Original Article

The Mediating Role of Mental Health in the Relations between Dietary Behaviors and General Health: A Cross-sectional Study

Abstract

Background: The aim of this study is to find a pathway to explaining the relations between dietary behaviors with mental health and psychological functioning. **Materials and Methods:** This cross-sectional study contains 4763 participants from the employees of Isfahan University of Medical Sciences. In this study, four questionnaires were administered which were provided as follows: demographic characteristics, 21-item dietary behaviors questionnaire, Hospital Anxiety and Depression Scale questionnaire, and 12-item General Health Questionnaire (GHQ-12). We started the analysis with the structural equation modeling (SEM) model with 4 unobserved latent and 16 observed variables. **Results:** The results show that the regression coefficient (standard error) of diet behavior on mental health and mental health on GHQ were -1 (0.37) and 0.02 (0.01) with their P values as 0.007 and 0.01, respectively. For this model, the estimated root mean square error of approximation is 0.062 with 90% confidence interval of (0.060–0.065). In addition, the comparative fit indices (CFIs) were as 0.866 for incremental fit index and 0.866 for CFI. All these indices represent fairly good fit of the model to the data. **Conclusion:** We can conclude that "lower scores on diet behavior – higher scores on mental health problems" and "higher mean scores in depression and/or anxiety – higher scores in GHQ domains." The SEM results showed that dietary behaviors have significance related to depression and/or anxiety and general health status.

Keywords: *Dietary behaviors, general health, mental health*

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Introduction

It is now well-recognized that good quality of diet is important for good health. Nowadays, dietary patterns and their contributions to human health have got much attention. Food or nutrients are not consumed in isolation, rather, in compounds, which can interact with each other. Addressing dietary patterns provide an opportunity to get a proper feature about people's food habits and behaviors.[1]

Diet can help reduce the risk of several diseases such as cardiovascular diseases, diabetes, and cancer.[2,3] Diet is influenced by several demographic characteristics. Numerous studies have reported that men are less likely to follow healthy eating recommendations. Men compared to women consume fewer fruits and vegetables, fewer high-fiber foods, fewer low-fat foods, and drink more soft drinks.[4,5] Marriage also has an impact on eating behaviors in the way that married individuals have healthier diets than unmarried counterparts.[4] Mental

disorders are an important cause of long-term disabilities.[6] The global burden of disease study conducted by the World Health Organization (2004) reported that by 2020, depression will be the second cause of disease burden worldwide behind cardiovascular diseases.[7] According to studies conducted in Iran, the prevalence of depression ranges between 5.8% and 21.3%.[8,9] In addition, anxiety disorders can be regarded as significant mental health disorders that in addition to their prevalence (4.9–8.35% in Iran),[9] have a substantial detrimental impact on general health.[10,11]

Depression has a long-lasting decrement in psychological functioning, as well. In a study conducted in Western Europe, the degree of disability was found to be related to the severity of depression.[12] Studies revealed that functioning abilities deteriorate with the severity of depression and co-morbid anxiety. In other words, functioning scores was higher among depressive anxious patients.[13-15] Scores

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of distress are a function of anxiety and depression, meaning that the highest degree of distress is found to be in depressive patients.[16] In addition, there is a higher likelihood for depressive individuals to lose their jobs.[17]

It is hypothesized that depression and/or anxiety may have a contribution on the patterns of food consumption; depressive symptoms may decline an individual's motivation to get involve in healthy eating and may lead to a poor diet.[18,19]

Notwithstanding, diet and nutrition interfere biological processes underlying mental health, such as inflammation, brain plasticity, stress response system, and oxidative processes,[20,21] much of the literature have focused on single food or nutrients.[22-27]

The risk of depression and/or anxiety has been related inversely to dietary patterns fully loaded by fruits, vegetables, seafood, whole grains, low-fat dairy products, and directly been related to processed and fried foods, sweetened drinks, and salt.[28-34]

Furthermore, few studies have investigated a number of variables of the effect of mood on feeding habits such as time and nutritional ingredients of meals, nutritional status, habitual patterns of feeding, and beliefs and attitudes about food. For example, breakfast intake is associated with improved mood and psychological status,[35-38] whereas intake of a large size lunch is associated with negative moods.[35,39] It is also shown that having dinner before going to bed is associated with the risk of depression in both men and women.[40]

To our knowledge, studies regarding the possible effects of different meals, time and feeding habits on mental disorders have not been addressed yet in Iran. On the other hand, mental disorders are one of the most costing disorders in work force and impulse a 27 times greater risk of disability in accomplishments;[41] hence, studying paths between dietary behaviors and mental morbidities could have a substantial impact on prevention strategies and could lead to parsimonious preventive approaches. Accordingly, this study is conducted to find a pathway to explaining the correlation of dietary behaviors with mental and psychological functioning morbidity.

Materials and Methods

This cross-sectional study contains information within the framework of the Study on the Epidemiology of Psychological, Alimentary Health and Nutrition (SEPAHAN) project, related to epidemiological characteristics, dietary behaviors, mental health, and general health scores of employees in the Isfahan University of Medical Sciences (IUMS). Details on design of the project and recruitment of participants have been provided elsewhere.[42]

A total of 4763 employees of IUMS were administered a demographic characteristics at baseline which included recording information about age, gender, marital status, and educational status. After collecting the questionnaires, data were available for 4147 respondents, which made the response rate as 87%.

Three questionnaires were administered as follows: A 21-item dietary behaviors questionnaire is used to assess the dietary behaviors of the respondents. Dietary behavior categories include the meals pattern with the total scores varying between 1 and 15; the intra-meal fluid intake with the total scores varying between 0 and 9; the eating rate with the total scores varying between 1 and 9; the fat intake contain with the total scores varying between 1 and 12; the spicy food intake with the total scores varying between 1 and 6; the meal-to-sleep interval with the total scores varying between 1 and 6; and the snack consumption with the total scores varying between 0 and 6. Higher score in the dietary behaviors of the respondents indicates a better habitant.

To assess mental health disorders, Hospital Anxiety and Depression Scale questionnaire was administered to the respondents. It contains 14 items and consists of two subscales: Anxiety and depression. Each item is rated on a 4-point scale (ranges between 0 and 3), giving the maximum score of 21 for anxiety and depression. Scores of 11 or more on either subscale are considered to be a significant "case" of psychological morbidity, whereas scores of 8–10 represent "borderline," and 0–7 represent "normal." This instrument yielded Cronbach's alpha coefficient to be 0.78 for the anxiety subscale and 0.86 for the depression subscale in Iranian population.[43]

To assess general health status, General Health Questionnaire (GHQ) was used. The scale asks whether the respondents were recently experiencing any particular behaviors or symptoms. Each item contains 4-point scale including less than usual, no more than usual, rather more than usual, or much more than usual.[44]

In this study, the 12-item version of GHQ (GHQ-12) was used as a screening tool for psychological functioning morbidity including three subscales as psychological distress (6 items), social dysfunction (4 items), and loss of confidence (2 items). Previous studies confirmed its validation and reliability properties in Iranian population. It gives a total score of 12 or 36 based on the selected scoring methods. The most common scoring methods are bi-modal (0, 0, 1, and 1) and Likert scoring style (0, 1, 2, and 3).[45] For the purpose of this study, the scoring method of (0, 0, 1, and 1) was used over the Likert scale method as the former eliminates any biases which might result from the respondents. A higher score indicates a greater degree of psychological distress.[44]

To find the factors of dietary behaviors, we used an exploratory factor analysis (EFA) with the principal

component method and the varimax rotation process. The dietary behaviors were explained by 7 underlying factors, namely "meal pattern," "eating rate," "spicy food intake," "fat intake," "intra-meal fluid intake," "meal-to-sleep interval," and "snack consumption."

Structural equation modeling (SEM) was performed to test a theoretical model in which demographic characteristics (age, gender, marital status, and educational level) and dietary behaviors were exogenous latent variables, and mental health disorders and general health status were endogenous latent variables. Global goodness of SEM fit indices included root mean square error of approximation (RMSEA) and comparative fit indices (CFIs). The RMSEA shows how well the model, with optimally chosen parameter estimates, would fit the population's covariance matrix. Values ≤0.05 for this index indicate good fit of the model. The CFIs are based on comparison of the default model with a base model, which is an independent model. CFIs comprise incremental fit index (IFI) and CFI; all range from 0 to 1. Values ≥0.9 indicate good fit of the model.[46]

We started the analysis of the SEM model with 4 latent variables, namely demographic (demographic characteristics), diet behavior (dietary behaviors), mental health (mental health problems), and General Health (GHQ) and 16 observed variables. The patterns for loading observed variables into latent compounds are as follows:
- Age, gender, educational level, and marital status were performed on demographic
- Meal pattern, eating rate, spicy food intake, fat intake, intra-meal fluid intake, meal-to-sleep interval, and snack consumption were performed on diet behavior
- Depression and anxiety scores were performed on mental health

- Psychological distress, social dysfunction, and loss of confidence were performed on GHQ.

The regression weights were computed with the maximum likelihood estimation method. We considered educational level, spicy food intake, depression, and psychological distress as reference variables for demographic, diet behavior, mental health, and GHQ, respectively.

For the purpose of the analysis, we used the SPSS and AMOS software (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY, USA: IBM Corp.). $P < 0.05$ was considered statistically significant. The analysis of data was performed using the SEM, based on Figure 1.

Results

The mean age standard deviation (SD) of respondents was 36.6 (8.1) years, and most were female (55.7% [95% confidence interval [CI]: 54.2–57.2]) and married (81% [95% CI: 79.8–82.2]). More than half of the respondents (55.7% [95% CI: 54.2–57.2]) had academic degree and also only 11.5% (95% CI: 10.5–12.5) of them reported some level of depression. Employing the bimodal method of scoring the mean (SD) of score for psychological distress (varying between 0 and 6) was 1.2 (0.4); for social dysfunction (ranging from 0 to 4) was 1.4 (0.4); and for loss of confidence (varying between 0 and 2) was 1.1 (0.3) [Table 1].

Since the mean GHQ score provides the rough guide to choose the best cut-off point (66), we decided to categorize mean scores above the mean as a potential psychological morbidity (60). This categorization indicated that nearly 27% (95% CI: 25.6–28.3); 46% (95% CI: 44.5–47.5); and 19% (95% CI: 17.8–20.2) of the respondents suffer from
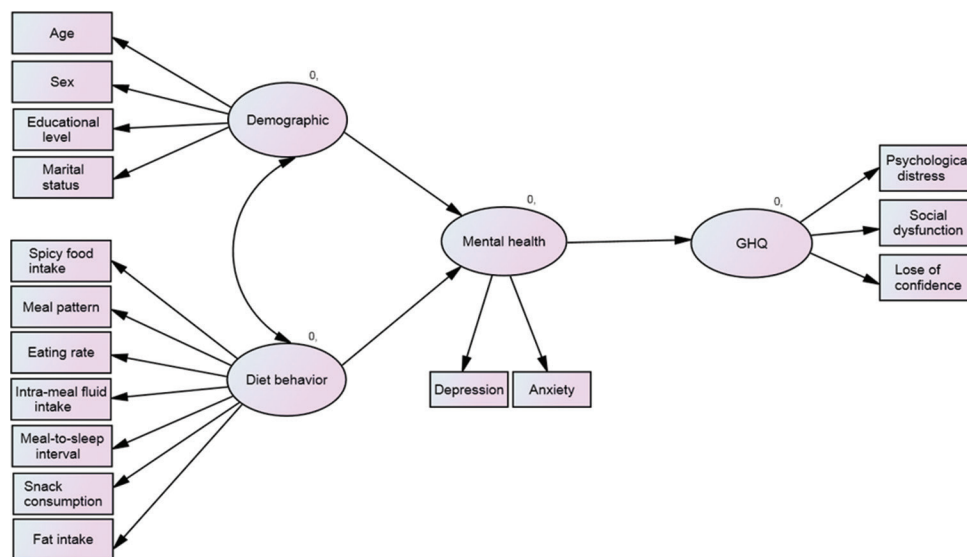

Figure 1: Structural equation modeling model with 4 latent variables of demographic (demographic characteristics), diet behavior, mental health, and General Health Questionnaire

psychological distress, social dysfunction, and loss of confidence, respectively [Table 1].

We used the factor analysis procedure to find the underlying factors related to the items of diet behaviors. Regression coefficients for diet behavior using an EFA with the principal component method are represented in Table 2.

SEM places emphasis to the extent on which the default (hypothetical) model fits the data best. Using the SEM technique, the hypothetical model contains 16 observed variables: Age, sex, marital status, educational level, meal pattern, eating rate, spicy food intake, fat

intake, intra-meal fluid intake, meal-to-sleep interval, snack consumption, anxiety score, depression score, psychological distress, social dysfunction, and loss of confidence; and 4 latent variables, namely demographic characteristics, dietary behaviors, mental health, and GHQ score [Figure 1].

The estimated RMSEA for this model is 0.062. The CFIs were 0.866 for IFI and 0.866 for CFI. These indices represent fairly good fit to the data.

The regression coefficient for the relationship between demographic characteristics and mental health was positive suggesting that being 1 year younger, being a female, being a single, divorced, or widowed and being in a 1 year higher educational level would result in 1.024 unit increase in mental health scores. The regression coefficient for the association between dietary behaviors and mental health problems showed a negative pattern which means that as individual scores one unit more on dietary behaviors, his/her anxiety and/or depression scores decrease by 1.00. The relationship between mental health and GHQ scores is positive (regression coefficient equal to 0.02). This can be interpreted as "higher mean scores in depression and/or anxiety – higher mean scores in GHQ domains." The path regression coefficients for this model are represented in Table 3.

The last paragraph is deleted because it was additional information once the mental health variable was removed from the model and the results have not been shown.

Discussion

Results of this study indicate a positive association between demographic characteristics and mental health disorders. It means that divorced or widowed females have the higher odd of being depressed and/or anxious. In addition, higher educational levels might be related to higher likelihood of depression and/or anxiety. These results have been supported by some other studies showing that females had approximately 2 times greater odds of being depressed and/or anxious compared to men.[8,9] The elevated rate of mental health problems in Iranian women could be due to the extensive tasks for them in and out of home. In addition, this increased rate compared to European countries could be explained by biological, social, and familial pressures.[8,47] It is suggested that eating mechanisms are defensive bodily barriers to cope with mental problems, especially in women.[48] Moreover, higher educational achievements could be related to occurrence of depression and/or anxiety.[9,49,50] Furthermore, divorced or widowed individuals have a higher likelihood of being psychologically disturbed.[8,9,12,50,51] Consistently, a study conducted on 18 countries worldwide showed that in developed societies being divorced and in developing ones being widowed was at elevated risk for mental morbidities compared to the others.[52] This relationship is found to be

Table 1: Main characteristics of the respondents (*n*=4763)*

Variables	Range/subgroup	n (%) Mean (SD)	Mean (SD)
Age (year)	19-70	4147 (87.1)*	36.6 (8.1)
Gender	Male	2106 (44.3)	-
	Female	2657 (55.7)	-
Education level	High school	638 (13.8)	-
	Collage	1348 (29.1)	-
	BSc diploma, but under master	2338 (50.4)	-
	MSc/PhD	312 (6.7)	-
Marital status	Married	3687 (81)	-
	Single, divorced, or widowed	853 (19)	-
Spicy food intake	1-6	4623 (97.1)*	2.6 (0.8)
Meal pattern	0-15	4375 (91.8)*	7.3 (1.5)
Eating rate	1-9	4527 (95)*	3.8 (1)
Intra-meal fluid intake	0-9	4478 (94)*	2.3 (1.1)
Meal-to-sleep interval	1-6	4351 (91.3)*	3 (0.9)
Snack consumption	0-6	4481 (94.1)*	2.6 (0.9)
Fat intake	1-12	4375 (91.8)*	4.4 (1)
Depression‡	0-21	4545 (95.4)*	6.1 (3.4)
	No	4073 (89.6)	-
	Yes	472 (10.4)	-
Anxiety⁰	0-21	4553 (95.6)*	3.6 (3.7)
	No	4290 (94.2)	-
	Yes	263 (5.8)	-
Psychological distress	0–6	4704 (98.8)*	1.2 (0.4)
	No	3451 (73.4)	-
	Yes	1253 (26.6)	-
Social dysfunction	0-4	4696 (98.6)*	1.4 (0.4)
	No	2544 (54.2)	-
	Yes	2152 (45.8)	-
Loss of confidence	0-2	4681 (98.3)*	1.1 (0.3)
	No	3771 (80.6)	-
	Yes	910 (19.4)	-

*The total number is different from strata because of missing values, ‡Depression based on HADS score ≥11, ⁰Anxiety based on HADS score ≥11. To deal with missing data, we used complete case analysis. SD: Standard deviation, HADS: Hospital Anxiety and Depression Scale

Table 2: Dietary behavior questions used in factor analysis (*n*=4763)

Diet behaviors	Questions	Regression coefficients
Meal pattern*	Q1 - Meals eaten per day	0.731
	Q2 - Eat meals regularly	0.530
	Q3 - Eat breakfast during a week	0.793
	Q4 - Eat lunch during a week	0.577
	Q5 - Eat dinner during a week	0.536
Eating rate‡	Q6 - How thoroughly chewing food	0.382
	Q7 - How long it takes to eat lunch	0.694
	Q8 - How long it takes to eat dinner	0.853
Intra-meal fluid intakeΦ	Q9 - How often drink fluids with meals	0.642
	Q10 - How many glasses of fluids drink during meals	0.823
	Q11 - How many glasses of water drink per day	−0.634
Meal-to-sleep intervalϲ	Q12 - How long it takes to go to bed after dinner	0.750
	Q13 - How long it takes to go to bed following the last snack	0.739
Snack consumptionø	Q14 - Eat snacks eaten per day	0.746
	Q15 - Eat snacks per week	0.728
Spicy food intake♦	Q16 - Eat spicy foods per week	0.753
	Q17 - Amount of spice used in foods	0.706
Fat intakeβ	Q18 - Removing observable fat from meat	0.748
	Q19 - Removing chicken's skin before cooking	−0.586
	Q20 - How fatty are the meals	0.399
	Q21 - Use animal fat in daily foods	0.656

*Meal pattern=$0.731 \times (Q1) + 0.530 \times (Q2) + 0.793 \times (Q3) + 0.577 \times (Q4) + 0.536 \times (Q5)$, ‡Eating rate=$0.382 \times (Q6) + 0.694 \times (Q7) + 0.853 \times (Q8)$, ΦIntra-meal fluid intake=$0.642 \times (Q9) + 0.823 \times (Q10) − 0.634 \times (Q11)$, ϲMeal-to-sleep interval=$0.750 \times (Q12) + 0.739 \times (Q13)$, øSnack consumption=$0.728 \times (Q14) + 0.746 \times (Q15)$, ♦Spicy food intake=$0.753 \times (Q16) + 0.706 \times (Q17)$, βFat intake=$0.748 \times (Q18) + 0.399 \times (Q19) + 0.656 \times (Q20) − 0.586 \times (Q21)$

inverses for age; in that older ages are at lower risk for mental problems. Studies showing the association between age and mental problems seem to follow a direct path in low- or middle-income countries, while an inverse path in high-income countries.[2,9,12] The direct association observed in developing societies could be due to transition of active life style to retirement status and consequent mental health disorders.[52] The association between dietary behaviors and mental health problems shows a negative pattern. Specifically, individuals who have regular meal patterns (consume 3 meals/day) have lower scores on mental problems. Benton *et al*. found that eating breakfast in the morning results in better mood and memory functions.[35] Kanarek in a review showed that timing of the meals and habitual patterns of feeding behaviors can positively influence mood and cognitive performance.[39]

While our results show the protective role of eating lunch on depression and anxiety (in terms of eating 3 regular meals/day), some studies showed that impaired mood was associated with consumption of lunch.[53,54] In addition, slow eating rate, long meal-to-sleep interval, intake of less intra-meal fluid, eating healthy snacks daily, and consuming foods without animal fat would result in lower scores on depression and/or anxiety. These results were concordant with studies showing that eating healthy snacks,[35,55] eating less animal fat,[22,26,28] and going to bed long after eating[40] could improve mood and mental tasks.

Conclusion

Our study showed that SEM model can be used as a useful technique to distinguish different paths that exist between demographic characteristics and dietary behaviors to mental problems and general health status. Interestingly, the SEM results show that dietary behaviors and demographic characteristics have a significant relation to depression and/anxiety and general health problems.

To our knowledge, this is the first study examining the effects of dietary behaviors on mental problems and disability functions in Iran. The regression coefficients of the model show that dietary behaviors derived in this study have been loaded satisfactorily on the latent variable diet behavior. In addition, the regression coefficients show that age, gender, educational level, and marital status are good components of the latent variable demographic and the significance level for all observed variables exceeds the acceptable level. Due to the cross-sectional nature of the data set, we have no other information about the history of the mental problem episodes of the respondents. We have found that dietary behaviors are associated with depression, but since increasing food intake is in the Diagnostic and Statistical Manual of Mental Disorders, 4th edition as a symptom for diagnosing depression, and on the other hand, mood may psychologically influence appetite and food choice and worsen eating behaviors of the individuals,[56,57] we cannot draw any conclusions about the real direction of this association.

The focus of this study was the effect of dietary behaviors on psychological functions, and since this association was found to be significant, it is suggested that future research focus on dietary behaviors and their contributions on mood. Moreover, we found that dietary behaviors have an indirect effect on the general health status which can be a focus of the impact of the general health status on the dietary behaviors for interested researchers.

Acknowledgments

Table 3: Regression coefficients for structure equation model (*n*=4763)

Variables	Unstandardized estimate	SE	Standardized estimate	*P*
Demographic				
Educational level	1.00	-	0.26	-
Sex	1.69	0.14	0.71	<0.001
Marital status	0.45	0.05	0.24	<0.001
Age	−12.4	1.2	−0.32	<0.001
Dietary behavior				
Spicy food intake	1.00	-	0.12	-
Meal pattern	0.69	0.11	0.05	<0.001
Eating rate	0.26	0.07	0.03	<0.001
Fat intake	−0.91	0.09	−0.09	<0.001
Intra-meal fluid intake	−0.77	0.09	−0.07	<0.001
Meal-to-sleep interval	0.17	0.06	0.02	0.007
Snack consumption	−0.90	0.08	−0.11	<0.001
Mental health				
Depression	1.00	-	0.94	-
Anxiety	0.96	0.09	0.82	<0.001
GHQ				
Psychological distresses	1.00	-	0.87	-
Social dysfunction	0.75	0.01	0.84	<0.001
Loss of confidence	0.38	0.01	0.74	<0.001
Demographic				
Mental health	1.02	0.51	0.07	0.043
Dietary behavior				
Mental health	−1.00	0.37	−0.03	0.007
Mental health				
GHQ	0.02	0.01	0.04	0.010
Demographic				
Dietary behavior	0.06	0.01	-	<0.001

GHQ: General Health Questionnaire, SE: Standard error

Conflicts of interest

There are no conflicts of interest.

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