 | 99.80 ± 5.26 | 0.634 |
| WHR | Male (85) | 0.92 ± 0.03 | 0.92 ± 0.04 | 0.92 ± 0.04 | 0.86 ± 0.08 | 0.019 |
| | Female (105) | 0.83 ± 0.06 | 0.85 ± 0.06 | 0.85 ± 0.12 | 0.89 ± 0.06 | 0.770 |

Values are presented as mean ± standard deviation.
DDS, dietary diversity score; KUMS, Kermanshah University of Medical Sciences; BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio.
*p value was calculated using analysis of variance.

## DISCUSSION

Dietary diversity is remarkably associated with nutrient adequacy and represents diet quality [19]. Low quality and monotonous diets not only are usually based on starchy foods but also fruits, vegetables, and animal sources are not consumed enough in such kinds of diets. Diets with low diversity could increase the risk of nutrient deficiencies especially in vulnerable populations such as children, elderly, and women [20]. The present study indicated that the DDS of employees in KUMS was at an optimal level, also a significant difference was observed between DDS and WHR in men.

In present study, both in men and women of our study the average of DDS was in its third quartile. Mirmiran et al. [4], performed in Iran on adolescents that the average of DDS was in the highest quartile and they concluded that DDS is a good indicator to assess nutrient intake adequacy in their studied population. In a study conducted by McDonald et al. [12] on 900 households in 4 rural regions of Cambodia, 23% of participants had low dietary diversity. Moreover, food insecurity was high according to Household Food Insecurity Access Scale (HFIAS). Therefore, participants in our study had earned good DDS.

In present study, higher DDS was associated with more consumption of vegetable and fruit groups. Mirmiran et al. [4] figure out that fruit and vegetable groups had highest DDS scores. Also, in another study by Fernandez et al. [11] conducted on US preschool children, dietary diversity was higher when fruits and vegetables were consumed. These studies have considered that there is a positive correlation between fruit and vegetables consumption and quality of diet. Therefore, in order to improve the quality of diet, studies suggest that fruit and vegetable consumption should be increased [21]. Further, in epidemiological studies it has been observed that reduced intake of fruits and vegetables is associated with higher risk of chronic diseases and mortality. So, we can conclude that there is a relationship between chronic diseases and dietary diversity [10]. This study showed that participants had increased their dietary diversity through consumption of low calorie (i.e., vegetables and fruits) foods.

In conflict with some previous studies [5,13], there was no significant difference between DDS and educational or marital status in our study. It may be due to low cost and easy access to some foods in Iranian society and also eating culture of Iranian people. However, a significant difference was observed between DDS and economic state. It has been considered that nutritional knowledge and adequate income play the important role in improving the quality of diet [22,23]. Tiew et al. [5] in Malaysia observed that having lower educational or economic status and being overweight or obese is significantly associated with lower DDS in type 2 diabetes mellitus patients ($p < 0.001$). Another study in Iran indicated that weak economic status was associated with low DDS. The researchers stated that accessibility is very important because the poor people often cannot consumption a variety of foods. However, knowledge about appropriate food choices is more substantial [2]. In the Observation of Cardiovascular Risk Factors in Luxembourg (ORISCAV-LUX) study on 1,351 subjects aged 18–69 years, income and nutritional knowledge were positively associated with DDS ($p < 0.001$) [13]. Indeed, low SES leads to food insecurity which reduced dietary diversity. In food insecurity condition, people may buy low-value foods such as refined grains with added sugar and fat. Therefore, this dietary pattern reduces healthier food consumption like lean meats, fruits, and vegetables which consequently leads to less dietary diversity [22]. This study showed that economic status could affect food choices. However, our findings showed that there is no difference between educational status and DDS. A probable reason for this finding is that our participants were employees from university of medical science and they may have relatively good nutritional knowledge.

The present study showed that a diverse diet is associated with lower WHR. In other words, in highest quartiles of DDS, the BMI was less in women (**Figure 1**). In study on 7,470 subjects the intake of diverse diet was inversely related with WC, and it was beneficial in prevention from obesity [8]. The odds of obesity in men and women were less than 40%–48% and 31%–55%, respectively. Similarly, Azadbakht et al. [19] indicated that risk of obesity decreased with increase in quartiles of DDS ($p = 0.04, 0.03$). In this study, it was observed that greater dietary diversity was associated with decreased anthropometric indices including WHR, WC, and BMI. Diverse diet could lead to increased intake of calcium, fiber and vitamin C which all of them could prevent the development of obesity. In contrast to earlier findings, Fernandez et al. [11] in their study observed that greater dietary diversity is associated with higher BMI in children ($p = 0.02$) due to increase energy intake. Therefore, it is yet to be cleared that a diverse diet could decrease or increase obesity. Our results show the importance of dietary diversity and its association with abdominal obesity. These findings put more emphasis on importance of dietary diversity for prevention of obesity and its related chronic diseases.

One of the most common jobs in Iran is a government employee. Due to disturbance in meal time [24], special occupational stress [25], long working hours, and reduced physical activity, these occupations are considered as risky behaviors and a risk factor for metabolic diseases such as obesity, diabetes, metabolic syndrome, and non-alcoholic fatty liver disease [24,26].

The main strength of this study was to evaluate the difference between anthropometric parameters and DDS which was evaluated for the first time in Kermanshah, Iran. This study could be the basis for other studies. However, our study had several limitations. Our sample size was relatively small. Moreover, the studied subjects were medical sciences university employees who may have rather high nutritional knowledge. Doing a research with large sample size and on subjects that are represent of different layer of community is us suggest for future studies.

Overall, our study showed that DDS could be a useful indicator for dietary diversity and was negatively correlated with WHR. It seems that dietary diversity might improve health status,


https://doi.org/10.7762/cnr.2017.6.4.247

particularly in the context of abdominal obesity and its related diseases. More researches in the field of dietary diversity based on DDS and its association with obesity as well as other chronic diseases are still warranted. Therefore, paying attention to the food pattern of this stratum is very important.

## ACKNOWLEDGEMENTS

We thank the participants involved in our study.

## REFERENCES

1. Azadbakht L, Esmaillzadeh A. Diet variety: a measure of nutritional adequacy and health. J Qazvin Univ Med Sci 2009;13:88-97.
2. Vakili M, Abedi P, Sharifi M, Hosseini M. Dietary diversity and its related factors among adolescents: a survey in Ahvaz-Iran. Glob J Health Sci 2013;5:181-6.
PUBMED | CROSSREF
3. Pangaribowo EH, Gerber N, Torero M. Food and nutrition security indicators: a review. Bonn: Center for Development Research; 2013.
4. Mirmiran P, Azadbakht L, Esmaillzadeh A, Azizi F. Dietary diversity score in adolescents - a good indicator of the nutritional adequacy of diets: Tehran lipid and glucose study. Asia Pac J Clin Nutr 2004;13:56-60.
PUBMED
5. Tiew KF, Chan YM, Lye MS, Loke SC. Factors associated with dietary diversity score among individuals with type 2 diabetes mellitus. J Health Popul Nutr 2014;32:665-76.
PUBMED
6. Wright MJ, Bentley ME, Mendez MA, Adair LS. The interactive association of dietary diversity scores and breast-feeding status with weight and length in Filipino infants aged 6–24 months. Public Health Nutr 2015;18:1762-73.
PUBMED | CROSSREF
7. Steyn NP, Nel JH, Nantel G, Kennedy G, Labadarios D. Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? Public Health Nutr 2006;9:644-50.
PUBMED | CROSSREF
8. Vadiveloo M, Dixon LB, Mijanovich T, Elbel B, Parekh N. Dietary variety is inversely associated with body adiposity among US adults using a novel food diversity index. J Nutr 2015;145:555-63.
PUBMED | CROSSREF
9. Black C, Ntani G, Kenny R, Tinati T, Jarman M, Lawrence W, Barker M, Inskip H, Cooper C, Moon G, Baird J. Variety and quality of healthy foods differ according to neighbourhood deprivation. Health Place 2012;18:1292-9.
PUBMED | CROSSREF
10. Conklin AI, Forouhi NG, Suhrcke M, Surtees P, Wareham NJ, Monsivais P. Variety more than quantity of fruit and vegetable intake varies by socioeconomic status and financial hardship. Findings from older adults in the EPIC cohort. Appetite 2014;83:248-55.
PUBMED | CROSSREF
11. Fernandez C, Kasper NM, Miller AL, Lumeng JC, Peterson KE. Association of dietary variety and diversity with body mass index in US preschool children. Pediatrics 2016;137:e20152307.
PUBMED | CROSSREF
12. McDonald CM, McLean J, Kroeun H, Talukder A, Lynd LD, Green TJ. Correlates of household food insecurity and low dietary diversity in rural Cambodia. Asia Pac J Clin Nutr 2015;24:720-30.
PUBMED
13. Alkerwi A, Sauvageot N, Malan L, Shivappa N, Hébert JR. Association between nutritional awareness and diet quality: evidence from the observation of cardiovascular risk factors in Luxembourg (ORISCAV-LUX) study. Nutrients 2015;7:2823-38.
PUBMED | CROSSREF

14. Mayén AL, Marques-Vidal P, Paccaud F, Bovet P, Stringhini S. Socioeconomic determinants of dietary patterns in low- and middle-income countries: a systematic review. Am J Clin Nutr 2014;100:1520-31.
PUBMED | CROSSREF

15. Mahan LK, Raymond JL. Krause's food & the nutrition care process. 14th ed. St. Louis (MO): Elsevier; 2017.

16. Mirmiran P, Hosseini Esfahani F, Azizi F. Relative validity and reliability of the food frequency questionnaire used to assess nutrient intake: Tehran lipid and glucose study. Iran J Diabetes Lipid Disord 2009;9:185-97.

17. Kant AK, Block G, Schatzkin A, Ziegler RG, Nestle M. Dietary diversity in the US population, NHANES II, 1976–1980. J Am Diet Assoc 1991;91:1526-31.
PUBMED

18. United States Department of Agriculture. USDA'S food guide pyramid booklet. 1st ed [Internet]. Washington, D.C.: United States Department of Agriculture; 1992 [cited 1996 October]. Available from: https://www.cnpp.usda.gov/FGP.

19. Azadbakht L, Akbari F, Esmaillzadeh A. Diet quality among Iranian adolescents needs improvement. Public Health Nutr 2015;18:615-21.
PUBMED | CROSSREF

20. Arimond M, Wiesmann D, Becquey E, Carriquiry A, Daniels MC, Deitchler M, Fanou-Fogny N, Joseph ML, Kennedy G, Martin-Prevel Y, Torheim LE. Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. J Nutr 2010;140:2059S-2069S.
PUBMED | CROSSREF

21. Johnson F, Wardle J. Variety, palatability, and obesity. Adv Nutr 2014;5:851-9.
PUBMED | CROSSREF

22. Amugsi DA, Lartey A, Kimani E, Mberu BU. Women's participation in household decision-making and higher dietary diversity: findings from nationally representative data from Ghana. J Health Popul Nutr 2016;35:16.
PUBMED | CROSSREF

23. Murakami K, Miyake Y, Sasaki S, Tanaka K, Ohya Y, Hirota YOsaka Maternal and Child Health Study Group. Education, but not occupation or household income, is positively related to favorable dietary intake patterns in pregnant Japanese women: the Osaka Maternal and Child Health Study. Nutr Res 2009;29:164-72.
PUBMED | CROSSREF

24. Rezaeian S, Ahmadzadeh J. Assessment of food habits and their association with cardiovascular risk factors in employees. Int J Collab Res Intern Med Public Health 2012;4:339-43.

25. Hoboubi N, Choobineh A, Kamari Ghanavati F, Keshavarzi S, Akbar Hosseini A. The impact of job stress and job satisfaction on workforce productivity in an Iranian petrochemical industry. Saf Health Work 2017;8:67-71.
PUBMED | CROSSREF

26. Choobineh A, Soltanzadeh A, Tabatabaee H, Jahangiri M, Khavaji S. Health effects associated with shift work in 12-hour shift schedule among Iranian petrochemical employees. Int J Occup Saf Ergon 2012;18:419-27.
PUBMED | CROSSREF