Major Dietary Patterns, Exercise Addiction, and Eating Disorders Among a Sample of Physically Active Young Adults

Nutrition and Metabolic Insights
Volume 17: 1–10

DOI: 10.1177/11786388241258938

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ABSTRACT

BACKGROUND: Regular exercise has been widely acknowledged for its numerous health benefits, including improvements in physical fitness, body function, and mental well-being. However, excessive exercise and unhealthy dietary patterns can lead to adverse effects on individuals' physical and psychological well-being. This study aimed to examine the association of dietary patterns, exercise addiction, and eating disorders among physically active young adults.

METHOD: In this cross-sectional study, a total of 200 physically active young adults aged 18-35 years were included. The participants' dietary intake was assessed using a validated semi-quantitative food frequency questionnaire (FFQ) consisting of 80 food items. To determine dietary patterns, factor analysis was employed. Exercise addiction was evaluated using The Exercise Addiction Inventory (EAI) and Exercise Dependence Questionnaire (EDQ), and eating disorders were assessed using The Eating Disorder Examination—Questionnaire Short (EDE-QS).

RESULT: Three main dietary patterns were identified: western, healthy, and traditional dietary patterns. The western dietary pattern was associated with increased waist-to-hip ratio ($P = .01$) that remained significant after adjustment for confounders (eg, age, gender, BMI, and physical activity $P = .03$), while the adherence to traditional dietary pattern was linked to higher waist circumference and body shape index ($P < .05$). Participants that followed the healthy dietary pattern showed a higher score of EAI and body shape concern ($P = .04$). Furthermore, in structural equation modelling (SEM), eating disorder was identified as a significant positive predictor of exercise addiction ($r = .17$, $P < .05$).

CONCLUSION: According to our finding, those with the higher adherence to healthy dietary pattern had higher scores of exercise addiction and body shape concern. Also, eating disorder was a potential predictor of exercise addiction among young physically active individuals. Further research and targeted interventions are needed to better understand these complex relationships and develop effective strategies to promote healthy behaviors and mitigate the risk of adverse outcomes.

KEYWORDS: Exercise addiction, eating disorders, major dietary patterns

RECEIVED: July 15, 2023. **ACCEPTED:** May 16, 2024.

TYPE: Original Research

FUNDING: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Present study has been financially supported by a grant from Tabriz University of Medical Sciences. The funders had no role in hypothesis generation, recruiting and designing the study. Their role was only financial supporting

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Introduction

Regular exercise is commonly defined as a series of structured, planned, and repetitive complex movement activities that are performed with adequate intensity, frequency, and duration.[1,2] Numerous studies have demonstrated that engaging in regular exercise can contribute to promoting overall health and preventing various diseases. These benefits include improvements in muscular strength and endurance, improvements in body function, increased flexibility, weight management, reduced risk of depression, and lowered risk of cardiovascular disease and developing type 2 diabetes mellitus.[3-5] While exercise is generally associated with numerous positive effects, in some cases, excessive exercise can lead to harmful consequences such as skeletal and muscular damage, as well as immediate changes in mood.[6,7] Exercise addiction (EA) is characterized as a maladaptive behavioral pattern wherein individuals who engage in regular exercise face challenges in maintaining control over their exercise habits. This leads to compulsive behavior, dependency, and adverse effects on their physical well-being, as well as their professional and social life.[8]

There is a growing focus on mental health in sports, with prominent institutions and organizations in the field of Sport Psychology, as well as other related fields, developing their own position statements advocating for comprehensive mental care for athletes.[9-12] However, it is important to note that mental health issues among athletes are often concealed by those who experience them, including athletes themselves, coaches, and clubs. This concealment can be attributed to the fear of shame and stigma associated with mental health problems in the sporting world.[13] Recent reviews have provided evidence of a clear connection between a dedication to excessive exercise and various factors, including preoccupation with weight and shape, dietary attitudes and behaviors, weight control efforts, and body image issues.[14,15]

Research has consistently demonstrated a high prevalence of EA among individuals who have indicated or clinically diagnosed eating disorders (EDs). Prevalence rates of EA in these populations have been reported to range from 29% to 80%.[16,17] In a study, examined the relationship between EA and the presence or absence of EDs, and it has concluded that individuals with indicated EDs are at a 3.5 times higher risk of developing EA compared to those without indicated Eds.[18] Another study demonstrated a correlation between body dissatisfaction (BD), exercise addiction, and risk behaviors for EDs. Additionally, individuals who expressed dissatisfaction with their bodies exhibited higher levels of exercise addiction and engagement in risk behaviors associated with Eds.[19]

EDs are mental conditions that have profound impacts on a person's physical well-being and social functioning, posing significant disability, mortality, and financial burdens. These disorders stem from distorted beliefs and behaviors surrounding weight, body image, and eating patterns, which are pivotal in their development and persistence. In the last 5 decades, there has been a notable surge in the prevalence of eating disorders, and alterations in the food environment have been suggested as contributing factors to this concerning trend.[20] Athletes have an elevated susceptibility to developing disordered eating behaviors.[21,22] Consequently, they may engage in unhealthy methods to control their weight, including skipping meals, following restrictive eating patterns, excessive exercising, adopting dehydration techniques, inducing vomiting, and utilizing diuretics, laxatives, or diet medications.[23]

Studies indicate that eating disorders are associated with concerns about weight and shape, which can lead to severe dietary restrictions and excessive exercise.[24,25] Considering the impact of eating disorders on food intake, analyzing dietary patterns instead of examining specific nutrients or foods provides a broader perspective on food consumption and nutrient intake. In fact, dietary patterns reflect the actual eating behaviors of a population.[26]

In light of the lack of previous studies simultaneously evaluating dietary patterns, exercise addiction, and eating disorders, our research aimed to investigate the relationship between major dietary patterns, exercise addiction, and eating disorders in physically active young adults.

Methods and Materials

Participants

This cross-sectional study involved the enrollment of 200 participants within the age range of 18-35 years, with 49% being males and 51% being females. The selection of participants was carried out using a simple random sampling method, and they were recruited from sporting clubs in Tabriz, Iran from May 27 to July 5, 2022. Out of 300 individuals invited to participate, 248 were eligible based on the inclusion/exclusion criteria. Of the eligible participants, 218 consented and enrolled into the study (response rate of 87.9%). However, complete data was available only for 200 participants as 18 did not complete all study procedures and questionnaires. The study group had relatively high educational levels, with 86% having attained a university degree. A majority (91.5%) reported being single.

The study objectives were clearly explained to the participants, and their informed consent was obtained, indicating their willingness to contribute to the scientific research. Furthermore, all participants were assured that their identities would be kept anonymous throughout the study. Individuals with chronic conditions that could potentially impact their food intake, including digestive problems and psychological issues identified by a psychologist, were excluded from the study. All participants were engaged in physical activity for a minimum of 4 hours per week.

General characteristics and anthropometric assessments

Demographic variables such as age, gender, education level, and marital status were gathered as part of the data collection process. Height and weight measurements of the participants were obtained using a wall-mounted stadiometer and a Seca scale, respectively (Seca company, Hamburg, Germany). The measurements were rounded to the nearest 0.5 cm for height and 0.1 kg for weight. To assess physical activity levels, the International Physical Activity Questionnaire-Short Form (IPAQ-SF) was utilized.[27] The waist circumference (WC) was determined by measuring the midpoint between the lower costal margin and the iliac crest using a tape measure. The measurements were recorded to the nearest 0.1 cm. Similarly, the hip circumference (HC) was measured at the widest part of the buttocks and recorded to the nearest 0.1 cm. For the thigh circumference (ThC), measurements were taken directly below the gluteal fold of the right thigh. Body Mass Index (BMI), waist-to-hip ratio (WHR) and body shape index (BSI) were then calculated based on these measurements.

Dietary assessments

To gather dietary information, a validated semi-quantitative food frequency questionnaire (FFQ) was utilized, which had been adapted specifically for the Iranian population.[28] This FFQ comprised a comprehensive list of commonly consumed food items in Iran, along with their specified serving sizes. Participants were asked to indicate the frequency of consumption for each food item, whether it was daily, weekly, monthly, or yearly. They were also requested to provide details regarding the quantity and frequency of consumption using standard portion sizes, cooking yields, and edible food portions outlined in the Iranian household manual.[29] Reported frequencies for each food item were converted to daily intake, and the portion sizes of consumed items were converted to grams using common measurements. As an example, a single slice of Taftoon

bread, a typical Iranian bread measuring 10 by 10 cm, was considered equivalent to 15 g.

Exercise addiction and eating disorders assessments

The Exercise Addiction Inventory (EAI)[30] and the Exercise Dependence Questionnaire (EDQ)[31] are both valid tools used to assess exercise addiction. The EAI consists of 6 items that measure the risk of exercise addiction and has been shown to have reliable and valid measurement properties in various physically active populations,[7,30,32] while the EDQ is a more comprehensive questionnaire with 29 items that assess exercise dependence across different domains. Participants rate their responses on a Likert scale to indicate their agreement or disagreement. The inclusion of both the EAI and the EDQ allows for a more comprehensive assessment of exercise addiction, capturing various aspects and domains related to it. To ensure the validity of these questionnaires in the Iranian population, rigorous methods such as backward translation, construct validity assessment, content validity assessment, and test-retest reliability analysis were employed. For EAI, Content Validity Index (CVI) was 0.87, Content Validity Ratio (CVR) was 0.81 and Cronbach's alpha was 0.7 and for EDQ, CVI was 0.88, CVR was 0.73 and Cronbach's alpha was 0.8. These results showed that both questionnaires have acceptable psychometric properties and can be reliably used in the Iranian population.

We also employed the Eating Disorder Examination-Short Questionnaire (EDE-QS) as a reliable and validated assessment tool to evaluate eating disorders.[33] The EDE-QS consists of 12 items designed to measure the symptoms of eating disorders experienced by individuals within the past 7 days. It utilizes a 4-point response scale. This questionnaire has been validated for use in Iranian population.[34]

Statistical analyses

The data analysis was conducted using SPSS version 21.0 (statistical package for social analysis, Inc, Chicago, IL, USA). The 80 food items from the FFQ were consolidated into 28 food groups based on their nutritional similarities. Factor analysis utilizing the principal component method was employed to derive dietary patterns. Varimax rotation was applied to enhance the interpretability of the analyzed factors. The determination of the number of factors to retain was based on the evaluation of eigenvalues, the scree plot, and interpretability. A 3-factor solution was chosen after considering solutions ranging from 2 to 8 factors, as determined by the evaluation of eigenvalues. This selection resulted in the identification of 3 distinct dietary patterns. For each participant, a factor score was calculated by summing the servings per day from all food groups and multiplying them by their respective factor loadings. The 3 identified dietary patterns, which explained the majority of the variance, were labeled as "western," "healthy," and "traditional" based on their primary components. Participants were categorized into tertiles based on their dietary pattern scores. One-way ANOVA and chi-square tests were used to examine significant differences between quantitative and qualitative variables across tertiles of dietary pattern scores. Furthermore, a linear regression model adjusted for age, gender, BMI, and physical activity was employed to investigate the association between dietary pattern scores and exercise addiction and eating disorders.

Structural equation modeling (SEM) was utilized to evaluate the theoretical models put forth. In the initial stage, conceptual models were constructed using information gathered from the existing literature. Our hypothesized model in which EDE and food patterns as mediating variables relates demographic variables to EAI summarized in Figure 1.

Results

Three major dietary patterns were identified through factor analysis: a western dietary pattern characterized by high consumption of processed meat, fruit juice, soda, pizza, organ meat, legumes, sweet and desserts, mayonnaise, and green leafy vegetables; a healthy dietary pattern characterized by high consumption of nuts, potatoes, dried fruits, poultry, fruits, fish, and whole grains; and a traditional dietary pattern characterized by high consumption of salt, dairy products, cruciferous vegetables, sugars, other vegetables, red meat, vegetable oils, French fries, and refined grains. These dietary patterns collectively accounted for 28.42% of the total variance in dietary patterns (Table 1). The demographic and anthropometric characteristics for the total study population, as well as across the tertiles of dietary pattern scores, are presented in Table 2. Subjects in the higher tertiles of western dietary pattern had a higher WHR compared with those in the lower tertiles ($P = .03$). WC was also higher in participants of upper tertiles compared with lower tertiles of traditional dietary pattern ($P = .04$). Also, compared with participants in the lower tertiles those in the upper tertiles of traditional dietary pattern had higher BSI ($P = .03$).

The dietary energy and nutrient intakes of the participants across different tertiles of dietary patterns are presented in Table 3. Participants in the upper category of the western dietary pattern had a significantly higher intake of protein ($P = .01$). In the healthy dietary pattern, subjects in the higher category had higher intakes of carbohydrate, protein, cholesterol, monounsaturated fatty acids, and fiber ($P < .05$). Similarly, individuals in the higher category of the traditional dietary pattern had higher intakes of protein, fat, cholesterol, and monounsaturated fatty acids ($P < .05$).

The scores of the Exercise Addiction Inventory, Exercise Dependence Questionnaire, and their respective domains, along with the scores of the Eating Disorder Examination and its domains, for the participants across different tertiles of dietary patterns, are presented in Table 4. The findings revealed that participants in the upper category of the healthy dietary

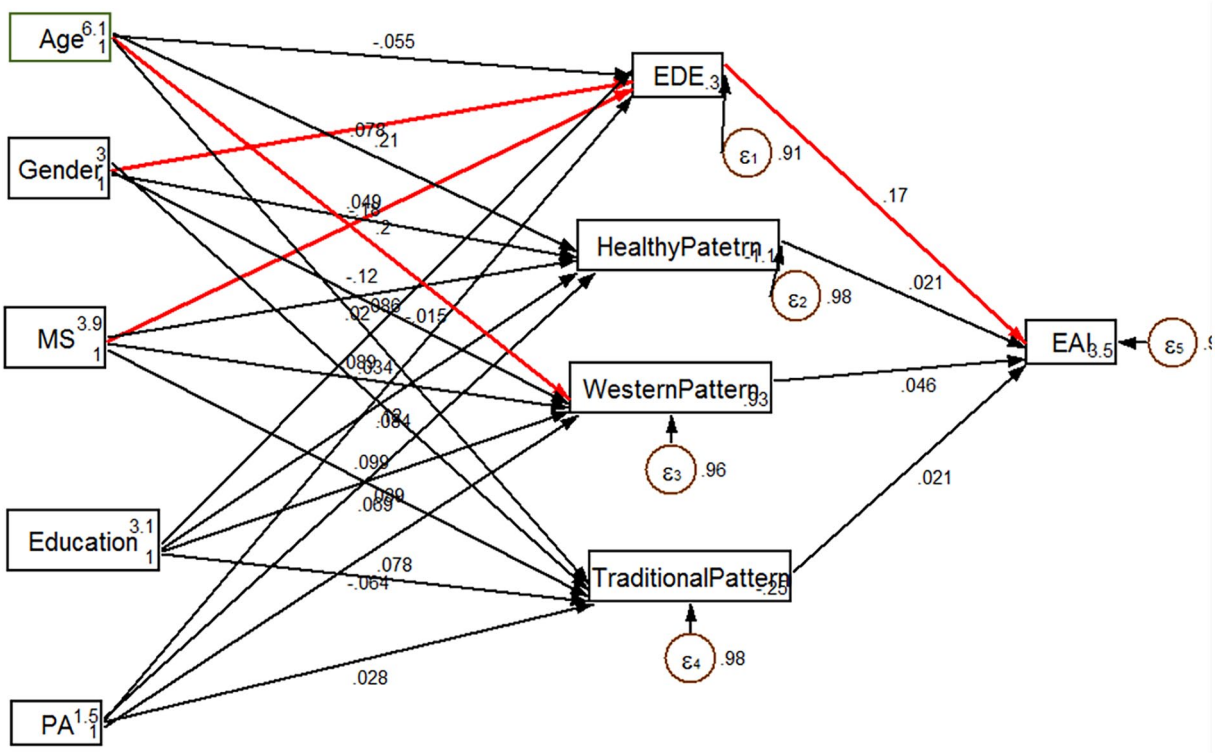

Figure 1. Hypothesized models in which EDE and food patterns as mediating variables relates demographic variables to EAI.
Abbreviations: EAI, exercise addiction inventory; EDE, eating disorder examination; MS, marital status; PA, Physical activity.

Table 1. Factor loading matrix in 3 major dietary patterns (ie, western, healthy, and traditional).

FOOD GROUP	WESTERN PATTERN	HEALTHY PATTERN	TRADITIONAL PATTERN
Dietary patterns			
Processed meat	0.687		
Fruit juice	0.611		
Soda	0.611		
Pizza	0.548		
Organ meats	0.458		
Legumes	0.447		
Sweet and desserts	0.381		
Mayonnaise	0.350		
Green leafy vegetables	0.314		
Pickles	0.180		
Nuts		0.706	
Potatoes		0.616	
Dried fruit		0.509	
Poultry		0.486	
Fruit		0.462	
Fish		0.389	
Wholegrains		0.307	
Hydrogenated fats		0.113	
Salt			0.673
Dairy products			0.651
Cruciferous vegetables			0.609
Sugars			0.469
Other vegetables			0.447
Red meat			0.443
Vegetable oils			0.434
French fries			0.407
Refined grains			0.273
Tea and coffee			0.197

(Continued)

Table 1. (Continued)

pattern demonstrated significantly higher scores in EAI and shape concern ($P < .05$).

Significant direct and indirect pathways of the association between demographic variables, EDE, dietary patterns and EAI among physically active young adults are showed in Table 5 (Figure 1). Among demographic parameters, females and married individuals positively associated with increase eating disorder ($P < .05$). Eating disorder was identified as a significant positive predictor of exercise addiction ($r = .17$, $P < .05$). Also,

Table 2. Basic demographic and anthropometric variables of overall participants according to major dietary pattern.

VARIABLES	OVERALL	WESTERN PATTERN SCORE					HEALTHY PATTERN SCORE					TRADITIONAL PATTERN SCORE				
		Q1	Q2	Q3	*P**	*P***	Q1	Q2	Q3	*P**	*P***	Q1	Q2	Q3	*P**	*P***
	MEAN (SD)	MEAN (SD)	MEAN (SD)	MEAN (SD)			MEAN (SD)	MEAN (SD)	MEAN (SD)			MEAN (SD)	MEAN (SD)	MEAN (SD)		
Age (y)	23.1 (3.81)	23.0 (3.6)	23.3 (4.2)	23.1 (3.7)	.87	—	23.0 (3.8)	23.9 (4.1)	22.5 (3.4)	.11	—	23.6 (3.6)	22.7 (3.8)	23.1 (4.1)	.39	—
Gender (male %)	98 (49)	31 (46.3)	39 (59.1)	27 (40.9)	.54	—	27 (40.9)	37 (55.2)	33 (50.0)	.30	—	36 (54.5)	31 (47.0)	30 (44.8)	.26	—
Education (university graduate %)	172 (86)	56 (83.6)	54 (81.8)	61 (92.4)	.10	—	56 (84.8)	57 (85.1)	58 (87.9)	.41	—	55 (83.3)	53 (80.3)	63 (94)	.15	—
Marital status (single %)	183 (91.5)	60 (89.6)	61 (92.4)	61 (92.4)	.55	—	59 (89.4)	64 (95.5)	59 (89.4)	1.0	—	64 (97.0)	59 (89.4)	59 (88.1)	.7	—
Weight (kg)	69.95 (13.30)	67.7 (11.9)	68.8 (12.4)	67.9 (14.3)	.86	—	67.3 (12.7)	69.2 (12.9)	67.8 (13.0)	.68	—	69.6 (12.0)	68.8 (12.8)	66.1 (13.7)	.25	—
Height (cm)	170.83 (9.08)	170.7 (9.5)	172.0 (8.5)	169.6 (9.2)	.33	—	169.6 (9.4)	171.7 (9.3)	171.1 (8.5)	.40	—	171.7 (8.8)	171.2 (9.3)	169.5 (9.1)	.37	—
BMI (kg/m^2)	23.25 (3.76)	23.1 (3.0)	23.4 (3.8)	23.5 (3.9)	.85	—	23.3 (3.6)	23.5 (3.7)	23.1 (3.5)	.78	—	23.7 (3.6)	23.4 (3.5)	22.9 (3.6)	.40	—
PA (Met. min/week)	424.05 (285.74)	367.6 (205.9)	467.3 (364.2)	440.0 (261.9)	.11	—	406.6 (267.9)	458.7 (218.1)	424.7 (286.3)	.49	—	394.3 (228.1)	459.5 (367.5)	420.2 (244.1)	.42	—
MUAC (cm)	28.92 (3.75)	28.5 (3.43)	29.5 (4.0)	28.7 (3.8)	.28	.54	28.6 (3.5)	29.7 (4.1)	28.4 (3.6)	.12	0.15	29.5 (3.7)	28.8 (3.7)	28.7 (3.8)	.21	.68
WC (cm)	77.36 (9.51)	75.7 (9.9)	78.3 (7.7)	77.9 (10.5)	.24	.21	75.8 (10.2)	78.1 (8.8)	78.0 (9.3)	.30	0.16	76.8 (10.0)	78.2 (9.0)	76.9 (9.5)	.61	**.04**
ThC (cm)	56.88 (6.64)	57.5 (8.0)	55.9 (6.4)	57.2 (5.2)	.35	.14	57.7 (7.9)	56.2 (6.4)	56.7 (5.5)	.44	0.23	57.7 (8.3)	56.9 (5.3)	56.0 (6.0)	.34	.57
WHR	0.77 (0.09)	0.75 (0.12)	0.79 (0.06)	0.78 (0.08)	**.01**	**.03**	0.77 (0.09)	0.79 (0.06)	0.78 (0.12)	.38	0.85	0.77 (0.08)	0.79 (0.07)	0.78 (0.12)	.36	.11
BSI	0.073 (0.006)	0.072 (0.006)	0.074 (0.005)	0.073 (0.005)	.12	.12	0.071 (0.008)	0.072 (0.004)	0.074 (0.004)	.14	0.21	0.071 (0.007)	0.073 (0.006)	0.073 (0.004)	.08	**.03**

Abbreviations: BMI, body mass index; BSI, body shape index; MUAC, mid-upper arm circumference; PA, physical activity; ThC, thigh circumference; WC, waist circumference; WHR, waist to hip ratio.
Data are presented as mean ± SD or percent.
**P* values derived from One-Way ANOVA or Chi-square tests.
***P* values derived from ANCOVA after adjustment for confounders (age, gender, BMI, and physical activity).
Bolded *P*-values provide the significant threshold.

Table 3. Dietary energy and nutrient intake of participants according to major dietary patterns.

VARIABLES	WESTERN PATTERN SCORE					HEALTHY PATTERN SCORE					TRADITIONAL PATTERN SCORE				
	Q1	Q2	Q1	*P**	*P***	Q1	Q1	Q3	*P**	*P***	Q1	Q2	Q3	*P**	*P***
	MEAN (SD)	MEAN (SD)	MEAN (SD)			MEAN (SD)	MEAN (SD)	MEAN (SD)			MEAN (SD)	MEAN (SD)	MEAN (SD)		
Energy (kcal/d)	2011.5 (885.9)	2196.2 (696.3)	3208.9 (1230.1)	<.001	—	2160.8 (914.4)	2081.9 (712.1)	3172.8 (1239.8)	<.001	—	2074.5 (1145.5)	2179.8 (662.6)	3145.0 1076.6	<.001	—
CHO (g/d)	288.2 (127.9)	313.8 (110.2)	467.2 (192.0)	<.001	0.46	323.2 (159.4)	305.9 (115.0)	439.8 (187.3)	<.001	**.01**	297.6 (149.8)	313.1 (112.0)	456.1 (456.1)	<.001	.73
Pro (g/d)	79.2 (45.9)	76.4 (27.9)	109.0 (46.5)	<.001	**0.01**	71.3 (28.2)	72.6 (23.3)	120.9 (52.6)	<.001	<**.001**	70.6 (42.0)	77.8 (27.5)	115.7 (44.6)	<.001	**.04**
Fat (g/d)	66.1 (35.4)	77.2 (32.1)	111.8 (58.1)	<.001	0.63	69.7 (30.4)	69.8 (27.6)	115.5 (61.0)	<.001	.08	73.4 (57.9)	76.5 (29.1)	104.6 (44.8)	<.001	**.04**
Cho (mg/d)	151.4 (101.4)	169.1 (77.3)	267.7 (206.6)	<.001	0.6	139.9 (58.4)	162.6 (80.4)	285.5 (211.3)	<.001	<**.001**	191.1 (208.6)	163.1 (75.9)	232.7 (122.9)	<.001	**.03**
SF (mg/d)	19.6 (10.3)	23.3 (8.3)	35.4 (26.4)	<.001	0.77	21.1 (8.6)	22.3 (11.4)	34.9 (26.2)	<.001	.60	23.6 (26.4)	22.8 (9.3)	31.8 (13.2)	<.001	.08
MUF (mg/d)	20.9 (12.8)	24.4 (11.7)	35.9 (18.9)	<.001	0.73	21.9 (11.1)	21.6 (9.5)	37.6 (20.0)	<.001	**.03**	23.4 (19.0)	24.2 (10.5)	33.3 (15.7)	<.001	**.04**
PUF (mg/d)	15.8 (9.4)	18.8 (12.8)	24.0 (15.9)	<.001	0.26	16.7 (9.1)	15.7 (8.6)	26.1 (17.7)	<.001	.45	16.0 (12.1)	18.6 (10.5)	23.9 (15.8)	<.001	.41
Fiber (mg/d)	13.8 (7.0)	14.9 (6.3)	22.4 (11.9)	<.001	0.85	13.2 (6.5)	14.0 (4.3)	23.9 (11.9)	<.001	<**.001**	14.5 (9.8)	14.9 (5.7)	21.6 (10.4)	<.001	.98

Abbreviations: CHO, carbohydrate; Cho, cholesterol; MUF, monounsaturated fats; Pro, protein; PUF, polyunsaturated fats; SF, saturated fats.
Data are presented as mean ± SD.
**P* values derived from One-Way ANOVA.
***P* values derived from ANCOVA after adjustment for confounders (age, gender, physical activity, and energy intake).
Bolded *P*-values provide the significant threshold.

Table 4. Exercise addiction, exercise dependency and eating disorder scores of participants according to major dietary patterns.

VARIABLES	WESTERN PATTERN SCORE					HEALTHY PATTERN SCORE					TRADITIONAL PATTERN SCORE				
	Q1	Q2	Q1	*P**	*P***	Q1	Q1	Q3	*P**	*P***	Q1	Q2	Q3	*P**	*P***
	MEAN (SD)	MEAN (SD)	MEAN (SD)			MEAN (SD)	MEAN (SD)	MEAN (SD)			MEAN (SD)	MEAN (SD)	MEAN (SD)		
Total EAI	17.5 (4.0)	17.7 (4.6)	18.3 (5.5)	.59	.59	17.6 (4.4)	17.1 (3.9)	18.7 (5.7)	.09	**.04**	17.0 (4.1)	17.6 (4.6)	18.8 (5.4)	.10	.07
Total EDQ	111.5 (16.1)	108.4 (23.1)	109.2 (19.6)	.63	.40	110.6 (18.4)	107.9 (20.5)	110.7 (20.3)	.65	.55	106.9 (20.7)	111.6 (18.9)	110.7 (19.4)	.34	.54
Withdrawal symptoms	22.8 (7.6)	22.0 (8.8)	21.5 (8.2)	.65	.25	22.8 (8.4)	21.3 (8.1)	22.3 (8.0)	.57	.26	21.0 (8.5)	22.4 (7.8)	22.9 (8.3)	.40	.57
Exercise for health reasons	25.4 (6.2)	23.3 (6.9)	24.2 (6.2)	.19	.24	24.1 (6.3)	24.3 (6.5)	24.6 (6.7)	.89	.85	24.0 (7.2)	24.2 (6.2)	24.7 (6.0)	.82	.73
Positive reward	24.0 (3.6)	23.6 (4.7)	23.5 (3.9)	.74	.49	23.2 (4.1)	24.1 (4.2)	23.7 (3.9)	.40	.51	23.4 (4.5)	23.6 (3.9)	24.0 (3.8)	.70	.80
Interference with work and social life	5.9 (3.0)	6.5 (3.0)	6.3 (6.0)	.70	.65	6.9 (6.2)	5.7 (2.6)	6.2 (2.7)	.28	.28	5.9 (2.7)	7.0 (6.0)	5.8 (2.9)	.15	.14
Insight into problem	14.4 (5.4)	13.7 (5.2)	14.7 (5.5)	.54	.81	14.0 (5.1)	13.9 (5.3)	14.9 (5.8)	.52	.55	14.1 (5.7)	14.8 (5.4)	13.9 (5.1)	.65	.62
Exercise for social reasons	7.5 (3.1)	7.8 (3.8)	7.2 (3.3)	.63	.66	7.7 (3.4)	6.9 (3.3)	7.8 (3.4)	.27	.32	7.0 (3.4)	7.4 (3.1)	8.1 (3.7)	.13	.22
Stereotyped behavior	11.6 (3.7)	11.5 (4.4)	11.7 (4.1)	.96	.68	12.0 (3.6)	11.7 (4.2)	11.2 (4.3)	.54	.42	11.4 (3.8)	12.2 (3.9)	11.3 (4.4)	.40	.46
Total EDE	9.1 (5.9)	8.1 (5.8)	9.0 (5.7)	.53	.47	8.8 (5.1)	8.1 (5.9)	9.3 (6.5)	.48	.26	7.8 (5.5)	9.7 (6.1)	8.7 (5.8)	.17	.16
Restraint	2.7 (2.1)	2.5 (2.2)	2.8 (2.2)	.82	.78	2.8 (1.9)	2.4 (2.3)	2.8 (2.3)	.56	.37	2.4 (2.1)	2.8 (2.2)	2.7 (2.3)	.54	.49
Eating concern	1.2 (1.5)	0.9 (1.4)	0.9 (1.3)	.43	.23	1.1 (1.4)	0.9 (1.3)	1.1 (1.5)	.62	.54	0.8 (1.3)	1.3 (1.5)	1.0 (1.4)	.12	.19
Shape concern	4.5 (2.9)	4.0 (3.0)	4.4 (3.0)	.59	.67	4.0 (2.7)	4.1 (3.0)	4.8 (3.3)	.24	**.04**	4.0 (2.9)	4.7 (3.3)	4.2 (2.9)	.43	.38
Weight concern	0.7 (0.9)	0.6 (0.9)	0.9 (1.1)	.17	.17	0.8 (1.0)	0.7 (0.9)	0.7 (1.0)	.53	.51	0.5 (0.8)	0.9 (1.0)	0.8 (1.1)	.11	.11

Abbreviations: EAI, exercise addiction inventory; EDE, eating disorder examination; EDQ, exercise dependence questionnaire.
Data are presented as mean ± SD.
**P* values derived from One-Way ANOVA.
***P* values derived from ANCOVA after adjustment for confounders (age, gender, BMI, and physical activity).
Bolded *P*-values provide the significant threshold.

Table 5. Statistically significant direct and indirect pathways of the association between demographic variables, EDE, food patterns and EAI among physically active young adults using SEM.

MODEL PATH	STANDARDIZED ESTIMATE*	SE	*P*
Age → EDE	–.054	.075	.467
Gender → EDE	.205	.069	**.003**
MS → EDE	.202	.066	**.002**
Education → EDE	–.015	.075	.838
PA → EDE	.119	.068	.079
Age → Western pattern	–.178	0.076	**.019**
Gender → Western pattern	–.124	.072	.087
MS → Western pattern	.089	.069	.200
Education → Western pattern	.088	.077	.253
PA → Western pattern	–.064	.070	.361
Age → Healthy pattern	.077	.078	.319
Gender → Healthy pattern	.048	.073	.510
MS → Healthy pattern	.020	.070	.775
Education → Healthy pattern	.084	.078	.283
PA → Healthy pattern	.692	.071	.330
Age → Traditional pattern	–.086	.078	.271
Gender → Traditional pattern	.033	.073	.646
MS → Traditional pattern	.098	.070	.161
Education → Traditional pattern	.078	.078	.318
PA → Traditional pattern	.028	.071	.690
EDE → EAI	.170	.068	**.013**
Western pattern → EAI	.020	.069	.768
Healthy pattern → EAI	.045	.069	.515
Traditional pattern → EAI	.021	.069	.758

Abbreviations: EAI, exercise addiction inventory; EDE, eating disorder examination; MS, marital status; PA, physical activity; SE, standard error of the estimate.
All standardized path coefficients and standardized residual covariance shown were significant ($P < .05$).
*Standardized path coefficients and standardized residual covariance coefficients.
Bolded *P*-values provide the significant threshold.

age has directly and negatively associated with western dietary pattern ($P < .05$).

Discussion

In this study, we identified 3 major dietary patterns among the participants: western, healthy, and traditional. Based on our findings, individuals who followed a western dietary pattern exhibited a higher WHR compared to those in the lower tertiles. Furthermore, participants who adhered to a traditional dietary pattern had higher WC and a higher BSI. Lastly, participants classified in the high category of the healthy dietary pattern showed significantly higher scores in EAI and shape concern.

The observed positive correlation between WHR and adherence to a western dietary pattern aligns with findings from previous research showing similar dietary patterns characterized by high consumption of high-fat foods, sweets, and processed meats.[35,36] Several previous studies have reported that traditional dietary patterns that contain high amounts of salt, red meat, and refined grains are associated with higher waist WC.[37,38] Also, contradictory results were observed, which may be attributed to changes in the composition of the traditional dietary pattern, which can be influenced by cultural differences. For example, in a 2010 study, items included in the traditional dietary pattern were rice, beans, bread, sugar, fats, and salad dressings was inversely associated with WC.[39] BSI is

designed to assess abdominal obesity by utilizing body shape measurements without the need for laboratory analysis of blood lipid parameters. Given WC is one of the contributing factors to BSI, an increase in WC would consequently lead to an elevation in the BSI value.[40]

Similar to how exercise can sometimes result in unhealthy behaviors, a preoccupation with consuming healthy foods can also develop into a pathological obsession.[41] Our findings indicate a significant and positive correlation between the healthy dietary pattern with the exercise addiction and shape concern. These results are consistent with previous research that has similarly identified a relationship between healthy food eating disorders and exercise addiction.[42,43] Also, individuals with a disordered eating pattern focused on consuming healthy foods exhibited greater preoccupation with their body shape.[44,45]

The results of our study indicate a significant and positive association between exercise addiction and eating disorders, which is consistent with previous research finding.[19,46,47] A study's findings suggest that exercise addiction among adolescents can have an impact on the development of eating disorders through various channels, including insomnia, psychological distress, and body image issues.[48] Furthermore, our results highlight a significant positive relationship between eating disorders and females. Gender plays a significant role in the development and manifestation of eating disorders. Research consistently demonstrates that eating disorders are more prevalent among females compared to males, with estimates suggesting a ratio of 3:1 or higher.[49] The higher rates in females may be attributed to societal pressures related to body image, thinness ideals, and cultural norms that emphasize appearance. Females often internalize these ideals, leading to a greater susceptibility to body dissatisfaction and disordered eating behaviors.[50]

It is important to note that the study has several limitations. Firstly, the cross-sectional design limits the ability to establish causality between dietary patterns, exercise addiction, and eating disorders. Future longitudinal studies are needed to further explore these relationships. Additionally, the reliance on self-reported measures, including dietary patterns and psychological assessments, may introduce response bias. Lastly, the study focused on a specific population of physically active young adults, and the generalizability of the findings to other age groups or populations may be limited.

In conclusion, according to our finding, those with the higher adherence to healthy dietary pattern had higher scores of exercise addiction and body shape concern. Also, eating disorder was a potential predictor of exercise addiction among young physically active individuals. These results emphasize the importance of considering dietary patterns, exercise addiction, and eating disorders collectively when assessing the health behaviors of young adults. Further research and targeted interventions are needed to better understand these complex relationships and develop effective strategies to promote healthy behaviors and mitigate the risk of adverse outcomes.

Acknowledgements

We thank all of the study participants. We also are thankful from Research Undersecretary of Tabriz University of Medical Sciences for their financial support (Grant number: 74600).

Author Contributions

All authors approved the final version of the article. MAF designed the project, supervised it. MAF and SK contributed in statistical analysis, and manuscript writing. MAF and SK were also involved in hypothesis generation and statistical approach.

Availability of Data and Material

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

This study protocol has been approved by the ethics committee of the Tabriz University of Medical Sciences (code: IR.TBZMED.REC.1400.1218). Written informed consent was obtained from all of the participants before participation in the study. All methods in the current research were performed in accordance with the declaration of Helsinki's guidelines and regulations.

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