

The Association between Dietary Diversity with Shift Work among the Nurses

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Abstract

Background: Nutrition is related to different health problems. Working in shifts has been identified as one of the factors associated with overweight and obesity. This study was performed to assess the association between food intake and dietary diversity with shift work among nurses.

Methods: This cross-sectional study was conducted on 270 nurses working in hospitals under the supervision of Tehran University of Medical Sciences. A three-day 24-h food recall was used to evaluate food intake and diversity, Blood pressure (mmhg), fasting blood glucose (mg/dl), insulin ($\mu\text{m/ml}$), lipid profile (mg/d), serum levels of cobalamin (ng/l), folic acid (pg/l) and anthropometric indices were also evaluated.

Results: Mean age of subjects was 35.01 ± 6.52 years. Mean dietary diversity scores (by Kant and IDDS methods) were 4.68 ± 1.18 and 5.77 ± 1.25 , respectively. Among study participants the mean weight ($p < 0.03$), waist circumference ($p < 0.02$) and hip circumference ($p < 0.001$) showed a significant difference across the tertiles of Kant dietary diversity score. A significant difference was seen in terms of body mass index (BMI) and WHR ($p < 0.03$). This means that by increasing dietary diversity score, average height and weight reduces. It was also seen that by increasing the dietary diversity score, systolic blood pressure decreased and serum folic acid level increased, though these changes were statistically insignificant. In the Kant method, weight and hip circumference were increased in dietary diversity in the morning shift ($p = 0.05$). In the FAO method, insulin and vitamin B9 (Folic acid) levels decreased by increasing dietary diversity in the morning shift. However, the serum level of vitamins B9 (Folic acid) and B12 was increased by the increment of dietary diversity in the rotating shift.

Conclusion: Anthropometric factors are decreased by increasing the dietary diversity. It was also found that the mean of some anthropometric indices was higher in the morning shift. Higher dietary diversity and lower carbohydrate intake was also seen in the morning shift.

Keywords: Dietary diversity score; Food intake; Shift work; Nursing

Introduction

Nurses are the largest group of health care workers in organizations providing health services, and provide direct and indirect care services to patients [1]. Based on studies, factors such as lack of facilities, workload, lack of administrative support, dealing with patients or their relatives, and handling workplace violence are the most common stressors among those working in this occupation [2]. These stressors may affect nurses' dietary intakes. Disturbances in dietary intake are linked to several conditions such as obesity and overweight, high blood pressure, anemia, osteoporosis, diabetes, cancer and heart disease [3-5]. The relationship between diet and different disease has proven and so modifying people's diets can be considered as a factor for assessing and evaluating their health status [5].

According to studies, shift work is defined as work outside usual office time, and includes irregular, flexi-time, rotating and evening shifts [6]. The link between shift work and health problems is not clear, but issues with changes in sleep, as well as lifestyle and behavioral changes such as diet and smoking may be potential mediators in this regard [7].

In addition, work shifts have been identified as one of the factors associated with overweight and obesity. Research suggests that the overall risk of obesity and overweight may rise up to 39% in shift workers [8-11]. Also, a significant association has been proven between shifts and overweight and obesity in various studies [12]. Obesity is a risk factor for chronic diseases and is more common among shift workers (intermittent) than day workers [13-15]. Nurses' work plans may influence their health by increasing the risk of overweight and obesity [16].

Despite previous evidence that shift work may influence dietary intake and anthropometric measurements, there are few studies available investigating the associations of nurses' shift work with these variables. Therefore, this study aimed to assess the associations between food intake and food diversity as well as anthropometric measurements with shift work among the nurses affiliated to Tehran University hospitals.

Methods

Subjects

This cross-sectional study was carried out with 270 nurses (246 females, 24 males) working in hospitals under the supervision of Tehran University. All personnel who graduated in the field of nursing from these hospitals were invited to participate in the study (Response rate=80.2%). Then, the study participants were recruited based on certain inclusion criteria. The inclusion criteria included: Under 45 years old for men and under the menopausal age for women. Another factor was their willingness to cooperate in the study and complete it. Certain psychiatric disorders, such as mood disorders and depression, and endocrine disorders such as diabetes and thyroid diseases as well as other chronic disorders were exclusion criteria, as well as subjects who were taking any medication, and non-cooperation.

This study was approved by the Ethics-in-Research Commission of Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences (Ref Number: E-00172). Also, a full explanation of the purpose and process of the study was presented, along with the sampling methodology, and relevant parties were assured of the confidentiality of all information. Finally, a written informed consent was obtained from the subjects, and questionnaires were completed by an interviewer.

Demographic characteristics

Demographic information was collected using a questionnaire and researcher interviews. Also, participants' age, gender, education level, working schedules and other related information were recorded. Iranian nursing shifts were divided into these groups: morning fix, evening, night fix, evening and night, morning and evening, rotating.

Anthropometric and blood pressure measurements

Blood pressure was measured after 15 min of seated rest from the right arm using a digital monometer. After resting for another 5 min, BP was measured again and the outcomes of these two measurements were recorded.

Anthropometric measurements such as weight, height, waist and hip circumference were recorded for all participants. Body weight was measured to the nearest 0.1 kg using a scale with subjects wearing light clothing (i.e. no sweaters, jackets, or belts) and no shoes. Height was measured to the nearest 0.5 cm using a Secastadiometer and with shoes removed. A plastic flexible tape was used to assess waist and hip circumferences to the nearest 0.5 cm. Waist measurement was assessed at half the distance between the bottom of the xiphoid process and the umbilicus, and the hip measurement was taken at the largest anterior protrusion. The ratio between waist and hip (WHR) was computed. Body mass index (BMI) was calculated from the height and weight data; $BMI = kg/m^2$.

Food intake and food diversity

A three-day 24-h food recall (2 working days and a holiday) was used to evaluate food intake and diversity. Then the food intake data were analyzed by Nutritionist [4]. Food diversity assessment was performed using the 2 suggested methods of the FAO (Food and Agriculture Organization) and Kant.

FAO [17] method proposes 9 food groups for evaluating individual dietary diversity score (IDDS), which is on a 0-9 scale. In this study, a score of 1 was allocated for the consumption of at least half a serving of each food group per day, while zero points were allocated for consumption lower than that. Finally, the scores obtained by these 9 groups are added together to provide the overall IDDS score. These 9 groups included: starchy foods, dark green leafy vegetables, fruits and vegetables rich in vitamin A, fruits and other vegetables, organ meats, fish, eggs, beans, seeds and nuts, and milk/dairy products.

In Kant's method [18], foods are first categorized to 5 main groups of grains, vegetables, fruits, meat and dairy products. Then the main groups are converted into 23 subgroups to provide the dietary diversity score among the groups in the food pyramid [19]. Groups were divided as listed below:

Cereals had 7 subgroups covering white bread, whole bread, wholegrain biscuits, cooked rice, cooked pasta, flour and breakfast cereals. Vegetables had 7 subgroups of vegetables, potatoes, tomatoes and its products, other starchy vegetables, legumes, yellow and orange vegetables, and green vegetables. Fruits were divided into 2 groups of citrus fruits and berries, other fruits and juices. Dairy products contained 3 subgroups: milk, yogurt and cheese & curd. Meats were divided into 4 subgroups of red meat, fish, poultry and eggs. The maximum dietary diversity score awarded to each of the five groups is 2 and ultimately, the sum of these numbers is calculated as the total score. As a result, dietary diversity score ranged from 0 to 10.

Biochemical assessment

12 cc fasting venous blood samples were collected after 8-12 h fasting in sterile condition. All blood samples were collected between 8:00 to 10:00 AM. Serums were centrifuged and stored at -40°C. Serum folic acid and cobalamin were measured by radio immune assay (RIA) and DRG diagnostic kit.

The Glucose Oxidase Phenol 4-Aminoantipyrine Peroxidase (GOD/PAP) method was used to measure fasting blood glucose level. The methods of Glycerol-3-phosphate oxidase Phenol 4-Aminoantipyrine Peroxidase (GPO-PAP), Enzymatic Endpoint and enzymatic clearance were used to measure serum triglycerides, total cholesterol and LDL & HDL, respectively. Fasting blood glucose and lipid profile measurements were carried out by Randox laboratory kit (Hitachi 902). Serum insulin level was determined by enzyme-linked immune-sorbent assay (Human insulin ELISA kit, DRG Pharmaceuticals, GmbH, Germany). The minimum detectable concentration level was 1.76 $\mu U/ml$, Intra CV was 2.19% and Inter CV was 4.4%.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS version 20.0). At first the normality of the variables were examined by the Kolmogorov-Smirnov test. FAO & Kant criteria were used in order to determine dietary diversity score (DDS). To evaluate the relationship between quantitative variables by tertiles of dietary diversity, and also in order to evaluate the dietary intake in grouped shifts, the ANOVA test (one-way analysis of variance) was used. To eliminate the effects of age, sex, and energy, ANCOVA was used. The chi-square test was used to evaluate differences between qualitative variables. To determine the association between dietary diversity in different grouped shifts and demographic and anthropometric and biochemical variables, correlations tests were used. A significance level of 0.05 was determined for all statistical tests.

The P-value was calculated using one-way analysis of variance. Post-hoc test was used in order to perform pairwise comparison of dietary diversity tertiles. Similar letters indicate significant differences ($p < 0.05$) between the two tertiles.

methods, and are shown in Table 1. The mean age of subjects was 35.01 ± 6.52 years. The mean range of dietary diversity score by Kant and IDDS method was 4.68 ± 1.18 and 5.77 ± 1.25 , respectively.

Results

Anthropometric, food intake and food diversity

The baseline characteristics of participants across categories of DDS (Dietary Diversity Scores) were calculated by the Kant and FAO

	KANT			P	P*	FAO			P	P*
	T1 (n=93)	T2 (n=87)	T3 (n=90)			T1 (n= 104)	T2 (n=82)	T3 (n=84)		
	Mean \pm SD	Mean \pm SD	Mean \pm SD			Mean \pm SD	Mean \pm SD	Mean \pm SD		
Age (year)	35.59 \pm 6.28	34.09 \pm 6.57	35.49 \pm 6.63	0.24	0.932	35.79 \pm 6.58	35.05 \pm 6.09	34.31 \pm 6.78	0.31	0.132
Height (cm)	161.72 \pm 7.01	160.98 \pm 8.59	161.58 \pm 7.71	0.79	0.1	162.55 \pm 7.29c	161.48 \pm 8.33	160.05 \pm 7.57c	0.09	<0.001*
Weight (kg)	68.70 \pm 12.76a	63.92 \pm 10.00a	66.39 \pm 12.51	0.03*	0.01*	68.08 \pm 13.28	65.49 \pm 10.07	65.27 \pm 11.94	0.2	0.02*
Waist (cm)	78.75 \pm 10.44a	74.65 \pm 8.84a,b	77.81 \pm 11.15b	0.02*	0.14	78.46 \pm 10.85	75.72 \pm 9.02	76.93 \pm 10.77	0.19	0.17
Hip (cm)	97.41 \pm 10.41a	92.96 \pm 8.74a,b	93.56 \pm 9.88b	<0.001*	0.04*	95.94 \pm 10.45	93.81 \pm 8.38	94.04 \pm 10.47	0.27	0.18
Shift Work (%)				0.44*	-				0.41*	
Morning	32.6	36.1	41.6			37.6	43.8	28.9		
Evening	3.3	6	1.1			3	1.3	6		
Night	15.2	19.3	14.6			16.8	20	12		
Rotation	38	33.7	33.7			35.6	30	39.8		
Evening & Night	8.7	4.8	9			6.9	2.5	13.3		
Morning & Rotation	2.2	0	0			0	2.5	0		
BP sistol (mmhg)	109.43 \pm 12.89	108.76 \pm 13.03	109.26 \pm 12.85	0.94	0.72	109.48 \pm 13.31	109.04 \pm 12.80	108.90 \pm 12.53	0.95	0.97
BP diastol (mmhg)	70.18 \pm 10.58	69.99 \pm 10.6	71.14 \pm 10.42	0.73	0.66	70.28 \pm 10.35	69.56 \pm 10.61	71.49 \pm 10.11	0.49	0.39
FBS (mg/dl)	87.74 \pm 17.86	89.08 \pm 23.94	85.42 \pm 13.06	0.42	0.51	89.71 \pm 24.42a	84.31 \pm 13.64a	87.51 \pm 13.85	0.15	0.48
LDL (mg/dl)	92.31 \pm 22.16	91.80 \pm 21.80	96.84 \pm 24.23	0.26	0.11	92.53 \pm 24.01	92.84 \pm 18.97	95.93 \pm 24.74	0.55	0.21
HDL (mg/dl)	53.39 \pm 13.19	53.98 \pm 12.52	52.72 \pm 12.38	0.81	0.72	53.24 \pm 11.92	52.54 \pm 13.41	54.27 \pm 12.93	0.68	0.41
TG (mg/dl)	102.28 \pm 59.99	109.60 \pm 74.61	118.70 \pm 84.18	0.31	0.27	107.46 \pm 80.23	113.63 \pm 70.19	109.96 \pm 68.49	0.85	0.96
Cholesterol (mg/dl)	172.34 \pm 33.34	174.20 \pm 33.50	178.94 \pm 34.23	0.39	0.12	172.55 \pm 35.25	173.65 \pm 28.24	179.83 \pm 36.40	0.3	0.09
Insulin (μ g/ml)	11.95 \pm 12.20	12.83 \pm 14.23	11.23 \pm 7.36	0.6	0.51	12.12 \pm 11.80	12.20 \pm 12.83	11.61 \pm 9.86	0.93	0.99
Folic acid (pg/l)	6.67 \pm 8.04	6.75 \pm 8.25	8.84 \pm 11.83	0.24	0.07	8.37 \pm 9.83	5.65 \pm 6.64	7.97 \pm 11.37	0.14	0.87
B12 (ng/l)	329.13 \pm 172.45	324.30 \pm 145.39	351.30 \pm 157.06	0.5	0.19	335.32 \pm 163.30	321.66 \pm 150.73	348.39 \pm 162.76	0.58	0.49
BMI (kg/m ²)	26.21 \pm 4.31a	24.66 \pm 3.38a	25.34 \pm 3.88	0.03*	0.08	25.71 \pm 4.41	25.10 \pm 3.33	25.41 \pm 3.87	0.58	0.66
WHR	0.80 \pm 0.07c	0.80 \pm 0.06b	0.83 \pm 0.09c,b	0.03*	0.23	0.81 \pm 0.07	0.80 \pm 0.06	0.82 \pm 0.09	0.5	0.88

P* represents ANCOVA assessment after adjusting for age, sex and energy

T (T1=morning fix, T2=evening, night, evening-night fix, T3=rotation, morning and rotation)

T represents DDS tertiles
 In the case of age, the only adjusted variables were sex and total energy intake
 a. Significant difference between first and second tertiles
 b. Significant difference between second and third tertiles
 c. Significant difference between first and third tertiles
 *Ptrend
 p<0.05

Table 1: Baseline characteristics across tertiles of dietary diversity score using KANT and FAO methods.

Mean weight, waist circumference and hip circumference showed a significant difference with dietary diversity score in Kant tertiles (p<0.03, p<0.02, p<0.001; respectively). Also, weight and hip circumference retained a significant difference after adjusting for age, gender and energy. Additionally, a significant relationship was seen in terms of body mass index and waist to hip ratio (p<0.03). Waist to hip ratio increased by increments in dietary diversity. However, after adjusting for age, gender and energy variables, this effect disappeared. After comparing variables through the post-hoc test, the mean weight, WC, WHR and BMI significantly decreased by increasing the food diversity from first tertile to the second. A significant relationship was observed in terms of WHR between the first and third tertiles, and also between the second and third tertiles. Both of which indicate that the mean WHR is increased with dietary diversity increment.

A significant difference was seen in terms of mean height (p<0.001) and weight (p<0.02) after adjusting for age, gender and energy in FAO tertiles. This means that by increasing dietary diversity score, the average of height and weight was reduced. It was also seen that by increasing the dietary diversity score, systolic blood pressure decreased and serum folic acid level increased, but none of these changes were statistically significant.

Relationships between other study variables

The mean and standard deviation of variables of different shifts is shown in Table 2. The mean age, weight, waist and hip circumference, HDL and insulin level and BMI were higher in the morning shift than in other shifts. Also, a significant relationship was seen between age (p<0.00) across different shifts, which remained significant even after adjusting for gender and energy (p<0.00).

BP _{sistol} (mmhg)	109.68 ± 12.05	107.17 ± 12.23	110.07 ± 13.87	0.3	0.08
BP _{diastol} (mmhg)	70.02 ± 9.67	69.34 ± 10.22	71.49 ± 10.88	0.38	0.02 [*]
FBS (mg/dl)	90.38 ± 22.77 ^a	83.65 ± 10.29 ^a	85.99 ± 17.52	0.05	0.28
LDL (mg/dl)	95.04 ± 24.39	90.24 ± 21.67	94.17 ± 22.00	0.37	0.26
HDL (mg/dl)	54.34 ± 12.70	53.80 ± 13.44	52.23 ± 11.67	0.48	0.3
TG (mg/dl)	110.19 ± 67.76	110.86 ± 85.70	106.66 ± 65.93	0.91	0.73
Cholesterol (mg/dl)	178.27 ± 34.51	171.59 ± 33.28	173.81 ± 32.77	0.41	0.66
Insulin (µg/ml)	12.07 ± 10.26	11.29 ± 9.84	11.03 ± 9.35	0.75	0.96
Folic acid (pg/l)	8.65 ± 9.78	6.27 ± 6.86	7.29 ± 10.88	0.28	0.58
B12 (ng/l)	368.51 ± 174.42 ^{a,c}	298.49 ± 153.42 ^a	320.33 ± 130.46 ^c	0.01	0.12
BMI (kg/m ²)	25.86 ± 3.80 ^c	25.45 ± 4.20	24.68 ± 3.50 ^c	0.09	0.66
WHR	0.82 ± 0.09	0.80 ± 0.07	0.81 ± 0.08	0.1	0.08

P^{*} represents ANCOVA assessment after adjusting for age, sex and energy
 T (T1=morning fix, T2=evening, night, evening-night fix, T3=rotation, morning and rotation)
 In the case of age, the only adjusted variables were sex and energy
 a. Significant difference between first and second tertiles
 b. Significant difference between second and third tertiles
 c. Significant difference between first and third tertiles
 p<0.05

	Shiftcat3			P	P*
	T1	T2	T3		
	Mean ± SD	Mean ± SD	Mean ± SD		
Age (year)	38.57 ± 6.20 ^{a,b}	33.61 ± 5.84 ^a	32.57 ± 5.79 ^b	<0.001	<0.0012
Height (cm)	161.60 ± 7.53	160.35 ± 7.96	162.15 ± 7.75	0.31	0.47
Weight (kg)	67.61 ± 11.27	65.58 ± 12.61	65.09 ± 11.64	0.29	0.42
Waist (cm)	78.84 ± 10.99 ^c	76.21 ± 10.26	75.46 ± 8.84 ^c	0.05	0.4
Hip (cm)	95.45 ± 10.68	94.62 ± 8.85	93.52 ± 9.32	0.38	0.62

Table 2: Mean ± SD of studied variables based on divided shifts.

Fasting blood glucose was significantly higher in the morning working group than the night working group. Morning shift nurses also had a significantly higher BMI than rotating shift nurses.

The mean and standard deviations of food intake across various shifts is shown in Table 3. A significant relationship was observed between carbohydrate intake (p<0.001), lipids (p<0.01) and PUFA (p<0.01). Protein intake was lower in morning shift nurses than night

or rotating shift nurses, but this difference was not statistically significant.

	Shiftcat3			P	P*
	T1	T2	T3		
	Mean ± SD	Mean ± SD	Mean ± SD		
Carbohydrate (g)	2.63 ± 3.94 ^c	2.68 ± 4.52 ^b	2.49 ± 4.14 ^{c,b}	<0.001*	0.05
Fat (g)	7.06 ± 1.75 ^c	6.74 ± 1.95 ^b	7.57 ± 1.75 ^{c,b}	0.01*	0.15
Protein (g)	5.84 ± 1.35	6.11 ± 1.68	6.12 ± 1.74	0.39	0.13
SFA (g)	1.75 ± 5.09	1.83 ± 8.88	1.85 ± 5.90	0.56	0.31
PUFA (g)	1.78 ± 7.96	1.58 ± 7.30 ^b	1.96 ± 8.39 ^b	0.01*	0.28
Linolenic acid (g)	2.80 ± 4.02	2.95 ± 5.06	3.40 ± 5.20	0.65	0.25
EPA (g)	0.01 ± 0.04	0.01 ± 0.06	0.01 ± 0.06	0.82	0.36
Vitamin A (µg)	8.40 ± 9.61	7.79 ± 5.91	8.68 ± 1.17	0.83	0.72
Zinc (mg)	8.50 ± 2.23	8.68 ± 2.23	8.60 ± 2.18	0.86	0.38
Vitamin E (mg)	1.89 ± 8.86	1.63 ± 7.43 ^b	2.04 ± 8.69 ^b	<0.001	0.54
Folate (µg)	3.11 ± 1.10	3.18 ± 9.76	3.18 ± 1.27	0.9	0.79
Folic acid (g)	2.58 ± 8.58	2.41 ± 9.19 ^b	2.72 ± 8.69 ^b	0.07	0.61

Linoleic acid (g)	7.99 ± 2.67	1.04 ± 3.46	1.10 ± 3.46	0.78	0.33
Calcium (mg)	1.32 ± 3.32	1.39 ± 3.20	1.36 ± 2.83	0.35	0.25
Vitamin D (IU)	5.31 ± 1.23	5.79 ± 1.76	4.43 ± 1.11	0.8	0.79
DHA (g)	0.03 ± 0.13	0.05 ± 0.17	0.04 ± 0.16	0.8	0.33

P* represents ANCOVA assessment after adjusting for age, sex and energy
T (T1=morning fix, T2=evening, night, evening-night fix, T3=rotation, morning and rotation)
In the case of age, the only adjusted variables were sex and energy
b. Significant difference between second and third tertiles
c. Significant difference between first and third tertiles
p<0.05

Table 3: Mean ± SD of dietary intakes based on divided shifts.

The work shifts were divided into 3 groups, and the relationship between dietary diversity and these shifts is presented in Table 4. In the Kant method, weight and hip circumference were increased along with increases in dietary diversity in the morning shift (p=0.05). In the FAO method, insulin and B9 (Folic Acid) level were decreased by increasing dietary diversity in morning shift. However, the serum level of B9 (Folic Acid) and B12 was increased by the increment of dietary diversity in the rotating shift group.

Variables	Morning Fix	Kant Evening/Night	Rotation/ Rotation	Morning	And	Morning Fix	FAO Evening/Night	Rotation/ Rotation	Morning	And
	R	R	R			R	R	R		
	P	P	P			P	P	P		
Age (year)	-0.071	0.008	-0.116			0.081	-0.049	-0.007		
	0.49	0.95	0.265			0.43	0.688	0.947		
Height (cm)	-0.083	-0.08	-0.177			0.039	0.107	1		
	0.421	0.503	0.087			0.701	0.371			
Weight (kg)	-0.195	0.01	-0.087			-0.096	0.047	-0.142		
	0.055	0.934	0.402			0.351	0.7	0.17		
Waist (cm)	-0.115	0.048	-0.096			-0.035	0.079	-0.142		
	0.261	0.691	0.356			0.733	0.51	0.171		
Hip (cm)	0.194	0.006	-0.018			-0.157	-0.052	-0.177		
	0.057	0.96	0.862			0.126	0.666	0.088		
BPsistol (mmhg)	-0.062	-0.008	0.096			0.145	-0.124	-0.042		
	0.55	0.947	0.362			0.164	0.298	0.688		
BPdiastol (mmhg)	-0.025	0.037	0.147			0.001	-0.044	0.132		
	0.812	0.76	0.164			0.993	0.719	0.212		
FBS (mg/dl)	-0.13	0.061	-0.037			-0.088	0.128	-0.063		
	0.204	0.615	0.724			0.394	0.289	0.548		

	0.102	0.003	0.095	0.087	0.002	0.165
LDL (mg/dl)	0.319	0.98	0.361	0.399	0.99	0.112
	0.04	-0.112	0.208	0.075	-0.177	0.189
HDL (mg/dl)	0.697	0.352	0.044	0.464	0.14	0.068
	0.055	0.062	-0.083	0.077	0.221	-0.104
TG (mg/dl)	0.59	0.61	0.425	0.451	0.064	0.318
	0.176	-0.031	0.12	0.132	-0.004	0.172
Cholesterol	0.084	0.796	0.251	0.198	0.97	0.096
	-0.025	0.182	-0.221	-0.089	0.056	-0.13
Insulin (µg/ml)	0.808	0.128	0.032	0.038	0.641	0.21
	-0.12	-0.151	0.113	-0.19	0.108	0.248
Folic acid (pg/l)	0.253	0.221	0.282	0.068	0.382	0.017
	0.09	-0.037	0.196	0.007	-0.02	0.257
B12 (ng/l)	0.392	0.764	0.061	0.947	0.869	0.013
	-0.123	-0.024	-0.138	-0.172	0.079	<0.001
BMI (kg/m2)	0.229	0.844	0.182	0.092	0.511	0.999
	0.129	0.135	0.004	0.07	0.033	-0.137
WHR	0.209	0.258	0.966	0.498	0.783	0.188

Table 4: The relationship between dietary diversity in different shifts and with different variables.

Discussion

In the current study, it was shown that by increasing dietary diversity, mean weight, waist circumference, hip circumference and body mass index scores were reduced, while the waist to hip ratio increases. Many similar studies have also confirmed these findings. For example, in a study by Mirmiran et al. [20], those who were in the first quartile of DDS had higher levels in some anthropometric factors. No significant difference was seen in their study between DDS quartiles by BMI and WC. However, waist to hip ratio was higher in the first quartile compared to the fourth quartile which indicates higher abdominal obesity in people who have less food diversity. Azadbakht et al. [21] showed a reduction in the possibility of obesity by increasing DDS. A significant difference was also observed in terms of mean BMI, WC and WHR in DDS quartiles. However, the results are contradictory on this issue as well. McCrory and his colleagues observed an increase in obesity due to DDS increasing [22]. The people with obesity and abdominal obesity had highest level of DDS than non-obese individuals in a study by Jayawardena et al. [23]. Increasing obesity levels in parallel with increasing dietary diversity could be due to increased appetite and consequent increased energy intake [24,25]. Several studies have shown a relationship between increased energy intake and increased dietary diversity [26,27]. Dietary diversity can act as a double-edged sword for energy regulation, and may have positive or negative effects on obesity, based on which food groups increase dietary diversity [22]. In addition, the present study's results demonstrated that DDS, as calculated by the Kant method, was more strongly associated with anthropometric measures, including indices of

central obesity like WC. Moreover, DDS calculated in that way was also associated with serum concentrations of insulin. This is in line with previous studies which found a significant association of central obesity with insulin resistance [8-11].

The present results also demonstrated a higher level of mean age, weight, waist and hip circumference, BMI, HDL and glucose in the morning shift. In this regard, the results are different. There was an inversely significant relationship between waist and hip circumference with increased dietary diversity in morning shift nurses.

The average intake of carbohydrates and age was higher in night and evening shift nurses. Unhealthy and irregular food plans, such as skipping breakfast, may cause weight changes. Work shifts are one of the causes for disturbed normal diets and unhealthy food choices [28-30]. Several studies have proven the relationship between shifts and overweight and obesity [11,31]. In a study of Korean nurses, it was found that rotating shift workers were younger. This study is in line with the current study, since younger people are more likely to be involved and active in night and rotating shifts. Also, those with longer shifts were older and had higher BMI and BP [32].

In a Malaysian study on women working in an electronic equipment factory, a significant relationship was observed between overweight workers and working in the night shift [11]. Long shifts were a predictor of increased BMI in a cross-sectional study [33]. In an Australian cross-sectional study, it was shown that nurses working shifts had a 1.15-times greater risk of obesity and overweight, while only fixed night shifts were linked to obesity [34,35].

Western studies have also shown high rates of obesity among night shift nurses [33,36]. In another study it was indicated that night shift workers had higher BMI than day shift workers [37].

In a Sudo et al. [38] study, total energy intake in night shift workers was less than in the day shift. This was due to the low frequency of meals and low-quality foods at night. Rotating schedules with night shifts may be a reason for lower weights in these nurses [39]. Job stress is also higher in rotating shifts [40]. In some studies, it was shown that nurses may miss opportunities to snack during the day due to their heavy workloads. Night shift nurses may also consume unhealthy snacks in the middle of the night [29,30,41].

Another study found that cookies and snacks consumption through the shift was higher than other healthy choices [42]. This may be due to differences in working hours in several countries. Korean and American nurses work 8 and 12 h, respectively [32,43]. It is different for Iranian nurses, who work 6 h in morning shifts and 12 h in night shifts. In general, nurses may enjoy better health due to higher levels of health education and self-care than the public [44,45]. Lower and higher blood pressure levels were observed in morning and night shifts, respectively [32].

It should be noted that nurses are among the most important members of a health care management process. More health care managers will manage health care processes better for a range of different patients. This will lead to increased patient health knowledge, self-management skills, and readiness to make changes in health behaviors [46]. Adherence to a better dietary approach is recommended for nurses in night or evening shifts, as well as those in rotations which involve night shifts.

Strengths and Limitations:

According to the literature search, no study exists evaluating the relationship between dietary diversity and dietary intake with nurses' shifts; this was one of the strengths of this study. In addition, two different methods for evaluation were used for evaluating dietary diversity score, each of which had its own pros and cons.

One of the limitations of this study was its cross-sectional nature, which has little ability to detect causality. In addition, the effect of different variables cannot be investigated over time. Other limitations include non-evaluation of economic status, which can affect people's stress levels, as well as their access to food. The majority of study participants were females. Further studies on both sexes are needed to determine the influence of gender differences on these findings. In addition, other nutritional data was not collected. It has been seen that nutraceuticals induce additional health benefits [47]. Furthermore, due to the limited sample size, it was not possible to perform multivariate regression analysis. Finally, data was not collected on participants' physical activity in this study, which is an important confounder.

Conclusion

In the current study, it was found that anthropometric factors such as weight, waist and hip circumference and BMI are decreased by increases in dietary diversity. While waist to hip ratio increased, it was also found that the mean age, weight, waist and hip circumference and body mass index was higher in the morning shift. Also, it was revealed that the average intake of carbohydrates was higher during night and evening shifts.

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