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Original article

Self-efficacy and cues to action: two main predictors of modified version of diet quality index in Iranian adolescents

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Summary. *Background:* The purpose of this study was to examine the association between health belief model (HBM) constructs and a modified version of diet quality index in Iranian adolescents. *Methods:* One thousand and fifty five adolescents aged 13-15 years old completed this cross-sectional study. Participants were selected from secondary schools in Shiraz, one of the megacities of Iran, using stratified random sampling. A modified version of revised children's diet quality index (M-RCDQI), was calculated for each adolescents and its association with the model construct was assessed using linear regression. *Results:* Mean M-RCDQI score was 58.91±8.58 out of the total of 90 points. Among the M-RCDQI components, the worse scores were obtained by dairy intake, dietary fiber and vegetables in which less than 20% of the students reached maximum score. Among HBM constructs, cues to action (B=0.194, p=0.003) and self-efficacy (B=0.04, p=0.007) had positive, significant association with adolescents' diet quality. Also there was a positive, significant association between cues to action and fruits consumption (B=0.026, P=0.026), and a negative significant association was seen between cues to action and total fat intake (B=-0.629, p=0.021). Furthermore, self-efficacy had a direct significant association with dairy intake. *Conclusion:* M-RCDQI could be a suitable tool for assessment of diet quality index and it is recommended for use in further studies in similar populations. Cues to action and self-efficacy would both be effective mediators in improvement of nutritional behavior among adolescents.

Key words: health promotion, eating behavior, healthy diet, healthy eating indices, adolescent

Introduction

Healthy eating patterns during adolescence years, as well as other healthy behavior, can play a significant role in growth and development of a teenager (1). Improper eating behavior and irregular food intake can make an individual susceptible to serious systemic diseases such as hyperlipidemia, arthrosclerosis, diabetes mellitus, certain types of cancer, and osteoporosis in adulthood (1). Adolescence is a vital time in life; it is in this period that an individual starts to become self-sufficient and makes independent choices regarding eating their habits (2). However, many adolescents follow a diet, which is inconsistent with the recommended healthy eating habit (3). A study in Tehran, Iran on 7,669 adolescents revealed that even though 82% of girls and 75% of boys were knowledgeable about healthy nutrition, only 25 % of the boys and 15 % of the girls had proper dietary behavior (4).

Behavioral theories and their constructs were used as guides to identify and analyze behavior determinants, as well as suggested strategies for behavioral change intervention (5). The health belief model (HBM) was initially designed to provide us with disease prevention models, as opposed to treatment (6). This behavioral model was previously used in other nutritional studies (7, 8). For instance, Hazavehei (7) and LaBrosse (8) used HBM in health education program to prevent osteoporosis and increase folate rich foods intake in adolescents respectively, but the effectiveness of its constructs has not yet been specified in their study and most other related studies, among Iranian teenagers. The present study aimed to assess the association between health belief model constructs, and a modified version of diet quality index in Iranian adolescents. We believe that our results can help health experts to use the most effective construct in designing a cost-effective intervention, with the aim to improve diet quality in a vast population of adolescents in Iran.

Methods

Study design and participants

This cross-sectional study was conducted among 1,124 adolescents. Participants were 13-15 year-old pupils selected through stratified random sampling from private and public secondary schools in Shiraz, the largest city in southern Iran. Thirty eight urban schools of 4 educational districts, and one class (average 30 students) in each school was selected randomly. Students who had special diet due to chronic diseases (such as diabetes and renal disease) or other reasons (like obesity and athletes), and refugee students were excluded from the study. All study procedures and aims were explained to the participants and their parents before commencing the study. An expert nutritionist did the assessments and filled questionnaires.

Measurements

Demographic characteristics and Anthropometric assessment: A questionnaire on demographic characteristics including gender, age, parents' education level and occupation was filled by face to face interview. Height was measured without shoes to the nearest of 0.1 cm using a non-stretchable tape. Weight was measured in light clothing to the nearest of 0.1 kg using a digital scale (Seca, Germany). The measurements were taken twice and the average values were recorded. BMI was calculated as body weight (kg) divided by height square (m^2). Underweight was defined as a BMI less than the 5^{th} percentile, overweight as a BMI at or above the 85^{th} percentile and below the 95^{th} percentile, and obesity as a BMI at or above the 95^{th} percentile for adolescents of the same age and gender.

Nutritional assessment: Information relating the participants' dietary intakes were collected over the previous month using a 168-item validated food frequency questionnaire (9) and it was assessed using modified Nutritionist 4 software (ver. 3.5.2) for Persian food.

The 13 components of the modified version of revised children diet quality index (M-RCDQI) were added sugar, total fat, fatty acids such as Linoleic and Linolenic acids, Eicosapentaenoic and Docosahexaenoic acid (EPA & DHA), grain and whole grains, fruit and vegetable, dairy, juice, iron, and two items attempting to characterize the energy balance (hours of watching television and total energy) based on the studies by kranz (10, 11). As some components of the index were not common in the dietary pattern of Iranians, thus we made certain alterations. For instance, whole grain bread are not that popular, but beans and legumes are used in many Iranian dishes, and their minerals and fiber can be substituted for whole grains. Since dietary fiber is an important item in public health, we replaced whole grains with it, with maximum of 5 points in the scoring system. Also daily consumption of freshly squeezed juices were not a routine dietary habit among Iranians and none of our participants had more than 360 ml (12 Oz) of juices per day to be scored as "excess juice" in the index (11). Thus, juice intake was added to "fruits" category and each 4 Oz was considered equivalent to one serving of fruits (12). Excess juice is a negative factor in assessment of diet quality, and given that extra juice was not an issue in our children's diet, the authors decided to replace it with an unhealthy eating habit among Iranian adolescent. Studies have shown that there is a high consumption of salty snacks among Iranian adolescents (13). Therefore, salty snacks were substituted for "excess fruit juice" as a component of diet quality index. As there is no cutoff point for the consumption of salty snacks, a tertile classification was used, and 10, 5 and 0 points were assigned to first, second and third tertile, respectively. In terms of scoring, children consuming within the recommended levels received full points (varying from 2.5 to 10 points, depending on the component) with reductions made proportionally to the suboptimal intake or overconsumption based on the recommended amount (11). Total M-RCDQI score was 90. For validity assessment of M-RCDQI, a principal component analysis was performed using Eigen value>1, factor loading>0.4 and a varimax rotation. All components had factor loading more than 0.4, except for total grains, which was not excluded since it was the component of main index. Overall, 61.6% of the variance could be explained by the modified index. A moderate positive correlation was observed between the modified components and M-RCDQI (dietary fiber score: r=0.412, p<0.0001, and salty snack score: r=0.501, p<0.0001).

To assess energy balance as a component of M-RCDQI, total physical activity was assessed using the modified version of adolescent physical activity and recall questionnaire-(APARQ) based on MET-minutes/week (14). After classification of physical activity as sedentary, moderate and vigorous, each individual energy intake was compared to appropriate Estimated Energy Requirement (EER) ±10%, based on age, gender and 3 level of physical activity.

Knowledge and Health belief model constructs: The content validity of all the questionnaires were assessed by 10 specialists using Lawshe (15) and Waltz (16) methods and the reliability was calculated using Cronbach's alpha.

Knowledge*:* To assess participants' nutritional knowledge, we used the general nutrition knowledge questionnaire (GNKQ) (17). Each correct answer was given 1 point and each incorrect answer and "I don't know" received a score of zero. Reliability of the questionnaire was acceptable (Cronbach's α= 0.76).

Perceived benefits and barriers: The questionnaire that assessed perceived benefit and barrier of healthy eating, (18) involved practical obstacles (6 items), as well as internal obstacles (5 items) and 5 items referring to the benefits of healthy eating. A Likert scale was used for scoring ranging from "not important at all"=1 to "very important"=5. In this study, Cronbach's alpha for barriers and benefits were 0.71 and 0.75, respectively.

Self-efficacy: Self-efficacy (SE) for healthy eating was assessed in different situations such as being alone, being with friends and family, and in certain places like restaurants and malls (18). Scoring was based on a Likert scale ranging from 1="not confident at all" to 5="very confident". Using Cronbach's α, reliability of the questionnaire was determined as 0.78.

Perceived severity: The questionnaire to assess perceived severity contained items about individual assessment of health problem severity and its potential risk factors. The reliability of the 7- item questionnaire (19) was assessed 0.81 in this study. A 5-point Likert scale was used to score the responses, ranging from "strongly disagree"=1 to "strongly agree"=5.

Perceived susceptibility: Self-evaluation of the risk of health problems was assessed through one question: "In your opinion, if you do not make healthy food choices, will you get severely ill in the future?" (19). Reliability of this tool was determined at 0.85 in this study. A 5-point Likert scale ranging from "strongly disagree"=1 to "strongly agree"=5, was used for scoring.

Cues to action: The health belief model suggests that a cue is necessary for prompting the engagement of health-promoting behaviors. Internal and external Cues to action (20) were assessed by 6 items in our study, and the reliability was at 0.79, using alpha Cronbach's α. Responses were scored via a 5-point Likert scale, ranging from completely disagree=1 to completely agree=5.

Statistical analyses

Descriptive analysis was done to assess demographic and anthropometric characteristics, as well as mean intake, mean score and maximum percentage achieving maximum score in each item. Using single variable analysis, all covariates with p value <0.2 were entered into the regression analysis. Linear regression was done to assess the association of the M-RCDQI score and its components with the health belief model constructs. P value <0.05 was considered statistically significant. Data were analyzed via SPSS (ver.19) and modified Nutritionist 4 software for Persian food was used to assess dietary intakes.

Ethics: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the local ethics committee of Shiraz University of Medical Sciences (IR-SUMS.REC.1394.13). Written informed consent was obtained from all parents.

Results

From the total of 1,124, 1,055 (rate of participation: 93.8%) (53.3% boys) secondary school students completed the study. About one fourth of the participants were overweight or at risk of becoming overweight (Table 1). Mean M-RCDQI score was 58.91±8.58 ranging from 24.41 to 82.37 points from the total maximum of 90 points. Of the M-RCDQI components, the worse scores were obtained for dairy intake, dietary fiber, vegetables, and EPA & DHA in which less than 20% of the students reached maximum score. Only 6.4% of the adolescents had 3 or more servings of dairy products per day, and sugar intake formed more than 10% of the total calorie intake in 73.2% of the students. Mean intake of salty snacks seemed to be high (Table 2). Among HBM constructs, cues to action (B=0.194, p=0.003), and self-efficacy (B=0.04, p=0.007) had positive significant association with adolescents' diet quality (Table 3). For every unit increase in cues to action score, a 0.19 unit increase in M-RCDQI was predicted, holding all other variables constant.

Table 1. Demographic and Anthropometric characteristics and diet quality of participants

Participants characteristics	Mean ± SD
Age (year)	13.88±0.91
M-RCDQI score	58.91±8.58
	n (%)
Gender	
Male	562 (53.3)
Female	493 (46.7)
Education district	
1 & 2 (medium to high socio-economic status)	620 (58.8)
3 & 4 (low socio-economic status)	435 (41.2)
Mother's education level	
Illiterate & Primary education	137 (13)
High school & diploma	639 (60.5)
University education	173 (16.4)
Father's education level	
Illiterate & Primary education	103 (9.8)
High school & diploma	600 (56.9)
University education	250 (23.7)
BMI (Kg/m^2)	
Underweight	143 (13.6)
Normal weight	643 (60.9)
Overweight and Obese	269 (25.5)
Physical activity (MET-minutes/week)	
Sedentary	210 (19.9)
Moderate	682 (64.6)
Vigorous	163 (15.5)

M-RCDQI: Modified-Revised Children Diet Quality Index, BMI: Body mass index

Evaluating the relationships between cues to action and M-RCDQI components, we found a positive, significant association between cues to action and fruit consumption (B=0.026, P=0.026). Also a negative significant association was observed between cues to action and total fat intake (B=-0.629, p=0.021) and linoleic acid (p=0.016).

For every unit increase in cue to action score, a 0.62 unit decrease in fat intake was predicted, holding all other variables constant. Furthermore, self-efficacy had a direct significant association with dairy intake (Table 4).

Discussion

Components of Modified version of RCDQI: Refined wheat and rice are the main staple food in our country, which forms the main part of the population carbohydrate intake based on Food and Agriculture Organization (21). Whole grain products are not acceptable in the eyes of the public, due to their dark colors. On the other hand, it is expected that dietary fiber consumption to decrease by ever increasing western diet pattern (22) in recent years. In light of all this, we decided to replace whole grains with dietary fiber. Only 13% of the participants reached the maximum score for dietary fiber. Our results were in line with the findings of previous studies in the same age group in Iran (23, 24) as well as other countries. In a survey, over 74 % of children reported meeting their daily recommendation for total grain intake, but less than 0.5% of the children, had met the whole grain recommendations (25). In our study no one met the recommended amount for whole grain (at least half of total daily

Table 2. Mean score, mean intake and percentage of participants who reach the max scores in each components of M-RCDQI

Component	Scoring criteria	Max score	Mean score (SD)	Intake Mean (SD)	Reach max score n (%)
Added sugar %	≤10% of total energy intake	10	6.31 (3.45)	13.39 (5.49)	283 (26.8)
Total fat %	25%-35%	2.5	1.91 (0.98)	32.92 (4.20)	733 (69.5)
Linoleic acid %	≤5%-10%	2.5	1.47 (1.21)	10.33 (6.62)	600 (56.9)
Linolenic acid %	0.6%-1.2%	2.5	2.15 (0.56)	0.71 (0.32)	651 (61.7)
DHA & EPA%	≤10% of α-linolenic acid	2.5	0.94 (0.73)	3.83 (3.08)	56 (5.3)
Total grain (OZ) Female male	Age appropriate 5-6 OZ 6-7 OZ	5	3.36 (1.09)	12.21 (3.86)	926 (87.8)
Dietary fiber (gr) Female male	Age appropriate 22.4-25.2 gr 25.2-30.8 gr	5	3.56 (1.02)	22.96 (6.78)	137 (13)
Fruit (cup) Female male	1.5 cup 2 cup	10	8.86 (2.27)	2.73 (1.48)	743 (70.4)
Vegetable (cup) Female male	2.5 cup 3 cup	10	6.87 (2.58)	1.97 (0.83)	184 (17.4)
Dairy (cup)	3	10	5.34 (2.85)	1.62 (0.90)	67 (6.4)
Salty snacks	1th tertile: 10 point 2ed tertile: 5 point 3rd tertile: 0 point	10	5.01 (4.08)	31.46 (28.85)	354 (33.6)
Iron	≤EAR = 0 points EAR-RDA = 5 point ≥RDA = 10 point	10	7.53 (3.29)	14.75 (5.04)	632 (59.9)
Energy	Energy ± 10% of EER	10	8.53 (1.74)	2449.66 (773.45)	311 (29.5)

M-RCDQI: Modified-Revised Children Diet Quality Index, DHA: Docosahexaenoic acid, EPA: Eicosapentaenoic acid, EAR: Estimated Average Requirement, RDA: Recommended Dietary Allowance, EER: Estimated Energy Requirement

Table 3. Association between HBM constructs and M-RCDQI score

	B†	SE‡	t	P value*
Cues to action	0.194	0.065	2.982	0.003
Self-efficacy	0.039	0.014	2.697	0.007
Perceived severity	0.008	0.037	0.223	0.823
Perceived sensitivity	0.150	0.195	0.773	0.440
Perceived benefit and barrier	0.028	0.029	0.955	0.340

HBM: Health Belief Model, M-RCDQI: Modified Revised Children Diet Quality Index.
**Linear regression*
†Unstandardized coefficient
‡ Standard error
Adjusted for BMI, district (1 and 2), knowledge and sex (male, female).

Table 4- Association between HBM constructs and M-RCDQI components

	Salty snacks			Sugar			Dairy			Fat			Fruit		
	B †	S.E ‡	P value*	B	S.E	P value*	B	S.E	P value*	B	S.E	P value*	B	S.E	P value*
Cue	-0.01	0.22	0.96	-0.35	0.34	0.30	0.008	0.007	0.21	-0.63	0.27	0.02	0.02	0.011	0.02
SE	-0.08	0.06	0.18	-0.07	0.09	0.41	0.004	0.002	0.04	-0.03	0.07	0.66	0.004	0.003	0.19

HBM: Health Belief Model, M-RCDQI: Modified Revised Children Diet Quality Index, Cues: cue to action, SE: Self-Efficacy
linear regression
† Unstandardized coefficient
‡ Standard error
Adjusted for BMI, district (1 and 2), knowledge and sex (male, female).

grain intake), which could be due to lack of access to whole grain products.

Regarding unhealthy food behaviors in adolescents, sodium intake, especially salty snacks has become an issue. Mean intake in the third tertile of salty snacks was more than 60 grams (about 0.5-1 gr salt in different products) per day among our participants. Although 89% of the adolescents were aware of the disadvantages of eating potato chips and cheese balls, almost half of them consumed such snacks during their break time in school (4).

A recent study on the relationship between physical activity and screen-time viewing among elementary school children in the United States didn't find a firm association between low levels of screen-time viewing, and higher levels of physical activity (26). A review of literature revealed no evidence of a causal relationship between sedentary behavior and obesity among the youth (27). According to these evidences, in the present study scoring the energy balance was based on EER by considering gender, age and physical activity, and not just the screen time. Only 29.5% of the participants met the appropriate energy intake in our study.

Health belief model constructs: Although cues to action and self-efficacy have significant association with adolescents' diet quality in our study, the effect was not strong, and it seems that there are many other factors that may have more affect. A systematic review study, identified self-efficacy as one of the mechanisms most consistently associated with dietary behavior changes (28). Hosseini et al. (29) study was almost in line with our study, which perceived self-efficacy to be statistically associated with daily milk consumption, while no statistically significant relationship was observed between daily consumption of milk and perceived susceptibility, and perceived severity in grade 7 to 9 students. One study on college students showed that among all HBM constructs, perceived barrier and self-efficacy had significant association with having healthy diet (19) which was similar to our results in terms of self-efficacy. In O'Connell study (30) perceived susceptibility and severity of obesity, cues to dieting and benefits of dieting, were the predictors of dieting behavior in obese and non-obese adolescents. Since the participants in our study were healthy adolescents, their perceived severity and perceived susceptibility of unhealthy diet couldn't have affected their eating behavior. Low age, and the perceived long time space between current age and adulthood disease, and certain characteristics of adolescence, all could be the reasons that perceived susceptibility and severity have little predictor effect in our study. However, this does not refute the importance of these two constructs, and it could occur due to unawareness of adolescents about the risks of unhealthy eating habits, which should be addressed in educational programs.

The strengths of this study was modifying a suitable diet quality index for teenagers, according to Iranian dietary pattern, and identifying nutrition problems of this age group based on recent researches. This newly modified index might be able to assess diet quality appropriately. It is highly recommended that other studies try to confirm the suitability of this index in Iranian children.

Dietary fiber, as a component of our modified diet quality index, was lower than the recommended amount, and policy makers should make whole grain products readily available and affordable for all social-economy groups as a preventive action for reducing chronic diseases. Since eating salty snacks has become popular among adolescents, strong and widespread regulations in school cafeteria, reducing salt in formulation of these snacks, and restricting TV advertisements of salty snacks are some of the suggested strategies to decrease adolescents' salt intake. Since, selecting effective constructs would be helpful to save time and money, we suggest cues to action and self-efficacy as useful constructs for changing nutritional behaviors in similar populations.

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