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Explaining the Nutritional Behavior of Pregnant Women with Gestational Diabetes; Application of the Health Action Process Approach

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ABSTRACT

Aims Gestational diabetes is a medical complication. This study was conducted to investigate the role of HAPA in predicting diabetes control behavior and eating style in diabetic pregnant mothers referred to the healthcare centers of Abadan University of Medical Sciences (South of Iran).

Instrument & Methods This descriptive cross-sectional study was done on 82 subjects selected by simple random sampling in 2021. Data were analyzed using SPSS 25 software.

Findings We found that 41.5% of mothers were in the age group of 21-30 years. Also, 43.9% were at the middle economic level. Among demographic variables, income was the strongest predictor of nutritional behavior (p=0.01, r=19.9, and β=-0.299). None of the model constructs alone predicted nutritional behavior in pregnant women. The HAPA model was able to predict 21% of the variance of the nutritional behavior among the subjects (p<0.001, r=0.210, and β=0.458).

Conclusion Behavioral intention and action planning are effective in educating pregnant women to prevent and control diabetes.

Keywords Eating; Pregnancy; Diabetes, Gestational; Nutritional Status

CITATION LINKS

[1] Classification and Diagnosis of Diabetes: Standards of ... [2] International Diabetes ... [3] Gestational diabetes mellitus in southeast Asia: ... [4] Gestational Diabetes and ... [5] IDF diabetes atlas: estimation of global and regional ... [6] Prevalence of gestational diabetes mellitus and its associated ... [7] Application of the health action process approach model for reducing ... [8] Gestational diabetes ... [9] Gestational diabetes mellitus: Results from a survey of country ... [10] Evidence that an HMGA1 gene variant associates with type 2 diabetes, ... [11] Is there an increased risk of perinatal mental disorder in women with ... [12] Dietary quality among men and women in 187 countries in ... [13] Determinants of physical activity based on health promotion ... [14] The effect of counseling on health promotion behaviors in diabetic ... [15] Investigating when, which, and why users stop using a ... [16] Evaluation theory of planned behavior and complications ... [17] A meta-analysis of the health action ... [18] Application of the health action process approach to social ... [19] Validation and psychometric evaluation of physical activity ... [20] Using the health action process approach to predict ... [21] Self-efficacy and planning strategies can improve physical ... [22] Predictors of physical activity following gestational diabetes: Application ... [23] Predicting factors associated with healthy eating nutritional behavior ... [24] Psychological factors of healthful diet promotion among diabetics: ... [25] Predictors of physical activity among adults with type 2 ... [26] Examining social-cognitive predictors of parenting skills ... [27] The prevalence of gestational diabetes mellitus and its ... [28] Understanding and modeling health behavior: The ... [29] Health behavior change: Using a ... [30] Evaluation of health action process approach in explaining healthy diet ... [31] The effect of group discussion on the quality of life and ... [32] Beliefs effective on nutritional practices of pregnant ... [33] Time preference, outcome expectancy, and self-management ... [34] Impact of cognitive factors on treatment of type 2 ... [35] How to overcome health-compromising behaviors: ... [36] Impact of obesity and type 2 diabetes on health-related ... [37] Development and psychometric properties of the ... [38] Proactive coping moderates the dietary ... [39] Adoption and maintenance of four health behaviors: ... [40] Social-cognitive correlates of expectant mothers' ... [41] Mechanisms of health behavior change in persons ... [42] Are diet-specific compensatory health ... [43] Effectiveness, moderators and mediators ... [44] Theoretical explanations for maintenance of behaviour ... [45] Health behaviors and behavior change during ... [46] Does social support really help to eat a ...

Introduction

Gestational diabetes mellitus (GDM) is a common pregnancy problem characterized by high blood sugar levels during pregnancy [1]. GDM is defined as "any degree of glucose intolerance at the onset or first diagnosis during pregnancy" [2]. GDM develops in the second and third trimesters of pregnancy and is characterized by marked insulin resistance secondary to placental hormone secretion. Some clinical risk factors for GDM are increased body weight (body mass index (BMI) greater than 25kg/m^2), decreased physical activity, a first-degree relative with diabetes, previous history of GDM or a baby with macrosomia, metabolic diseases, such as high blood pressure, low high-density lipoprotein (HDL) levels, triglyceride levels more than 250 mg/dl, polycystic ovary syndrome, hemoglobin A1C greater than 5.7%, and a history of cardiovascular disease [3]. GDM is increasing globally at an alarming rate. According to recent updates, 16.2 million live births were affected by hyperglycemia in pregnancy [3, 4]. The global standardized prevalence of GDM was 14.0%. The standardized regional prevalence of GDM is 7.1% in North America and the Caribbean, 7.8% in Europe, 10.4% in South and Central America, 14.2% in Africa, 14.7% in the Western Pacific, 20.8% in Southeast Asia, and 27.6% in Southeast Asia. In the Middle East and North Africa, the standard prevalence of GDM in low-, middle-, and high-income countries was 12.7%, 9.2%, and 14.2%, respectively. Among the three World Bank country income groups, high-income countries had the highest standardized prevalence of GDM [5]. Also, a study in 2020 showed that 11.5% of Iranian pregnant women had GDM and among the selected variables, a BMI of more than 25kg/m^2 and a family history and history of GDM were associated with increased risks of GDM [6]. Women with a history of GDM are at higher risk for weight gain, preeclampsia, and cesarean section [7, 8]. The increasing prevalence of GDM in Asia depends on demographic characteristics, such as maternal age, socioeconomic status, race/ethnicity, body composition, screening approaches, diagnostic criteria, and genetic factors [9, 10].

Evidence suggests that a large proportion of the risk of GDM in women may be prevented by lifestyle modifications, especially nutritional behaviors [3]. GDM has several adverse consequences for mothers and infants, including hypertension, polyhydramnios, preterm delivery, fetal macrosomia, and respiratory distress. It is believed that improving the diet of patients can prevent or at least delay the effects of diabetes [11]. Although the global consumption of healthy foods has increased, the consumption of unhealthy foods has increased more [12]. However, the diet and its trends have been very different throughout the world [12]. According to theorists, health-promoting behaviors positively affect the quality of life so that people with healthy habits are healthier and it is easier to prevent and even treat physical and mental problems [13, 14]. Psychological factors that guide people to change their behavior are very important. Cognitive factors are included in several theories of behavior change [15]. In this regard, the health action process approach (HAPA) can be useful. This model was proposed by Schwartzer in 2008 based on Bandura's social cognitive theory. The main hypothesis of the HAPA is that in order to adopt a behavior, the person should go through motivational and volitional phases [16-18]. After behavioral intention formation, the person as a volunteer, joins the stages of coping, adaptation, and action planning, action self-efficacy, improvement of self-efficacy, and maintenance of self-efficacy [19]. HAPA is a cognitive-social psychological model that identifies the determinants of the initiation and maintenance of health behavior. It includes the motivational and volitional phases.

A review of previous studies revealed the power of HAPA in predicting health outcomes [19]. Recently, the HAPA model provided good evidence for predicting healthy dietary intention and behavior among diabetic patients [16]. The model differentiates between two distinct stages each comprising sets of constructs and processes that determine behavioral enactment. The motivational phase includes outcome expectancies, action self-efficacy, and risk perceptions, which implicate intention formation. Outcome expectancies reflect an individual's belief about desired outcomes, which can be achievable by engaging in the behavior. It encompasses behavioral intention, action and coping planning, maintenance of self-efficacy, and recovery of self-efficacy, which results in healthy behavior [17]. HAPA has been used to predict design and evaluate educational interventions in many health behaviors [7, 18]. Macphail *et al.* using a health action process approach to predict and improve health outcomes in people with type 2 diabetes, showed that the constructs of this model can predict BMI and only risk awareness and recovery self-efficacy were significant independent predictors. However, HAPA did not predict healthy eating [20]. Awareness of risk perception, self-efficacy, and intention were also significant predictors of health outcomes [20].

Another study showed that HAPA explained 11% of the variance of physical activity behavior in women with GDM, and action self-efficacy was the only significant predictor of behavioral intention. They also predicted the intention and self-efficacy of maintaining action planning [21]. Mohammadi Zeidi *et al.* showed that HAPA constructs predicted 48% of the variance of intention and 35% of the variance of physical activity in women with GDM, and action self-efficacy and coping planning were the most important predictors of intention and behavior, respectively [22]. Some studies in Iran have shown that HAPA can be used to predict the nutritional behavior

of students and nutritional behavior and physical activity in people with type 2 diabetes [23-26].

However, a theory should be used to identify predictors of nutritional behavior in pregnant women of a geographic region. Due to the use of this model in recent years and the lack of study on the application of the model dimensions for women with GDM, we studied the effectiveness of HAPA in predicting appropriate eating behavior in pregnant women with diabetes living in Abadan covered by the Abadan University of Medical Sciences (South of Iran). We determined the scores of HAPA constructs and eating styles regarding GDM. Also, the relationship between blood sugar levels, blood pressure, and eating style, and the HAPA constructs was investigated.

Instrument and Methods

Study Design

The statistical population of this descriptive cross-sectional study was pregnant women with diabetes referred to the urban health centers in Abadan in 2021. The diagnosis was performed using a fasting blood sugar (FBS) test.

Sample Size

The sample size was calculated based on the sample size formula to estimate the ratio of an attribute in a community and the prevalence of GDM in Iran. Rahimi *et al.* 2016 [27] reported the prevalence of GDM among Iranian women is 6%. Based on the Cochran formula, the minimum sample size was 85 people (d=0.05, p=0.06, and q=0.94), but three questionnaires were not complete and removed. Finally, we had 82 subjects.

Inclusion and Exclusion Criteria

Being a positive case for GDM based on the FBS test, being literate, satisfaction with participating in the study, and having no cognitive disorder were considered inclusion criteria. Incomplete completion of the questionnaire was considered as the study exclusion criterion.

Sampling Method

The subjects were selected by simple random sampling according to the electronic health records in urban health centers in Abadan.

Eighty-five participants were interviewed. Three participants refused to complete all questionnaires; thus, their information was not entered into the data analysis.

Data Collection

A demographic questionnaire assessed information, including age, education level, etc. The second questionnaire was HAPA constructs. The items of this questionnaire were scored on a seven-point Likert scale [from 1= very unlikely to 7= very likely].

The sum of the scores obtained from the items was calculated as the individual score in all constructs. In order to evaluate the perceived risk, participants were asked to estimate the chance of facing health problems, such as heart attack, stroke, and cardiovascular; for instance, "How high do you think your risk of heart attack is because of unhealthy nutrition during pregnancy time or even then". Outcome expectancies were evaluated by eight items that mothers considered as consequences of nutritional behaviors; for example, "I will have a healthy fetus." To assess the perceived action self-efficacy, we used four different items, such as some obstacles that make it difficult to change eating habits; for example "how confident are you that you can overcome the time limitation to maintain healthy nutritional behavior". To assess intention about nutritional behaviors, three items were applied. One example was "I intend to follow a healthy diet in the next month". Action planning was assessed with five items that showed whether mothers had made detailed plans regarding their healthy diet; for example, "I have planned how to change my eating habits". Maintenance self-efficacy measured the confidence of mothers in their ability to continue a healthy diet when they were blocked by some barriers. For example, "Even if one day I cannot follow a healthy diet, I will resume my diet again". Recovery self-efficacy measures the confidence of individuals in their ability to resume a healthy diet when they have stopped the healthy diet because of various obstacles. For example, "Even if one day I cannot follow a healthy diet, I will resume my diet again".

The Nutrition Style Scale, developed by Lippke and Ziegelmann in 2006, was used to measure healthy eating behavior. This scale was used in previous studies on Iranian diabetic patients and showed good reliability and validity. The scale consisted of 14 items, scoring on a four-point Likert scale (never, somewhat, very, and very much). Higher total scores obtained on this scale indicate the healthier nutritional style of the person [28-30].

Data analysis

Data were described using descriptive statistics and analyzed by regression analysis, analysis of variance (ANOVA), and correlation tests using SPSS 25 software.

Findings

The present study was conducted on 82 pregnant women with GDM. Table 1 shows the demographic characteristics of participants. Most pregnant mothers were in the 21-30 age group (n=34, 41.5 %). Most subjects and their husbands had a diploma (42%). Most pregnant mothers were housewives (62.2%) and 43.9% were at the moderate economic level. Also, 51.2% of the subjects received information on GDM through a physician or health expert and 30.5% received information through the Internet or social networks. In addition, 34.1% of the subjects had close relatives who had been affected by diabetes.

Table 1. Demographic characteristics of participants (n=82)

Variable	Category	No.(%)
Age (year)	15-20	10(12.2)
	21-30	34(41.5)
	31-40	32(39.0)
	41-45	6(7.3)
Education	Elementary school	10(12.2)
	Junior high school	22(26.8)
	Diploma	33(40.2)
	Academic	17(20.7)
Spouse's education	Elementary school	6(7.3)
	Junior high school	10(12.2)
	Diploma	35(42.7)
	Academic	31(37.8)
Occupation	Housewife	51 (62.2)
	Worker	5(6.1)
	Employee	15(18.3)
	Self-employed	11(13.4)
Spouse's Job	Unemployed	11(13.4)
	Worker	11(13.4)
	Employee	21(25.6)
	Self-Employed	19(23.2)
	Retired	20(24.4)
Income status	Very good	2(3.7)
	Good	16(19.5)
	Mediocre	36(43.9)
	Weak	16(19.5)
	Very weak	11(13.4)
Body mass index	Underweight	5(6.1)
	Normal	23(28.0)
	Overweight	26(31.7)
	Obese	28(34.1)
Awareness	Friends and relatives	5(6.1)
	Healthcare providers	42(51.2)
	Magazine or newspaper	6(7.3)
	TV or radio	4(4.9)
	Internet or social networks	25(30.5)
Family history of diabetes	Yes	28(34.1)
	No	54(65.9)

Table 2. Mean scores of the HAPA constructs and nutrition behavior

Construct	Mean±SD	Minimum	Maximum
Risk perception	26.62±8.70	11	58
Action initiation self-efficacy	13.83±5.12	4	28
Outcome expectancies	33.74±8.58	18	56
Maintenance self-efficacy	12.72±4.01	4	27
Action planning	16.21±5.53	7	35
Intention	11.57±4.48	3	21
Recovery self-efficacy	13.52±4.71	4	28
Total HAPA score	161.07±21.90	126	259
Nutrition	32.85±4.79	19	46

Most subjects' spouses were employed (25.6%) and 34.1% of pregnant women were overweight.

The mean scores of weight, gestational age, systolic and diastolic blood pressure, and blood sugar were 77.37±14.15, 25.33±7.28, 110.43±10.92, 70.51±10.19, and 116.17±32.19, respectively. The mean scores of nutrition and the total HAPA score and its constructs are presented in Table 2.

The Pearson correlation coefficient showed a positive and significant relationship between all HAPA constructs and the model total score. The highest correlation was obtained between the total score of the model and outcome expectations ($p<0.001$, $r=0.651$).

Behavioral intention had a positive and significant correlation with outcome expectations ($p<0.001$, $r=0.482$) and action planning ($p<0.001$, $r=0.448$) (Table 3).

Table 3. Correlation between the HAPH constructs

Constructs	7	6	5	4	3	2	1
1-Risk perception	r=-0.207 p=0.062	r=-0.275 p=0.012	r=-0.020 p=0.859	r=0.036 p=0.747	r=-0.184 p=0.098	r=-0.023 p=0.837	1
2-Action initiation self-efficacy	r=0.229* p=0.038	r=0.079 p=0.480	r=0.141 p=0.207	r=0.313** p=0.004	r=0.151 p=0.175	1	
3-Outcome expectancies	r=0.350** p<0.001	r=0.482** p< 0.001	r=0.193 p=0.082	r=0.217* p=0.050	1		
4-Maintenance of self-efficacy	r=0.206 p=0.064	r=0.014 p=0.902	r=0.032 p=0.775	1			
5-Action planning	r=0.286** p=0.009	r=0.448** p<0.001	1				
6-Intention	r=0.350** p<0.001	1					
7-Recovery of self-efficacy	1						

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Linear regression analysis showed that demographic variables (education and income) predicted the total score of HAPA with the strongest predictor being income status ($p=0.01$, $r=19.9$, and $\beta=-0.299$). Also, blood sugar level was a good predictor of the HAPA ($p<0.001$, $r=0.479$, and $\beta=0.528$). In addition, blood glucose levels predicted action self-efficacy ($p=0.03$, $r=0.056$, and $\beta=0.237$), outcome expectations ($p<0.001$, $r=0.123$, and $\beta=0.351$), behavioral intention ($p=0.006$, $r=0.092$, and $\beta=0.304$), recovery self-efficacy ($p=0.002$, $r=0.117$, and $\beta=0.341$) and predicted the outcome expectations more strongly ($p<0.001$, $r=0.173$, and $\beta=0.416$; Table 4).

Regression analysis for HAPA constructs showed that risk perception, action self-efficacy, maintenance of self-efficacy, and improvement of self-efficacy could not predict behavioral intention in healthy nutrition. Regression analysis indicated that no construct of the model could predict nutritional behavior in pregnant women. However, the total score of the HAPA was able to predict 21% of the nutritional style ($p<0.001$, $R^2=0.210$, and $\beta=0.458$; Table 5).

Table 4. Linear regression analysis for demographic variables

Parameter	B	β	t-value	p-Value
Gestational age	0.187	0.068	0.673	0.503
Age	-3.453	-0.135	-1.315	0.193
Education	-3.240	-0.151	-1.325	0.012
Spouse's education	4.203	0.186	1.765	0.082
Job	-1.125	-0.065	-0.605	0.547
Spouse's job	0.061	0.004	0.039	0.969
Income status	-2.360	-0.025	-1.088	0.013
Body mass index	-0.524	-0.024	0.220	0.826
Systolic blood pressure	0.184	0.100	0.857	0.395
Diastolic blood pressure	-0.308	-0.156	-1.353	0.181
Blood sugar	0.287	0.460	4.228	0.001

Table 5. Linear regression analysis for HAPA constructs

Variables	B	β	t-Value	p-Value
Risk perception	0.052	0.094	0.809	0.421
Action initiation self-efficacy	-0.066	-0.071	-0.600	0.551
Outcome expectancies	-0.005	-0.008	-0.62	0.950
Maintenance self-efficacy	0.219	0.184	1.540	0.128
Action planning	0.022	0.025	0.201	0.841
Intention	0.094	0.257	1.670	0.099
Recovery self-efficacy	0.257	0.094	0.783	0.436

Discussion

We examined the HAPA to explain the behavior and nutrition style of diabetic pregnant mothers. The findings showed that some demographic variables were related to the HAPA constructs. There was a relationship between the subjects and their spouses' education level and the outcome expectancy construct, and this result was observed in the subjects with a college education. Also, there was a relationship between the income of pregnant women's spouses and action self-efficacy and action planning, which was observed in women with moderate, poor, and very poor economic status. It seems that the initiation of any change and planning for it depends on income, and if the limitation is at the beginning, the adoption of health behavior may be delayed [31]. For Iranian women who are often housewives, the husband's income by influencing food choices plays a very important role in the nutritional status of pregnant women. Iranian pregnant women may rely on the food knowledge of others, including their husbands in choosing their food. Only 21% of mothers consulted nutritionists for healthy eating habits during pregnancy [32]. In the present study, mean blood sugar scores were related to outcome expectations, behavioral intention, and maintenance self-efficacy. Expecting a good outcome seems to have a better commitment, and high outcome expectations are associated with higher adherence rates [33]. In a study, there was no significant relationship between blood sugar levels and outcome expectations, but blood sugar levels and self-efficacy had a negative and significant relationship, and subjects who had higher blood sugar believed that they were less capable of carrying out treatment programs [34]. People need to know how to adjust their behavior by understanding the possibilities between their actions and the consequences. There was a relationship between the HAPA neither systolic nor diastolic blood pressure, which was slightly surprising as previous research has shown that determinants of health behavior are also related to health consequences [20]. In our study, pregnant women had a lower risk perception of GDM. Furthermore, risk perception and action planning in pregnant women were associated with having close relatives with type 2 diabetes. Previous research has shown that awareness of risk is a less important construct in HAPA even among individuals with chronic health problems [35]. However, MacPhail *et al.* showed that awareness of risk is also an important predictor of some health outcomes. Risk perception is a perceived health threat, which is necessary to start mobilizing action and is considered the first step in confronting the possibility of behavior change [20, 36]. The findings of this study showed that BMI was only related to outcome expectations. Outcome expectations are environmental factors that affect individuals and groups. This construct may be useful in weight control and improving BMI. Our results are in line with those of MacPhail *et al.* and Arefi *et al.* [20, 37]. Some dimensions of the HAPA were correlated with each other, but the highest correlation was related to behavioral intention and outcome expectations. The more a person believes that the behavior will cause a positive change the more she/he is willing to do this behavior [30]. In the current research, none of the constructs could predict the risk of GDM, which was consistent with the results of Zhou *et al.* [38]. The strongest predictors of behavioral intention in pregnant women were outcome expectations and action planning. The HAPA assumes that intentions are formed by evaluating expected outcomes. Our results suggest that such a process underlies the formation of intention for feeding behavior in pregnant women and the relationship between intention and behavior represents the important role of motivational processes [39-41]. The results of this study were inconsistent with those of Radtke *et al.* [42]. In nutritional behavior, outcome expectations predict behavioral intention. When an individual's outcome expectancy appraisal is positive, the intention to adopt appropriate nutritional behavior can be promoted [21, 43, 44]. However, in one study, it was reported that not all women participating in the research changed their unhealthy behaviors, even though ensuring the health of the baby and themselves was a high-level goal. Pregnant women may have difficulty converting intention into behavior [45]. From the perspective of the theory, unforeseen obstacles may be accompanied by temptations and challenges, and the more favorable the behavior for the individual, the more likely the behavior will be planned with the mediation of self-efficacy [39]. The effects of unhealthy nutrition on the fetus and mother and the resulting fear are important factors for maintaining a healthy diet in mothers [32]. After the formation of the behavioral intention, a person enters the voluntary

stage of behavior through planning [23]. In this research, the sample size and the average level of self-efficacy of pregnant women may be the reason for the lack of mediation of self-efficacy for behavior planning. This finding is consistent with that of MacPhail *et al.* and contradict that of Scholz *et al.* [20, 46]. Finally, in general, the HAPA could partially (21%) explain the variance of nutrition behavior in pregnant women with diabetes. The limitation of this study was not addressing all husband's characteristics, which probably affects the nutritional behavior in pregnant women. The strength point of this study is the use of a theoretical framework-based approach to explaining the nutritional behavior of pregnant women. However, the values were limited, and healthy nutrition was not predicted by the constructs.

Conclusion

The HAPA is successful in predicting health outcomes. It is also a good model for identifying gaps and weaknesses in healthy nutrition behavior in pregnant women with diabetes and can be useful in designing effective interventions.

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Ethical Permissions: The present study was approved by the Ethics Committee of Abadan University of Medical Sciences (IR.ABADANUMS.REC.1398.018). For all the subjects (even those under 18 years old), the benefits of participating in the research, the laboratory blood sampling method, and the confidentiality of the answers were explained according to the ethics approval form. It was emphasized to the subjects that participating in the study and performing blood tests would not cause any human harm to them. All procedures were also performed in accordance with the Declaration of Helsinki.

Conflicts of Interests: The authors declared no conflicts of interests.

Authors' Contribution: Changizi M (First Author), Introduction Writer/Methodologist/Main Researcher/Discussion Writer/Statistical Analyst (65%); Mohamadian H (Second Author), Introduction Writer/Assistant Researcher (25%); Shojaezadeh D (Third Author), Assistant Researcher/Discussion Writer (10%)

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