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Development and Psychometric Evaluation of a Health Action Process Approach Inventory for Healthful Diet Among Type 2 Diabetes Patients

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ABSTRACT

Background: Long-term effects of diabetes could be prevented or delayed by adopting a proper diet. The aim of this study was to adapt and provide a pilot test using health action process approach (HAPA)-based inventory to capable of capturing significant determinants of healthful diet for diabetics.

Methods: The inventory was reviewed by eight diabetes patients and verbal feedbacks with regard the comprehension, item relevance, and potential new content were obtained. Then, the inventory items were evaluated by an expert panel. Next exploratory factor analysis (EFA) was conducted to assess the scale constructs. Criterion validity was measured by Pearson correlation. Finally, reliability measures of internal consistency and test-retest analysis were determined.

Results: A total of 121 diabetic patients participated in this study. EFA extracted seven factors (risk-perception, action self-efficacy, outcome expectancies, maintenance self-efficacy, action and coping planning, behavioral intention, and recovery self-efficacy) explaining 81.14% of the total variance. There were significant correlations between behavioral intentions and both outcome expectancies (r = 0.55, P < 0.05) and action self-efficacy (r = 0.31, P < 0.004) and small to moderate correlations (rs = 23–40) between behavior and the volitional constructs of the HAPA model. Cronbach's alpha ranging from 0.65 to 0.95 and intraclass correlation coefficients ranging from 0.71 to 0.92 indicated an acceptable internal consistency.

Conclusions: Developed scales were valid and reliable for measuring HAPA variables to be used with type 2 diabetes mellitus patients. Further examination with minority persons is warranted.

Keywords: Diabetes mellitus, diet, health behavior, measurement, psychometrics

INTRODUCTION

Type 2 diabetes mellitus (T2DM) and its complications (heart disease, stroke, hypertension, blindness, and kidney disease) are the main causes of death and various types of disease in the world[1] and Iran.[2] There is a considerable rate for the burden of this disease at all levels of social and economic parts.[3] T2DM complications account for 53% of the total excess direct costs of T2DM.[4] Apart from unmodifiable determinants such as age and genetic factors, mild changes in diet along with more

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physical activities can prevent or, at least, delay T2DM complication.[5] In spite of extensive efforts, a remarkable proportion of Iranians continues to choose unhealthy foods leading to the complications of T2DM.[6,7] While it is hard to change a person's behavior, it has been suggested to "sell" the behavior as an appealing stuff.[8] From this point of view, understanding beliefs of diabetes patients about healthful diet (HD) may help to change these beliefs by developing interventions resulting in changes in dietary behaviors in this population.

Because of the lack of prospective theory-based HD studies in this field, there is a need for potential HD determinants and their important roles to be clearly identified.

Health action process approach (HAPA) has been applied widely so as to figure out the determinant factors of HD behavior.[9] The HAPA considers two distinct phases of behavior change with possibly various social-cognitive predictors.[10] The first is preintentional motivation phase which centralizes on the beliefs that make a person perform a specific behavior[11] and are included as follow: Risk perceptions (realizing the situation of being exposed to a health threat),[12] outcome expectancies (inner opinion about the consequences of an action within a certain period),[13] and action self-efficacy (self-confidence to start an action).[14] Those individuals who are in the motivational phase are called preintenders.

The second phase, postintentional volition, focuses on the self-regulatory tactics required for planning, initiating, and maintaining the behavior.[15] This phase consists of action planning (establishing tangible plans specifying how, when and where a purpose will be turned to an action),[14] coping planning (anticipate plausible barriers and developing corresponding self-regulatory strategies),[14] maintenance self-efficacy (self-confidence in dealing with unanticipated challenging situations),[16] and recovery self-efficacy (self-confidence in resuming the behavioral function after a failure).[15] Therefore, people in the early volition phase (intenders) aim to act, but without going any further doing the task, while those in the later volition phase (actors) have started to act what they have intended before (actors).[17]

There are other obstacles and resources that are placed to affect intentions, planning, and behavioral involvement, thus dynamically influence by the behavior change process. Unlike common models and theories of motivated behavior which mostly focus on behavior,[18,19] the HAPA model consists of both pre- and postintentional factors of the behavior change process. In the motivation phase, risk perceptions, outcome expectancies, and action self-efficacy are main factors which are proposed to increase behavioral intentions in people who are not motivated.[20] However, the HAPA also enables the investigators to aim at the postintentional (volition) phase with specific factors which are action and coping planning, maintenance, and recovery self-efficacy in the situation that starts to perform behavior and maintenance are of importance.[21] These self-regulatory skills are crucial for enhancing HD behavior in T2DM patients. Because self-regulatory skills can facilitate healthy decision-making in their nutritional behavior, especially when a sudden drop in their blood sugar level occurs. These HAPA constructs therefore, would be suitable to target in patients with T2DM to help them make healthy decisions while eating.

Currently, no theoretically grounded instruments based on HAPA measure cognitive beliefs related to HD in diabetes patients in Iranian population. Therefore, this study was aimed at evaluating the psychometric properties of an instrument to measure the underlying beliefs of diabetes patients based on HAPA with respect to HD.

METHODS

Procedure

To test the scale in diabetic patients, a cross-sectional study was conducted in Al-Zahra and Feyz Hospitals, Isfahan, Iran between January and April 2015. We included individuals with established T2DM, no history of T2DM complications, and not on a special diet. Patients suffering from mental and disabling disorders were excluded. Participants were referred to the study by nurses. We used convenience sampling and referred participants to trained interviewers to pass a face-to-face interview. One month from the first interview, we re-administered the scale to 20 individuals. To provide a more adapted inventory with the target population, participants were asked for their opinion on drafts of the inventory throughout an interview. After a content analysis framework, the feedback was incorporated into the inventory.

Face validity

To confirm clarity and readability of the items, the HAPA inventory was then administered to eight T2DM patients (3 males, 5 females) for item refinement before reliability testing.

Content validity

Content validity of the HAPA inventory was proved by reviews from five experts in nutrition and HAPA methodology. The review was about to examine[1] if the responses are in line with the belief expressions in the modal sets;[2] if each item properly describes the construct, and[3] if the modal statements are clear enough to be used to construct the items.

Construct validity

Construct validity was determined using the intercorrelation and mutual exclusiveness of the items.

Exploratory factor analysis (EFA) with principal axis factoring and oblique rotation was used to confirm the construct validity. Since the correlation between some of the factors was <0.3, varimax rotation with Kaiser normalization was applied.[22] Sampling adequacy for EFA was checked by Kaiser-Meyer-Olkin (KMO) measure and Bartlett test. The best structure was extracted based on the scree plot (eigenvalues >1) and factor loadings equal to or >0.4.[23]

Criterion validity

As a preliminary test of criterion validity, we assessed the correlation between mean scores for scales and HD intention and behavior while correlations between scales were evaluated using relevant paths within the HAPA model.

Reliability

The Cronbach alpha, as an internal consistency indicator, were examined to estimate true score variance with a 95% confidence interval. We set the acceptance threshold of 0.70 for Cronbach alpha to recognize new scales.[24] The reliability over time was determined by the intraclass correlation coefficient (ICC).[24] Test-retest reliability was calculated based on the data from 20 participants who completed questionnaire1 month after the first completion. Total scale scores from the first and second interview were put into the analysis. Then, the test-retest reliability of each scale was determined using the Pearson correlation (*r*) between the mean scores of the 2 time points.

Health action process approach inventory

The HAPA inventory was consisted of eight scales, each to be rated by a seven-point scale with anchors varying according to the content of the scales. The outcome was the performance of HD for all scales.

Risk perceptions

Participant perceived risk on high cholesterol level, heart attack, hypertension, stroke, and cardiovascular disease were obtained. To evaluate the perceived absolute own risk, participants were asked to estimate the chance of facing each health problem, for instance, "How high do you think is your risk of heart attack during your life time?"[25] Participants rated their odds of developing each disorder in the future using a separate seven-point scale (1 = very unlikely; 4 = moderately likely; 7 = very likely).[26]

Outcome expectancies

Outcome expectancies were measured by seven items based on Ajzen's recommendations[27] and participants feedbacks. They were requested: "What do you think will be the consequences for yourself if you adopt an HD?" Following this header, responses were educed to eight more specific questions and were identified based on the previous researches among the patients with type 2 diabetes[19,28] and feedback from responders during the HAPA inventory adaptation interview such as: "If I stick to a low-fat diet, then…" (a) "I will be healthier," (b) "I will feel better mentally," (c) "It will improve my body weight. Participants stated their compromise with the anchors of each pair using a seven-point scale 1 (strongly disagree) to 7 (strongly agree).

Action self-efficacy

To assess the perceived action self-efficacy, we used four different items based on the Schwarzer's recommendations.[14] The following stem for all items was used, "How sure are you that you can overcome the following obstacles? I can start an HD even…" Afterward, specific barriers were presented such as: (a) "if I initially have to make plans," (b) "if I take a long-time to get used to it," (c) "if I have to start all over again several times until I succeed." Responses were made on 7-point scales ranging from 1 (strongly disagree) to 7 (strongly agree).

Behavioral intention

For assessment of intention to follow an HD, 3 items were applied adapted from Ajzen:[27] (1) "I intend to eat an HD each day in the next 2 months," with responses from 1 (extremely unlikely) to 7 (extremely likely); (2) "I will try to eat an HD each day in the next 2 months," with responses from 1 (definitely false) to 7 (definitely true); and (3) "I plan to eat an HD each day in the next 2 months," with responses from 1 (strongly disagree) to 7 (strongly agree).

Action planning

Action planning was assessed with two items recommended by Schwarzer *et al*.[29] Participants rated 1 (strongly disagree) to 7 (strongly agree) whether they had made detailed plans regarding their HD in terms of (a) how; (b) when they will start an HD.

Coping planning

Three items, with same scale anchors as action planning, was used to assess this concept. Participants scored if they had made plans in detail about: (a) What to do if their plans go under a trouble, (b) how to face the defeats in their plans, and (c) how to stick with their aims even under circumstances. These items were made based on Schwarzer's recommendations.[29]

Maintenance self-efficacy

Measured confidence of individuals in their ability to do HD even if they were blocked by some barriers. We identified seven barriers from previous research within the type 2 diabetes patients[30,31] and also the feedbacks from this study, during the pilot stage of the HAPA inventory. Time limitation for cooking, the taste of foods, and peer pressure are some of these barriers. Seven-point scale (1 = not confident at all and 7 = completely confident) was used to rate the items.

Recovery self-efficacy

Measured participants' convictions to see if they can recover themselves after being on a failure.[29] Participants were asked to answer the following questions regarding their confidence in ability to return to HD after quit this behavior using a seven-point scale as above: "I am sure I can continue healthy diet" (a) "if I have not succeed in doing so for sometimes," (b) "if I have not eaten healthy foods for a day," (c) "if I have not eaten healthy foods for a week," (c) "if I have not eaten healthy foods for a month."

All HAPA inventory scales were scored from 1 to 7 where higher scores indicate the better status of responder in that scale toward eating an HD.

Healthy eating behavior

Participants' self-reported HD was assessed using the nutrition style questionnaire designed by Renner and Schwarzer.[32] In this scale, nutrition behavior was ascertained using 19 items related to a HD such as: (a) "I follow a low-fat diet," (b) "When I eat milk products or drink milk, I choose low-fat products (such as low-fat milk or yogurt)," (c) "I usually eat fresh food," and (d) "I only eat low-salt food." Responses were made on 4-point scales ranging from 1 (strongly disagree) to 4 (strongly agree). Scores were averaged for a possible range from 19 to 76, with higher scores indicating Healthier nutrition style.

Ethical considerations

All the participants were assured that their information will be kept with confidence remaining under the custody of the main researcher and could not be available to any unauthorized person except supervisors.

RESULTS

Sample characteristics

Of n = 121 participants, 51.8% were male and 78.3% married. Mean age was 49.63 ± 17.2 years, and the most frequent educational status was high school diploma (26.5%). Other descriptive results are shown in Table 1.

Table 1: Summary of participant demographics (n=121)

Demographics	Value (%)
Age	
Mean (SD)	49.63 (17.2)
Gender	
Male	51.8
Female	48.2
Education	
Not educated	22.9
Elementary	16.9
Secondary	18.1
Diploma	26.5
Graduated	6
Postgraduate	2.4
Marital status	
Single	12
Married	78.3
Divorced or widowed	9.6
Income adequacy	
Adequate	10.4
Not adequate	89.6
Diabetes duration	
Mean (SD)	8.92 (7.44)
Healthful diet	
Mean score (SD)	37.3 (7.92)

SD=Standard deviation

Face validity

In general, no major changes were required to be made on the original HAPA scales except for some reword and visual improvements of the inventory so as to reduce complexity and to assure for consistency.

Content validity

In the aspect of the experts, 91% of the statements supported the modal belief sets for HD, and they also believed that 95% of the items were either relevant or very relevant.

Construct validity

The KMO was 0.79, and the Bartlett's test of sphericity was significant (P < 0.0001). A seven-factor solution with 30 items was extracted and named based on the corresponded items of the construct: Risk-perception, action self-efficacy, outcome expectancies, maintenance self-efficacy, action and coping planning, behavioral intention, and recovery self-efficacy. Two items of risk perception, one item of outcome expectancies and three item of maintenance self-efficacy were discarded because they did not load high enough (lower than 0.4) on their related factors. This solution explained 81.14% of the total variance of the hypothesized model. The detailed results are shown in Table 2.

Criterion validity

Relationship between the motivational HAPA stage constructs and intentions [Table 3] illustrates bivariate correlations of the motivational HAPA factors with intentions. Intention to have a healthy diet was significantly associated to outcome expectancies (r = 0.55, P < 0.05) and action self-efficacy (r = 0.31, P < 0.004).

Correlations between the risk perception and behavioral intentions was not significant (r = 0.17, P < 0.88).

Relationship between the volitional HAPA stage constructs and HD [Table 3] shows bivariate correlations between the volitional HAPA constructs and HD behavior. Small to moderate-sized (nonsignificant) associations were indicated between healthy diet behavior and all of the HAPA volitional constructs (r = 0.23–0.40),

Table 2: Results obtained from exploratory factor analysis

Construct name	Items	F1	F2	F3	F4	F5	F6	F7
Risk perception	Heart attack	−0.082	0.070	0.107	−0.037	**0.909**	−0.082	−0.004
	Osteoporosis	0.040	0.162	0.009	0.046	**0.919**	0.040	−0.107
	Cardiovascular disease	−0.095	0.224	0.172	0.061	**0.887**	−0.095	0.009
Action self-efficacy	If I have to start all over again several times until I succeed	0.151	0.180	**0.882**	0.035	0.072	0.151	0.005
	If I initially have to make plans	0.126	0.244	**0.898**	0.010	0.096	0.126	0.019
	If I takes a long-time to get used to it	0.133	0.264	**0.890**	0.073	0.085	0.133	−0.003
	It's be difficult	0.097	0.333	**0.852**	0.100	0.062	0.097	0.001
Outcome expectancies	Improving blood sugar	0.008	**0.822**	0.261	−0.055	0.091	0.008	0.186
	Improving weight	0.064	**0.814**	0.306	0.016	0.129	0.064	0.202
	Improving health	0.010	**0.911**	0.175	0.145	0.118	0.010	0.014
	Food won't taste as good	−0.413	**−0.664**	0.190	0.043	0.113	−0.413	0.094
	Preventing diabetes complication	−0.022	**0.885**	0.223	0.106	0.171	−0.022	−0.024
	I'll feel more comfortable mentally	−0.265	**0.638**	0.224	0.323	0.021	−0.265	0.129
	I'll have to make an effort of buying the right products	−0.029	**−0.753**	−0.305	−0.171	−0.182	−0.029	0.179
Behavioral intention	I intend to adoption a healthful diet over the next month	0.818	0.017	0.131	0.214	−0.012	**0.818**	0.106
	I'll try to adoption a healthful diet over the next month	0.775	0.031	0.311	0.224	−0.104	**0.775**	0.091
	I'll plan to adoption a healthful diet over the next month	0.850	−0.002	0.176	0.294	−0.006	**0.850**	0.025
Maintenance self-efficacy	That will be a burden for my financial situation.	0.237	−0.061	−0.022	**0.779**	0.261	0.237	0.198
	I like to eat fried and sugary foods	0.242	00.219	0.045	**0.761**	−0.035	0.242	0.272
	I accustomed to unhealthy diet	0.172	00.186	0.114	**0.855**	−0.117	0.172	0.014
	Its be Necessary to preparing different food for me and the other members of my family	0.425	00.372	0.242	**0.421**	0.050	0.425	−0.284
Action and coping planning	How to change my nutrition habits	**0.779**	−0.096	−0.074	−0.095	0.309	0.222	0.246
	When to change my nutrition habits	**0.883**	0.152	0.101	0.003	−0.080	0.198	0.232
	When to especially watch out to maintain my new nutrition habits	**0.892**	−0.069	−0.040	−0.031	−0.083	0.352	0.017
	What to do in difficult situations to stick to my intentions	**0.912**	0.073	0.100	0.131	−0.066	0.143	0.074
	How to deal with relapses	**0.890**	0.035	0.129	0.188	0.031	0.225	0.063
Recovery self-efficacy	I've tried several times without success	0.639	−0.004	−0.121	0.179	−0.160	0.390	**0.566**
	I did not follow a healthful diet for a day	0.568	0.051	0.033	0.213	−0.154	0.195	**0.659**
	I did not follow a healthful diet for a week	0.552	0.104	0.070	0.389	−0.010	0.205	**0.603**
	I did not follow a healthful diet for a month	0.502	0.224	0.054	0.348	0.061	0.750	**0.594**
Eigen value		8.4	6.3	2.4	2.3	1.8	1.7	1.1
Explained variance (%)		17.5	16.84	12.83	9.61	9.53	8.3	6.52

F=Factor loading

Table 3: Summary of health action process approaches inventory psychometric properties and correlation with healthful diet intention and behavior

	Number of items	Mean (SD)	Cronbach' alpha	ICC[a]	Correlation (*r*) with intention	Correlation (*r*) with HD
Risk perception	3	15.02 (2.85)	0.90	0.81	0.17	
Action self-efficacy	4	14.85 (4.91)	0.95	0.92	0.31**	
Outcome expectancies	7	34.21 (4.39)	0.85	0.71	0.55*	
Behavioral intention	3	12.70 (3.51)	0.69	0.84		0.40**
Action and coping planning	5	19.90 (5.59)	0.94	0.74		0.27**
Maintenance self-efficacy	4	14.82 (4.08)	0.65	0.85		0.23
Recovery self-efficacy	4	15.37 (4.45)	0.92	0.88		0.38**

*Correlation is significant at the 0.05 level (two-tailed), **Correlation is significant at the 0.01 level (two-tailed), [a]Intraclass correlation coefficient. SD=Standard deviation, HD=Healthful diet

except for planning (action and coping), behavioral intention, and recovery self-efficacy ($P = 0.01$). There was a week association between healthy diet behavior and maintenance self-efficacy ($P < 0.06$).

Reliability

The Cronbach's alpha for the subscales ranged from 0.65 to 0.95 [Table 3]. The ICC for the HAPA inventory scales was satisfactory (ICC ranged from 0.71 to 0.92).

DISCUSSION

This study contains the initial phase of a larger research program that aiming at examining the effectiveness of the HAPA framework for prediction of HD behavior among T2DM patients. Overall, there is preliminary evidence that the HAPA scales are valid and reliable measures. Factor analyses revealed that the risk-perception, action self-efficacy, outcome expectancies, maintenance self-efficacy, action and coping planning, behavioral intention, and recovery self-efficacy were mutually exclusive.

In addition to the incentive results obtained for the reliability of the HAPA scale, primary support was represented by criterion validity for our modified HAPA inventory. For the motivational stage constructs, there were large, significant correlations between measures of action self-efficacy and outcome expectancies with intentions to adopt an HD. These findings were consistent with the HAPA concepts,[16] physical activity behavior research among patients with schizophrenia,[23] and HD research among T2DM patients[9] which have found high correlations between behavioral intentions and both action self-efficacy, and outcome expectancies. The research on a larger sample of T2DM patients to better understand these findings and to extend them is under way.

Interestingly, the correlation between action self-efficacy and behavioral intentions was lower than outcome expectancies and behavioral intentions. According to the HAPA tenets,[16,33] both outcome expectancies and action self-efficacy have a great impact on the prediction of behavioral intentions, while risk perceptions seem to be more of a "distal antecedent" in forming behavioral intentions. However, Bandura's social cognitive theory[13] believes that self-efficacy has a stronger influence on behavioral intentions than outcome expectancies. Small sample size is a limitation of this study; therefore, further research is required to determine the most significant HAPA-based predictors of intentions to adopt an HD among individuals with T2DM. Determining such predictors will help us to develop practical, theory-based intentions to improve the following HD within this population in the future.

Overall the internal consistency of the HAPA inventory was acceptable, although Cronbach's alpha for some scales was low. However, no significant increase in the Cronbach's alpha was seen by removing any items. This result may be a consequence of few items included in these dimensions (behavioral intention and maintenance self-efficacy). Furthermore, small alpha coefficients may be explained by high homogeneity among the individuals, and small variability of the scores.[34] It seems that increasing both the sample size and the number of items in some dimensions could further support the reliability of the scale. This result is in line with those previously reported by Tan[35] and Leung *et al*.[36]

Some participants may have over-reported their adoption to HD behavior because of the self-report HD measure used in this study.

Moreover, the self-report nature of the other instruments used in this study may have resulted in some shared methods variance, and consequently, significant correlations between the measured constructs since there was a same origin of the data, then using more objective methods are recommended in future studies for measuring nutritional status. This will also lead to a more precise illustration of HD within the T2DM patients' population. Besides rather a sample size, unsatisfactory reliability coefficients of some factors were the other limitation. Hence, the findings should be interpreted with caution until further evidence is gathered.

CONCLUSIONS

In overall, our findings provided primary support for both the reliability and validity of the HAPA inventory for evaluating predictors of HD intentions and behavior among patients with T2DM. Further, validation research with this inventory using a more objective measure of HD behavior will definitely provide additional support for its psychometric properties within the T2DM patients. This is the first main step yet crucial while developing effective interventions to promote HD in this population.

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Conflicts of interest

There are no conflicts of interest.

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