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Original Article

Diet quality is associated with pain intensity and quality of life in a sample of patients with knee osteoarthritis: a cross-sectional study

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Abstract

Introduction: Knee osteoarthritis (KOA) is the most common degenerative joint disease resulting in bone pain and disability. The aim of current study is to determine diet quality by healthy eating index (HEI)-2015 in association with pain and functional status among a sample of participants with primary knee OA.

Methods: In this cross-sectional study, 220 patients with knee OA were recruited via convenience sampling in the outpatient clinics of Tabriz University of Medical Sciences between April and September 2018. The HEI-2015 score was calculated from dietary data collected using a Food Frequency Questionnaire (FFQ). Visual analogue scale, Western Ontario and McMaster Universities Osteoarthritis Index and the SF36 quality of life (QoL) questionnaire were applied to measure the pain intensity, functional status and QoL in the participants, respectively. Participants were categorized based on the quintile cutoff points of HEI score including 42-62, 63-69, 70-75, 76-78 and 79-100.

Results: The mean score of HEI was 70.62 ± 10.18 (range: 42–89). Participants with greater HEI-2015 scores had higher total energy intake ($P=0.008$) and greater dietary intake of carbohydrates ($P=0.01$), protein ($P=0.009$), monounsaturated fatty acids ($P=0.01$), polyunsaturated fatty acids ($P=0.007$) and fiber ($P=0.009$) and lower intake of saturated fatty acids ($P=0.005$). Participants in higher quintiles of HEI had significantly lower pain intensity ($P=0.001$) and higher scores of physical function ($P=0.001$), pain ($P=0.001$) and role limitation due to physical problems ($P=0.005$) subscales of SF-36 QoL questionnaire in comparison with participants in lower quintiles of HEI-2015.

Conclusion: The HEI-2015 score is associated with pain intensity and two domain of QoL in patients with knee OA.

Introduction

Knee osteoarthritis (OA) is a chronic degenerative joint disorder disturbing many people worldwide.[1] The rapid aging of human societies has leaded to fast rises in musculoskeletal disorders that are initiated by degenerative variations in the joints. OA is described as one of the most prevalent aging related disorders.[2] Patients with knee OA reveal several symptoms, including joint pain, stiffness and physical dysfunction leading to major comorbidities and affecting quality of life (QoL) unfavorably.[3] Furthermore, OA wastes a considerable amount of healthcare system resources and budgets.[4]

OA is associated with many factors, such as age, sex, genetics, trauma, infection and dietary factors.[5-7] Through the recent decades, several studies have been performed concerning the links between dietary factors and OA.[8-10] Moreover, overweight is related with a two-time higher ORs of OA while obesity had approximately 4 times higher ORs of OA in comparison with subjects with normal body mass index (BMI).[10]

Most of investigations targeted on restricting calorie intake to develop weight loss, have established favorable short-term impacts on weight loss, inflammation, and physical dysfunction.[11,12] Nevertheless, unwanted effects of calorie constraint on lean muscle mass[13] and problems in conserving weight loss in the long-term period[14] has directed investigators to search for substitute dietary interventions that may be more sustainable but

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equivalent concerning body fat mass and inflammatory consequences.[15]

It has been indicated that investigating particular nutrients and their involvement, probably doesn't provide a competent representation of diet-disease connections, while a composed investigation of food and nutrients has been used in nutritional epidemiology to inspect the association between diet and chronic diseases, as foods may have "synergistic and cumulative effects on health and disease" rather than the impact of single nutrient.[16] However, little is known about diet quality in patients with OA and its relation with pain, physical dysfunction and QoL.

The Dietary Guidelines for Americans (DGA) has been planned to provide recommendation on how to select healthier diets.[17] More recent DGA version has provided the emphasis on not only getting dietary sufficiency but also focusing on the links between food patterns and decreased non-communicable diseases risk.[18] It has been established that good compliance of some dietary patterns for instance, the Harvard Healthy Eating Plate, which inspires a dietary pattern high in fruits, vegetables, fish and whole grains, and moderate intake of alcohol and low consumption of sugar-sweetened beverages, is related to disease prevention and low mortality.[19] Measuring a certain dietary pattern compliance by statistical methods or a scoring index, such as the Healthy Eating Index-2015 (HEI) which assesses adherence to the DGA, allows examination of associations between diet quality and chronic diseases. The HEI-2015 score obtains key nutrients and food groups that reverberates recent proofs on the healthy dietary ingredients.[20] The latest version of HEI comprises seven food groups (fruits, vegetables, grains, dairy, protein foods, fats, and refined grains), in addition to sodium, saturated fats, and sugars. Numerous studies have confirmed the HEI as a valid tool to evaluate global diet quality and revealed relations between the HEI and health consequences.[21-23]

There are little evidence concerning associations between diet quality with knee OA and much less in Iranian knee OA patients. In the study of Vergis et al on 400 overweight/obese African American patients with lower limb OA, a lower HEI-2010 total score was stated for participants with a higher Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) total score in comparison with those with a lower score (65.2 vs. 67.4; $P = 0.04$).[24] In practice, to design impressive interventions for targeting diet quality, a knowledge of existing diet quality is important. So, the purpose of this study was to determine the association between HEI-2015 score and pain intensity, functional status and QoL among a sample of Iranian patients with primary knee OA.

Methods

Participants

A hospital-based, cross-sectional study was conducted between March 2018 and October 2018 in Tabriz, Iran. Patients with primary knee OA were enrolled from Imam Reza hospital, Tabriz University of Medical Sciences by convenience sampling.

The OA was diagnosed according to the diagnostic criteria of American College of Rheumatology (ACR). ACR criteria included knee pain, osteophytes, and one of the followings: age greater than 50 years, morning stiffness duration less than 30minutes, or crepitus on active motion of the knee.[25] The inclusion criteria were 1) age greater than 40 years, 2) suffering knee pain on most days of the past month, 3) BMI in the range of 18 to 34.9 kg/m^2 and 4) having intact cognitive functioning. Exclusion criteria were 1) energy intake less than 800 and more than 3000 kcal/day, 3) subjects with a history of nervous system disease, 4) secondary arthritis (inflammatory or metabolic) and 5) patients receiving surgery or intra-articular injection in the involved knee joint within the past 6 months.

Assessment of dietary intake

A validated semi-quantitative 168-item Food Frequency Questionnaire (FFQ) was used to measure usual food intake over the preceding year.[26] Nutritional data was gathered by two trained nutritionists by interviewing. Participants stated their food intake frequency for each item throughout the previous year on a daily, weekly, or monthly basis. Subjects were asked about the average consumption frequency of food items (9 levels, from 'never or less than once per month' to '6+ per day'). Serving sizes were also estimated. Images of various portion sizes were presented to assist participants in approximating the serving size of consumed food items. Then, the accounted frequency of each food item was transformed to daily consumption using NUTRITIONIST IV software adjusted for Iranian foods.

HEI-2015 scoring

The HEI-2015, the most recent version of HEI, consists of nine adequacy and four moderation components on a density basis out of 1000 calories, except fatty acids, which is a ratio of unsaturated to saturated fatty acids (SFAs).[27]

Six adequacy components include total fruits, whole fruits, total vegetables, seafood and plant proteins, greens and beans, and total protein foods; they were scored 5 in the highest consumption and 0 in the lowest consumption. Other adequacy components [whole grains, dairy and fatty acids (ratio of poly- and monounsaturated fatty acids (PUFAs and MUFAs) SFAs)] obtain a maximum of 10 points. Four moderation components include refined grains, sodium, added sugars and saturated fats, and were scored 10 in the lowest consumption and 0 in the highest consumption.[27,28] Point values were considered proportionally for quantities between the maximum and minimum levels. Component scores were summed to obtain a total score ranging from 0 to 100.

Demographic, anthropometric and physical activity assessments

Social-demographic characteristics; including age, sex, education and employment status were collected using a specific demographic questionnaire designed for this study. Other variables, such as OA severity, affected side and the duration of OA (in years) were recorded for each participant.

Physical activity of the participants was assessed by the short-Form International Physical Activity Questionnaire (IPAQ).[29] Three categories of physical activity were suggested: low, moderate, and high.[30] Weight of participants was measured using a Seca scale (Seca 813 digital scale, Germany) to the nearest of 100 g. Height was also measured in a standing position without shoes using a tape measure with a precision of 0.1 cm. BMI was calculated as weight (kg) divided by square of the height (m^2).

Clinical evaluation

Visual analog scale

Knee pain was measured in the last 24 hours by means of the visual analog scale (VAS), a valid and reliable tool for evaluating perceived pain in participants with knee OA.[31] The score is specified by measuring the distance (in cm) on a 10-cm horizontal or vertical line within a range of 0–10. A higher score means the greater pain intensity.

Western Ontario and McMaster Universities Osteoarthritis Index

Self-perceived functional status was assessed using the WOMAC. WOMAC consists of three subscales: pain, stiffness and physical function and is a recognized valid and reliable method.[32] A greater score means higher functional dysfunction. The validity and reliability of the Persian version of this index have been established in studies.[33]

Short form-36 questionnaire

Health related QoL was measured using the reliable and valid Persian version of 36-Item Short Form Health Survey (SF-36),[34] composed of 36 items in 8 domains that evaluate the participant's physical and mental health. The physical health includes the 4 physical domains, consisting of physical functioning (PF) (10 items), role limitations due to physical functioning (RP) (4 items), pain (P) (2 items), and general health (GH) (5 items). The mental health includes the 4 mental domains, and consists of energy/fatigue (EF) (4 items), social functioning (SF) (2 items), role limitation due to emotional problems (RE) (3 items), and mental health (MH) (5 items). The physical health and mental health scores vary from 0 to 100. The greater score means a better QoL.

Sample size

The 168-item modified semi-quantitative FFQ applied in this study divides the foods into 22 groups. The sample size for such studies is considered to be 10 individuals per variable. So, the sample size was accounted 220 subjects, according to the reference book.[35]

Statistical analysis

Statistical analysis was conducted with IBM Statistical Package for the Social Sciences (SPSS) version 22. The normality assessment was performed by descriptive measures such as coefficients of skewness and kurtosis. All continuous variables were normally distributed. Continuous and categorical variables are presented as the means± standard deviation and frequency (percentages), respectively. Participants were categorized based on quintile cutoff points of HEI score including 42-62, 63-69, 70-75, 76-78 and 79-100. Continuous variables were compared across HEI quintile categories using one-way analysis of variance (ANOVA) with Tukey post hoc comparisons. Significant differences in the categorical variables across HEI quintile categories were estimated by a chi-square test. We then evaluated the relationships between the quintiles of HEI and VAS, WOMAC and QoL using multivariable logistic regression analyses adjusted for age, sex and BMI.

Results

A total of 293 patients were agreed to contribute in the study. After application of the exclusion criteria, 73 individuals (30 males and 43 females) were excluded (Figure 1).

Table 1 shows the characteristics of participants included in this study according to quintiles of HEI-2015 scores. In 220 participants, the mean ± SD of HEI score was 70.62 ± 10.18 (range: 42–89). Patients with higher HEI scores tended to be female, however there was no significant difference regarding age, BMI, education level and occupation status between participants across the HEI quintiles.

Table 2 confirms significant associations between participants' nutrient intakes and HEI-2015 scores stratified by quintiles. Subjects with greater HEI-2015 scores had a higher total energy intake and a greater dietary intake of carbohydrates, protein, MUFA, PUFA and fibre and a lower intake of SFA.

Table 3 shows the mean ± SD values of VAS, WOMAC and QoL in the participants according to quintiles of HEI scores. Patients with higher HEI scores tended to have a lower pain intensity in VAS scale and a higher PF and lower RP on SF-36 questionnaire than patients with lower scores.

Table 4 displays the associations between the quintiles of HEI and VAS, WOMAC and QoL using multivariable logistic regression analyses adjusted for age, sex and BMI.

Discussion

We performed a cross-sectional analysis to describe

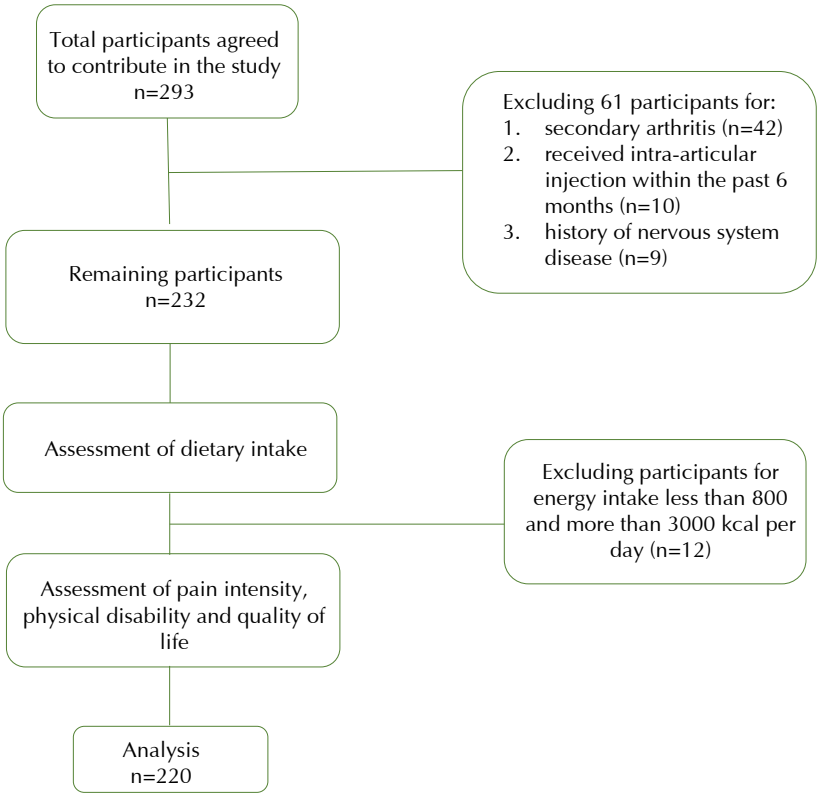

Figure 1. Participants' flowchart

Table 1. General characteristics of individuals participating in the study based on healthy eating index quintiles

	All Participants (n=220)	Quintile 1 (Lowest) 42-62	Quintile 2 63-69	Quintile 3 70-75	Quintile 4 76-78	Quintile 5 (Highest) 79-100	*P* value*
Age (year)	56.89±9.45	54.08±1.70	58.48±1.35	54.77±9.78	59.20±1.36	57.27±1.26	0.057
Weight (kg)	80.08±1.28	76.87±2.11	77.58±1.83	79.26±1.82	76.28±1.91	83.14±2.04	0.081
Height (cm)	161.7±9.87	163.7±8.32	158.4±10.4	157.9±8.41	162.8±9.17	159.58±8.91	0.124
BMI (kg/m^2)	30.77±5.09	29.27±0.63	29.35±0.77	35.81±0.98	32.91±0.82	31.97±0.75	0.467
Sex							
Male	68 (30.91)	17 (25.00)	19 (27.94)	18 (26.47)	3 (4.41)	11 (16.17)	0.001
female	152 (69.09)	25 (16.44)	24 (15.78)	28 (18.42)	34 (22.36)	41 (26.97)	
Education level							
Illiterate/Primary school	107 (48.64)	20 (18.69)	25 (23.36)	19 (17.75)	20 (18.69)	23 (21.49)	0.362
High school	71 (32.27)	12 (16.90)	12 (16.90)	18 (25.35)	14 (19.71)	15 (21.12)	
Higher education	42 (19.09)	10 (23.80)	6 (14.28)	9 (21.42)	3 (7.14)	14 (33.33)	
Occupation							
Employed	70 (31.8)	15 (21.42)	8 (11.42)	19 (27.14)	12 (17.14)	16 (22.85)	0.083
Unemployed	115 (52.2)	23 (20.00)	22 (19.13)	22 (19.13)	20 (17.39)	28 (24.34)	
Retired	35 (15.9)	4 (11.42)	13 (37.14)	5 (14.28)	5 (14.28)	8 (22.85)	
Physical activity							
Mild	161 (73.18)	35 (21.73)	34 (21.11)	35 (21.73)	30 (18.63)	39 (24.22)	0.450
Moderate	59 (26.81)	7 (11.86)	9 (15.25)	11 (18.64)	7 (11.86)	13 (22.030	

Note: means ± SD for continuous variables and n (%) for categorical variables.
* One-way analysis of variance (ANOVA) for continuous variables and $\chi 2$ test for categorical variables.

Table 2. Participants nutrient intakes according to quintiles of HEI-2015 scores (means ± SD)

	Quintile 1 (Lowest) 42-62	Quintile 2 63-69	Quintile 3 70-75	Quintile 4 76-78	Quintile 5 (Highest) 79-100	*P* value*	Correlation with HEI**
Total energy (kcal/d)	1993.5±937.7	2147.8±1034.5	2357.4±1082.2	2526.3±1023.3	2681.6±1145.5	0.008	0.16
Carbohydrate*** (g/d)	175.6±112.5	198.2±135.9	281.5±126.8	331.8±132.8	351.2±162.8	0.01	0.21
Protein*** (g/d)	69.2±49.8	76.3±56.8	95.8±75.2	110.8±91.5	115.4±101.8	0.009	0.24
Total fat*** (g/d)	91.1±53.1	93.5±51.9	95.8±75.2	105.2±81.5	106.5±59.85	0.09	-0.07
SFA*** (g/d)	44.0±32.2	41.5±29.8	39.8±42.5	38.1±34.2	36.9±22.1	0.005	-0.13
MUFA*** (g/d)	29.4±26.8	30.5±17.5	32.4±19.5	33.5±31.9	35.9±26.8	0.01	0.12
PUFA*** (g/day)	13.4±17.2	14.9±12.6	14.5±21.5	17.5±15.2	18.1±13.5	0.007	0.18
Cholesterol (mg/d)	319.5±198.2	329.5±216.8	325.9±175.3	331.9±301.5	339.1±196.5	0.12	0.05
Fibre*** (g/d)	15.9±11.2	18.3±12.5	20.6±21.5	24.1±9.4	30.5±15.9	0.009	0.45

* One-way analysis of variance (ANOVA); ** Pearson correlation coefficients; ***Adjusted for daily energy intakes.

Table 3. Functional status, pain intensity, and quality of life of participants based on healthy eating index quintiles (means ± SD)

Variable	All Participants (n=220)	Quintile 1 (Lowest) 42-62	Quintile 2 63-69	Quintile 3 70-75	Quintile 4 76-78	Quintile 5 (Highest) 79-100	*P* for trend*
VAS	5.52±1.67	7.41±0.64	6.38±0.95	5.47±1.18	4.57±1.48	4.10±1.51	0.001
WOMAC	42.96±14.69	42.55±2.37	47.71±1.89	43.44±2.40	39.81±2.18	38.44±2.31	0.068
QOL							
PF	43.09±33.11	45.31±4.70	32.71±5.22	48.72±5.11	59.25±4.54	59.74±5.02	0.001
RP	43.75±4.37	42.50±5.18	44.48±4.78	62.50±3.58	55.77±4.25	49.89±29.04	0.005
RE	39.58±4.72	22.86±5.25	39.53±5.11	35.01±4.91	35.90±5.39	34.70±32.53	0.157
EF	47.96±19.10	51.54±2.74	51.28±3.08	49.19±3.19	43.29±3.26	47.29±2.77	0.333
EW	46.06±16.26	46.77±2.26	41.40±2.25	49.30±2.82	45.49±2.91	48.68±2.58	0.202
SF	52.33±21.88	56.73±3.24	53.44±3.58	52.33±3.36	50.00±3.28	51.56±3.38	0.724
P	59.17±3.12	45.86±3.75	59.19±3.55	65.13±3.21	69.87±3.31	59.31±23.09	0.001
GH	48.87±24.03	54.23±3.64	47.28±3.61	51.86±3.46	43.43±4.09	46.67±3.43	0.260

EW: emotional well-being, GH: general health, MH: mental health, P: pain, PF: physical function, PH: physical health, QOL: quality of life, RE: Role limitation due to emotional problems, RP: Role limitation due to physical health, SF: social function, VAS: Visual analogue scale, WOMAC:Western Ontario and McMaster Universities Osteoarthritis Index.
*One-way analysis of variance (ANOVA) test; **EF: energy/fatigue.

Table 4. OR (95% CI)* of functional status, pain intensity, and quality of life of participants based on healthy eating index quintiles

Variable	Quintile 1 (Lowest) 42-62	Quintile 2 63-69	Quintile 3 70-75	Quintile 4 76-78	Quintile 5 (Highest) 79-100
VAS	Reference	0.97 (0.76-1.67)	0.94 (0.65-1.49)	0.89 (0.71±0.94)	0.84 (0.73-0.91)
WOMAC	Reference	1.78 (0.65±4.51)	1.34 (0.49-6.32)	0.82 (0.73-7.43)	0.74 (0.54-4.78)
QOL					
PF	Reference	0.67 (0.45±6.08)	1.07 (0.53-5.64)	1.10 (1.06-5.78)	1.12 (1.03-4.35)
RP	Reference	1.23 (0.73-6.09)	1.48 (0.78-7.34)	1.35 (0.66-4.66)	1.29 (0.61-5.44)
RE	Reference	1.43 (0.87-6.54)	1.33 (0.65-7.06)	1.31 (0.56-8.43)	1.24 (0.77-6.87)
EF	Reference	0.94 (0.73-4.41)	0.74 (0.55-5.14)	0.56 (0.44-4.25)	0.63 (0.55-5.23)
EW	Reference	0.68 (0.45-5.18)	1.32 (0.77-6.05)	0.72 (0.51-5.69)	1.29 (0.58-7.01)
SF	Reference	0.84 (0.59-4.72)	0.81 (0.62-5.12)	0.72 (0.53-4.98)	0.77 (0.45-3.67)
P	Reference	1.12 (0.57-3.82)	1.21 (0.77-2.98)	1.32 (1.04-3.71)	1.14 (0.72-3.82)
GH	Reference	0.81 (0.51-3.01)	0.89 (0.55-2.99)	0.73 (0.58-3.51)	0.79 (0.61-2.78)

EF: energy/fatigue, EW: emotional well-being, GH: general health, MH: mental health, P: pain, PF: physical function, PH: physical health, QOL: quality of life, RE: Role limitation due to emotional problems, RP: Role limitation due to physical health, SF: social function, VAS: Visual analogue scale, WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.
* Multivariable logistic regression analyses adjusting for age, sex and BMI

the DQ (HEI-2015) of 220 subjects with knee OA. In this study, we showed that most of the men (19 subjects, 27.94 percent) were in the second quintile of HEI, while most of the women (41 subjects, 26.97 percent) were in the fifth quintile of HEI-2015. In addition, subjects in the first and second quintiles of the HEI had more pain intensity in the VAS questionnaire than the third, fourth and fifth quintiles. Participants in the fourth and fifth quintiles of HEI had significant lower odds of increasing pain intensity (VAS) in comparison with participants in the first quintile of HEI after adjusting for age, sex and BMI (OR= 0.89, 95% CI: 0.71-0.94 and 0.84, 95% CI: 0.73-0.91, respectively). Also, the first and second quintiles had higher pain scores and lower physical performance in the QOL questionnaire than the third, fourth and fifth quintiles. Participants in the fourth and fifth quintiles of HEI had significant higher odds of increasing PF scale of QOL in comparison with participants in the first quintile of HEI after adjusting for age, sex and BMI (OR= 1.10, 95% CI: 1.06-5.78 and 1.12, 95% CI: 1.03-4.35, respectively). Additionally, participants in the fourth quintile of HEI had significant higher odds of increasing pain scale of QOL in comparison with participants in the first quintile of HEI after adjusting for age, sex and BMI (1.32, 95% CI: 1.04-3.71).

DQ, as a new impression in nutritional epidemiology, is dedicated on the quality and interaction of complete foods incorporated in a dietary pattern rather than single nutrient.[36] DQ can be a more relevant intervention goal for handling obesity-related OA, since it includes altering one's dietary pattern but not confining calories. DQ can be specified by different methods; one common method is the HEI.[37]

Existing studies assessing relations between HEI and WOMAC global scores are rare. However, in a cohort of 400 urban overweight and obese African American older adults with self-reported lower extremity OA by Vergis et al, a lower HEI-2010 total score was reported for those with a WOMAC global score greater than or equal to the median compared to those with a global score less than the median; that means those with better DQ had lower global scores on WOMAC and thus better functional status.[24] On the other hand, in the study by Veronese et al, higher compliance to a Mediterranean diet was connected with lesser WOMAC total scores and better function among subjects with OA, proposing that OA severity is associated with DQ.[38]

On the other hand, interest and awareness of the prominence of QoL has increased in current years. Joint discomfort, daily activity limitations, and deteriorating of QoL are main consequences of knee OA.[39,40] There is a scarcity of data that has measured the association between the dietary patterns and QoL in older adults specifically in subjects with knee OA. One detailed review,[41] including studies with somewhat younger participants (>45 years), has investigated the effect of dietary patterns on QoL as a part of 'successful aging' and established that most of studies stated the relationship between a healthier dietary pattern and improved health outcomes.

Study Highlights

What is current knowledge?

- There are little evidence concerning associations between HEI-2015 with knee OA and much less in Iranian KOA patients.

What is new here?

- The HEI-2015 score is associated with pain intensity and QoL in patients with knee OA.

This study has some limitations which must be considered in interpreting the results. First, because of the cross-sectional approach of the study, causality cannot be concluded. Second, the use of a FFQ to gather dietary data at the baseline may present bias from under-reporting of dietary intake, especially by obese/overweight subjects, leading to null results.[42] Third, our study included only patients with knee OA referred to Tabriz Imam Reza hospital, Iran, so findings may not be generalizable to all patients. Fourth, remaining confounding because of unidentified or unmeasured confounders in this investigation cannot be excluded. Last, as dietary habits and other socio-demographic variables in Tabriz may be unlike to those in other regions of the country, our findings cannot be generalized to all Iranian patients. Irrespective of these limitations, to our knowledge, this is the first study to evaluate the HEI-2015 in association with pain, functional disability and QoL among patients with knee OA. Furthermore, using a reliable and validated FFQ to get dietary data is a significant strength of current study.

Conclusion

The findings of current study suggest the association between HEI-2015 and pain intensity and two domains of QoL in patients with knee OA. Additional prospective studies are required to endorse the discoveries of this study.

Conflict of Interest

Authors declare no conflict of interest in this study

Ethical Approval

The study protocol was approved by the Research Council of Physical Medicine and Rehabilitation Research Center and Ethical Committee of the Tabriz University of Medical Sciences, Tabriz, Iran (research ethics number: IR.TBZMED.REC.1395.12.90). Written informed consent was obtained from all participants before the participation.

Author's contributions

VVT, DA, and ND contributed to the conception and design

of the study and literature review. SA collected all data and contributed to data interpretation and manuscript drafting. MH and MR drafted the first manuscript. All authors reviewed and approved the final version of the article.

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