



## Original article

# The Application of Transtheoretical Model to Identify Metabolic Control and Fruit and Vegetable Consumption in Patients With Type 2 Diabetes



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## ABSTRACT

**Background:** Diabetes is a major and costly health problem for patients and health care system, and requires a change in patient's lifestyle. The present study aimed to determine the factors predicting fruit and vegetable consumption and HbA1C control in diabetic patients based on the transtheoretical model.

**Methods:** In this cross-sectional study, 98 women with diabetes in Qazvin city were recruited. Information regarding demographic characteristic, transtheoretical model questionnaire, HbA1C level and weekly consumption of fruits and vegetables were completed for each participant. The variables were compared using analysis of variance.

**Results:** The mean HbA1C level was 7.87 and the amount of consumed fruit and vegetables was 2.58 units per day. Of all participants, 77.55% were in the pre-action stage and 22.45% in the action stage of consumption of five portions of fruit and vegetables a day. Diabetic women in action stages of change had significantly higher mean score of self-efficacy (P-value= 0.046) and process of change (P-value= 0.023) compared to women in pre-action stage of change.

**Conclusion:** The results showed that stage of change contributed to the behavior of fruits and vegetables consumption, patients' self-efficacy and process of change. This study recommends applying transtheoretical model in intervention programs for taking fruits and vegetables in diabetic patients.

**Keywords:** Diabetes, Glycated Hemoglobin A, Lifestyle, Theoretical model

**Citation:** Zavarmoghadam M, Farmanbar R, Zeidi IM, Omidi M. The application of transtheoretical model to identify metabolic control and fruit and vegetable consumption in patients with type 2 diabetes. Caspian J Health Res. 2018;3(1):10-14. doi: 10.29252/cjhr.3.1.10

## ARTICLE INFO

Received: June 30, 2017

Accepted: February 08, 2018

ePublished: March 04, 2018

## Introduction

Diabetes is one of the most important metabolic disorders worldwide and costly health issue for patients and healthcare systems (1). According to world health organization, The

number of people with diabetes were 422 million in 2014 and projected to be the seventh leading cause of death in 2030 (2). In Iran, the prevalence of diabetes is 24% in those above 40 years old (3). After the diagnosis, adhering to healthy diet is a

crucial factor in controlling diabetes (4). Despite the benefits of consuming fruits and vegetables in improving physical state and reducing the burden of chronic diseases, the daily consumption of 5 servings of fruits and vegetables has not yet been accepted as an effective health-promoting strategy (5). The American Diabetes Association recommends the daily consumption of 20 to 35 g of fiber (6). Previous study conducted on nationally representative sample of the Iranian population showed that 87.5% of participants consume less than the five servings as recommended daily amount for fruit and vegetables (7). Fruits and vegetables are rich sources of vitamins A, C, and E that can reduce hemoglobin glycation and thus help control the complications of diabetes (8). The level of glycated hemoglobin (HbA1C) is a good indicator of how well diabetes is being controlled (9).

Behavior change towards a specific goal is a continuous process or a series of distinct steps that reflect cognitive or behavioral characteristics (10). The transtheoretical model describes a logical series of decision stages for changing a behavior. This model considers the behavioral change not as an incident event but as a process, and people may be at various stages of behavioral change (11). The transtheoretical model is the most widely used for studying determinants of behavior and employed in dietary studies including fat intake, weight control, diets, and fruit and vegetable consumption (12). There are four constructs in this model. The construct of “stage of change” is a framework used for determining, changing, and transferring external motivations to internal ones (13). Based on this construct, individuals utilize processes of change to pass the stages of change, move from pre-action to action stages, and adopt a new behavior. Processes of change include activities and strategies which assist individuals in moving forward in stages of change, and divided into two main categories: cognitive processes (related to one’s thoughts and feeling regarding unhealthy behaviors) and behavioral processes (which bring about changes in unhealthy behaviors) (14)

In this model, the balance between the perceived advantages of adopting a new behavior and its disadvantages or barriers is known as the “decisional balance”. When advantages are more than disadvantages, a movement is expected from pre-action to action (pre-contemplation, contemplation, and preparation) and maintenance stages (15).

Furthermore, the construct of “self-efficacy” is defined as the confidence of individuals of regarding their ability to cope with a high-risk situation without relapsing to their previous unhealthy or high-risk habits. In this application, self-efficacy indicates the level of confidence in diabetic patients to perform the behavior of physical activity in difficult situations (16).

Considering the effect of fiber on diabetes control and the low percentage of fruit and vegetable consumption as sources of fiber among patients with diabetes, the present study was conducted to determine the predictive factors of metabolic control and fruit and vegetable consumption using transtheoretical model in patients with type 2 diabetes in Qazvin, Iran.

## Methods

This descriptive cross-sectional analytic study was carried out on 98 women with type 2 diabetes in 2013. Inclusion criteria were having diabetes, age below 60 years, willingness to participate, being literate, absence of any acute or chronic diseases except diabetes, lack of any prescribed diet which would prevent them from consuming fruits and vegetables, absence of advanced complications of diabetes, and not taking analgesics or any other medications.

Patients with diabetes were identified through a screening program for diabetes that had already been conducted in two healthcare centers in Qazvin. For all patients the necessary care had been offered to them based on the national program. A list of women with diabetes was compiled and participants were invited to participate in the study using convenience sampling method via telephone calls. This process continued until reaching the predetermined sample size in both centers. The study was explained to the participants and informed consent forms were obtained. The questionnaires were completed self-administered by the participants.

HbA1C were collected from healthcare records of participants. Data collection instruments included a three-part questionnaire. The first part of the questionnaire focused on demographic information including age, marital status, duration of the disease, occupation, and level of education. The second part explored the level of fruit and vegetable consumption using a weekly consumption checklist. The third part measured the constructs of the transtheoretical model regarding fruit and vegetable consumption in which a five-item algorithm was employed to determine the stages of change in fruit and vegetable consumption behavior. For the construct of “processes of change”, a researcher-made questionnaire was used with 20 items scored on a Likert scale (never, rarely, sometimes, often, and always). For the construct of “decisional balance”, a perceived advantages and disadvantages questionnaire (decisional balance) for fruit and vegetable consumption was used. This questionnaire comprises 25 items scored on a Likert scale (not important, a little important, fairly important, quite important, and totally important). For the construct of “self-efficacy” in fruit and vegetable consumption, a five-item questionnaire scored on a Likert scale (not sure, almost sure, very sure, and quite sure) was employed.

To determine content validity, the questionnaire was given to the experts, and the content validity ratio (CVR) was calculated based on the opinions of experts. The content validity index (CVI) of the questionnaire was 0.98, indicating an acceptable content validity. The internal consistency of questionnaires was also determined (Cronbach’s alpha=0.82). After checking for normality of distribution, data were compared using one-way ANOVA at the significance level of 0.05. Data were analyzed using SPSS version 16.

## Results

Mean age of participants was  $47.07 \pm 6.23$  years. The majority of participants (92.85%) were married, 76.53% did not have a high school diploma, and 90% were homemakers. A total of 65

women (66.32%) had diabetes for less than 5 years, and 33.67% had more than five years since the onset of diabetes.

Regarding the transtheoretical constructs of daily consumption of 5 servings of fruits and vegetables, 77.55% of participants were in pre-action stages (pre-contemplation, contemplation)

and 22.45% were in action stages (action and maintenance). Table 1 shows the mean levels of vegetable consumption and HbA1C by construct of stages of change. Participants consumed 2.58 servings of fruits and vegetables per day.

**Table 1.** Vegetable Consumption and HbA1C Levels According to the Construct of “Stages of Change” in Participants

Stage of change	Number	Daily consumption of fruits and vegetables			HbA1C		
		Mean	Standard deviation	P-value	Mean	Standard deviation	P-value
Pre- Contemplation	33	2.32	0.81		8.31	1.58	
Contemplation	28	2.30	0.82		7.86	1.47	
Preparation	15	3.04	1.10	0.002	7.38	1.05	0.134
Action	3	2.85	0.70		6.93	1.18	
Maintenance	19	3.17	0.98		7.65	1.02	

There was significant relationship between the level of fruit and vegetable consumption and progress in the stages of change. As the participants progressed in the stages of behavior change, the level of fruit and vegetable consumption increased, with the highest mean consumption observed in the stage of maintenance, and the lowest observed in contemplation and pre-contemplation stage (P-value= 0.002). Overall, the mean level of HbA1C was 7.87 and there was no significant relationship between progress in stages of change and improvement in the metabolic control state as measured by HbA1c (Table 1).

Table 2 shows the relationship between the constructs of transtheoretical model and the stages of change. The results revealed a significant relationship between stages of behavior

change with self-efficacy and processes of change in the daily consumption of 5 servings of fruits and vegetables. As participants progressed through the stages of change, their self-efficacy increased and they used more cognitive and behavioral processes (p=0.046). For the construct of “self-efficacy”, the highest mean was belonged to the maintenance stage and the lowest was belonged to pre-contemplation stage. For the construct of “processes of change”, the highest mean pertained to preparation and maintenance, and the lowest pertained to pre-contemplation. No significant relationship was found between the construct of “decision making” (advantages and disadvantages) and the stages of change in daily consumption of 5 servings of fruits and vegetables.

**Table 2.** Constructs of the Transtheoretical Model According to the Stages of Behavior Change

Stage of change	Self-efficacy			Processes of change			Decisional balance		
	Mean	SD	P-value	Mean	SD	P-value	Mean	SD	P-value
Pre-conception	9.78	4.51		61.05	10.50		13.01	8.58	
Contemplation	11.57	4.50		61.28	11.68		13.1	11.59	
Preparation	13.00	4.01	0.046	70.73	18.21	0.023	17.01	10.13	0.136
Action	12.33	3.78		65.66	4.16		26.06	1.89	
Maintenance	13.05	3.23		70.15	12.14		15.46	6.86	

Abbreviation: SD, Standard deviation

## Discussion

The present study aimed to determine the predictive factors for metabolic control and fruit and vegetable consumption in patients with type 2 diabetes in Qazvin based on the transtheoretical model. Based on the results, mean level of HbA1C was 7.87 which is desirable. A near-normal level of HbA1C reduces the risk of diabetes complication in the long term (17). In line with these results, Moeini et al. reported a favorable mean level of HbA1C, i.e. 7.92 (18). However, Tabesh et al. and Kasaeian et al. reported unfavorable levels of HbA1C (20, 21).

In the present study similar to Moeini et al. there was no significant relationship between the level of HbA1C and the construct of “stages of change” (18). Participants in the present study consumed fruits and vegetables less than the

recommended daily level. Tabesh et al. reported the mean level of daily fruit and vegetable consumption as 1.3 and 1.9 servings, respectively, which are lower than the recommended level (19). Ma et al. reported the daily consumption of fruits and vegetables to be 2.6 and 2.8 servings, which shows a better state (20). In the present study, there was a significant increase in fruit and vegetable consumption with progress in the stages of change. This finding is in agreement with previous studies that found higher level of fruit and vegetable consumption with a progress in stages of change (21-23). In the study by Bawadi et al. (26) among university staff, those at the pre-contemplation stage consumed a significantly lower amount of fruits and vegetables (24).

The construct of “stages of change” is based on the principle that education can improve individuals’ progress in the stage of

change. Results of the present study showed that most participants were in pre-action stages (pre-contemplation, contemplation, and preparation), while 22.45% were in the action stages (action and maintenance) of consuming 5 servings of fruits and vegetables per day. In the study by Bawadi et al. half of patients with diabetes were in the pre-contemplation stage for consuming 5 servings of fruits and vegetables per day (25). In the study by Henry et al. 49.8% of participants were in pre-action, while 50.2% were in action stages of fruit and vegetable consumption (26). In the study by Abbasgholizadeh et al. on patients with prediabetes, 82.72% of participants were in pre-action, while 17.2 were in action stages of a healthy diet (27). Results indicated that participants in the present study were in lower stages of change compared to those in other studies. This shows the necessity of educational interventions to help people progress in the stages of behavior change and increase their intake of fruit and vegetable.

Regarding the relationship between the constructs of the transtheoretical model and the stages of change, results revealed a significant relationship between stages of behavior change and self-efficacy and processes of change in the daily consumption of 5 servings of fruits and vegetables. As participants progressed through the stages of change, their self-efficacy increased and they used more cognitive and behavioral processes. Henry et al. (26), Van Duyn et al. (28), and Wakui et al. (15) also reported a positive relationship between self-efficacy and stages of change in fruit and vegetable consumption. According to previous studies with progressing of stage of change, cognitive and behavioral processes were more likely to be used (18,26). In the present study, no significant relationship was observed between the construct of "decisional balance" (advantages and disadvantages) and the stages of change in the daily consumption of 5 servings of fruits and vegetables. Similar results were reported by Moeini et al. (18). In accordance with previous report, there was no significant difference between the construct of "decisional balance" and stages of change (23,26) Results from this study did support previous research indicating that individuals with a higher self-efficacy to consume fruit and vegetables would be more likely to consume fruit and vegetables (29-31).

In general, it appears essential to educate patients regarding self-care behaviors and diabetes control. Therefore, desirable outcomes of improving the behavior of interest can be achieved through educational interventions for each stage of change and by improving the other constructs of the model.

The limitations of the present study were the small sample size, self-report nature of data, low level of education in the majority of participants, and including only women with diabetes.

## Conclusion

In this study the construct of stage of change in transtheoretical model was associated with self-efficacy and fruit and vegetable consumption. This finding may be useful for planning health education programs in diabetic patients to promote metabolic control.

## Ethical consideration

This study was reviewed and approved by Institutional Review Board of Guilan University of Medical Sciences, Rasht, Iran

## Conflict of interests

None declared.

## Funding

This study has been funded by Research Deputy of Guilan Univeristy of Medical Sciences as thesis.

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