



## Prediction of Food Safety Behaviors Based on the Theory of Planned Behavior in Iranian Women

Mahdiah Momayyezi<sup>a</sup> | Hossein Fallahzadeh<sup>a\*</sup> | Zohreh Rahaei<sup>b</sup> | Fatemeh Akrami<sup>c</sup> |  
Mahdiah Hosseini<sup>d</sup> | Shokufeh Shakhs<sup>d</sup>

a. Research Center of Prevention and Epidemiology of Non-Communicable Disease, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

b. Department of Health Education, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

c. Department of Food Safety and Hygiene, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

d. Student of Public Health, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

\*Corresponding author at: Research Center of Prevention and Epidemiology of Non-Communicable Disease, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. Postal code: 891517316.

E-mail address: [Hofaab@yahoo.com](mailto:Hofaab@yahoo.com)

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### ABSTRACT

**Background:** Proper food management during food preparation and maintenance is essential to reducing foodborne diseases. The theory of planned behavior (TPB) is commonly used for the examination of health behaviors. No research has assessed the effectiveness of TPB in predicting food safety behaviors in Iran. The present study aimed to examine food safety behaviors based on the TPB.

**Methods:** This cross-sectional study was conducted on 220 women in Yazd, Iran in 2018. Data were collected using a researcher-made questionnaire consisting of items on food safety behaviors and TPB constructs with confirmed reliability and validity. Data analysis was performed in SPSS version 21.0.

**Results:** A significant, positive correlation was observed between food safety behaviors and all the TPB constructs ( $r = 0.15-0.38$ ;  $P < 0.05$ ). In addition, intention was significantly correlated with food safety behaviors ( $r = 0.35$ ;  $P < 0.001$ ), and 27% of the behavior variance was explained by the TPB constructs. Perceived behavioral control was the strongest predictor ( $\beta = 0.3$ ;  $P < 0.001$ ), and 31% of the intention variance was explained by the TPB constructs. Subjective norm was considered the strongest predictor ( $\beta = 0.41$ ;  $P < 0.001$ ).

**Conclusion:** The TPB could be used as a framework for the educational interventions aimed at health observance in food preparation.

## 1. Introduction

Nutrition is a basic human need, and maintaining food safety is of utmost importance [1]. Food poisoning affects numerous individuals in developing countries due to the lack of hygiene in food storage [2]. Moreover, consumer behaviors such as eating raw foods, inadequate cooking, and lack of hygiene play a key role in the epidemics of foodborne diseases [3]. Foodborne diseases constitute a large group of diseases and are considered to be a major health concern in

in different countries [4].

Foodborne diseases are manifested through a wide array of symptoms, such as gastrointestinal disorders, diarrhea, and vomiting, which are most common. Failure in the treatment of such diseases could cause damage to the joints, nervous system, kidneys, and heart [5]. On the other hand, if appropriate measures are not taken to control foodborne diseases, these disorders spread quickly, affecting a larger number of individuals [6].

According to the estimates of the Centers for Disease



Control and Prevention, approximately 48 million individuals contract various diseases due to the consumption of contaminated food, which led to 128,000 hospitalizations and 3,000 deaths in the United States in 2011 [7]. In Iran, foodborne diseases have not been studied nationally, and accurate statistics are not available in this regard.

According to statistics, 50-87% of foodborne diseases occur at home as unhealthy food management plays a pivotal role in the incidence of these diseases [8]. The most common indicators that are involved in foodborne diseases include improper food storage, use of contaminated tools, consumption of unhealthy, raw products, poor personal hygiene, and insufficient cooking [9].

The theory of planned behavior (TPB) is a model commonly applied for the examination of health behaviors. According to the TPB, behaviors depend on the intention of the individual for a specific behavior (intention), attitude of the individual toward the behavior (attitude), perception of the individual regarding social pressure for adhering to or avoiding the behavior (subjective norms), viewpoint of the individual toward their capacity to perform a particular behavior based on their skills, opportunities, barriers, and available resources to perform a behavior (perceived behavioral control) [10].

To date, no studies have been focused on the effectiveness of the TPB in the prediction of food safety behaviors in Iran. The present study aimed to assess the predictors of food safety behaviors based on the TPB in Yazd, Iran.

## 2. Materials and Methods

This cross-sectional study was conducted on 220 women in Yazd, Iran in 2018.

### 2.1. Subject Selection

The participants included the women who were responsible for food preparation at home and lived in Yazd in 2018. The sample size was calculated to be 220 at 95% confidence interval (CI) ( $d=0.5$ ,  $S=3$ ). The subjects were selected via cluster sampling. The healthcare centers in Yazd were divided into 10 clusters, and 22 families were randomly selected from each cluster for enrollment in the study.

### 2.2. Instrumentation

Data were collected using a researcher-made questionnaire, which consisted of three sections. The first section included sociodemographic factors (age, education level, occupation status, and marital status) and items regarding food safety behaviors (frequency of the main meals prepared at home, frequency of main the meals eaten out, frequency of food poisoning, and frequency of referrals to physicians due to food poisoning). The second section was focused on the measurement of food safety behaviors using 36 items in six dimensions, including the awareness of the food contents (four items), use of appropriate containers (seven items), preserving food at the proper temperature (nine items), full cooking (five items), personal hygiene in the kitchen (four items), and use of healthy raw materials (seven items). The items in this section were scored based on a four-point Likert scale (Never = 0,

Rarely=1, Sometimes=2, Always=3). Notably, items seven, 11, 13, 15, and 33 were coded reversely. The third section consisted of the TBP constructs, which were assessed separately. Attitude was measured with four items in the form of seven questions (e.g., "I think full cooking is as important as choosing healthy foods."), perceived behavioral control was assessed by five questions (e.g., "Because I am in a hurry most of the time, it is difficult for me to slowly defrost frozen food."), subjective norms were evaluated by five questions (e.g., "Washing my hands before starting to prepare food is important to the people who are important to me."), and intention was assessed by seven questions (e.g., "In the next five times you buy food packaging, how many times do you notice the production date and expiration date?). The items regarding attitude, perceived behavioral control, and subjective norms were scored based on a three-point Likert scale (Disagree=0, Impartial=1, Agree=2), while the items regarding intention were scored based on a four-point Likert scale (Never=0, Once or Twice=1, 3-4 Times=2, 5-6 Times=3).

The face validity of the questionnaire was evaluated by 10 women, who were asked to comment on each question in terms of clarity, relevance, content, and simplicity. The qualitative content validity of the instrument was assessed by six experts, including two health educationalists, two food hygiene and safety experts, one nutritionist, and one statistician. They were asked to comment on the appearance, grammar, wordings, item allocation, scaling, writing style, semantics, and syntax of the questionnaire items, and modifications were made accordingly.

The construct validity of the research tool was confirmed using factor analysis, and the dimensions of the questionnaire were determined. According to the results of factor analysis using principal components analysis, six dimensions were extracted for food safety behaviors. The Cronbach's alpha coefficient was used to assess the reliability of the questionnaire, which was estimated at 0.8-0.95 for the TPB constructs.

### 2.3. Study Process

The women were met in their homes by the research team. Initially, the researchers explained the objectives of the research, and participation was voluntary. In total, 211 women completed the questionnaires.

Data analysis was performed in SPSS version 21.0 using descriptive statistics (mean and standard deviation [SD]) and the Kolmogorov-Smirnov test to evaluate the distribution of the quantitative variables. In addition, one-way analysis of variance (ANOVA) was applied to evaluate the mean score of the food safety behaviors based on the demographic variables, and Pearson's correlation-coefficient was used to assess the correlations between the food safety behaviors and TPB constructs. Multiple linear regression analysis was also performed to examine the significance of the TPB constructs in explaining the variances of food safety behaviors. In all the statistical analyses,  $P$ -value of less than 0.05 was considered significant.

The study protocol was approved by the Research Ethics Committee of Shahid Sadoughi University of Medical Sciences (code: IR.SSU.SPH.REC.1397.154).

### 3. Result and Discussion

According to the results, 70.1% of the participants were housewives, 81.5% were married, and 47.8% had academic education (Table 1). Table 2 shows the frequency distribution of the variables related to the food safety behaviors. Regarding the correlations between the demographic variables and dietary habits, 58.9% of the married and 21.4% of the single women reported that they always or most often prepared their main meals at home ( $P < 0.001$ ). Moreover, the frequency of food poisoning was higher in the single participants compared to the married women ( $P = 0.02$ ).

Table 3 showed the mean scores of the food safety behavior and its dimensions in the participants. The obtained results indicated that in the dimension of the awareness of the food contents, the most frequent practice was attention to the expiration date of packaged food products as 89% of the subjects reported that they did not use expired products. In the dimension of using appropriate containers, 71.8% of the participants stated that they always kept raw and cooked food in separate containers inside the refrigerator. In the dimension of preserving food at proper temperatures, the most frequent practice was keeping meat in airtight freezer bags (66.4%). In the dimension of full cooking, the most frequent practice pertained to the boiling of raw milk for 20 minutes before consumption (91%). In the dimensions of personal hygiene in the kitchen and the use of healthy raw materials, the most frequent practices were hand washing immediately after touching raw meat, chicken or fish (85.2%) and washing fruits before consumption (95.7%), respectively.

The results of the correlation analysis indicated positive associations between the food safety behaviors and TPB constructs. Accordingly, intention had positive and significant correlations with the TPB constructs, and behaviors and intention had the same correlation. According to the information in Table 4, the most significant correlation was observed between subjective norms and intention ( $r = 0.47$ ).

In the present study, linear regression analysis was used to assess the significance of the TPB constructs in explaining the variances of food safety behaviors. According to the findings, 27% of the behavior variance was explained by the TPB constructs, which was considered statistically significant ( $P < 0.001$ ) (Table 5).

**Table 1:** The frequency distribution of participants' demographic variables

Variable	Variable Label	Number	Percentage
Marital Status	single	30	14.2
	Married	172	81.5
	Widowed -Divorced	9	4.3
Occupation	Employed	58	27.5
	Housewife	148	70.1
	Retired	5	2.4
Level of Education	Below High School	31	14.7
	Diploma		
	High School Diploma	79	37.5
	Associate Degree	15	7.1
	Bachelor's Degree	64	30.3
	Masters Degree and Higher	22	10.4
Field of Study in university	I have no college education	110	52.4
	Medical and Health Sciences	28	13.4
	other fields	72	34.2

**Table 2:** The frequency distribution of the variables related to food safety behaviors in the participants

Variable	Variable Label	Number	Percentage
Frequency of main meals prepared at home	Always	116	55
	Often	69	32.7
	Sometimes	24	11.4
	never	2	0.9
Frequency of main meals eaten out	never	42	19.9
	1-2 times per month	124	58.8
	3-4 times per week	38	18
	5-6 times per week	3	1.4
	More than 6times per week	4	1.9
Frequency of food poisoning	never	154	73
	1-2 times	38	69.1
	3-5 times	16.4	9
	More than 5 times	14.5	8
Frequency of referral to physician due to food poisoning	never	73	154
	1-2 times	18.5	39
	3-5 times	4.7	10
	More than 5 times	3.8	8

Furthermore, the higher scores of subjective norms were associated with the increased scores of behavior (ratio: 1:0.1). Similarly, the higher score of perceived behavioral control was associated with the increased scores of behavior (ratio: 1:0.3), and higher scores of attitude also results in the increased scores of behavior (ratio: 1:0.2). Finally, the higher score of intention was associated with higher behavior scores (ratio: 1:0.1). With respect to the TPB constructs in explaining the behaviors, perceived behavioral control was considered to be the strongest predictor, while subjective norms could not explain the variances of food safety behaviors.

According to the results of the present study, 31% of the intention variance was explained by the TPB constructs, which was considered statistically significant (Table 5). Moreover, the increased score of subjective norms was associated with the higher behavior scores (ratio: 1:0.4). Similarly, the higher scores of perceived behavioral control resulted in the increased scores of behavior (ratio: 1:0.27), and the increased score of attitude was associated with the higher scores of behavior (ratio: 1:0.08). In terms of the TPB constructs in explaining the intention variance, subjective norms were considered to be the strongest predictor, while attitude could not explain the intention variance.

According to the findings of the current research, the women with a history of food poisoning had lower scores of overall food safety behaviors ( $P = 0.01$ ), as well as in the dimension of the awareness of the food contents ( $P = 0.005$ ). Conversely, the married women had higher score of overall food safety behaviors ( $P = 0.005$ ), as well as in the dimensions of using healthy raw materials ( $P = 0.001$ ), personal hygiene in the kitchen ( $P=0.03$ ), and preserving food at proper temperatures ( $P = 0.009$ ) compared to the single women. Our findings showed no significant correlation between food safety behaviors and education level.

**Table 3:** The mean and standard deviation of food safety behaviors

Dimensions	Mean	Standard Deviation	Range
Awareness of food content	10.57	1.3	0-12
Use appropriate containers	11.04	2.4	6-15
Keeping food at the proper temperature	19.14	3.2	6-21
Full cooking	13.01	1.9	0-15
Personal hygiene in the kitchen	10.7	1.5	0-12
Use of healthy raw materials	16.63	1.9	3-24
Food Safety Behaviors (Total)	81.07	7.9	15-99

**Table 4:** The correlation matrix of TPB constructs about food safety behavior

	1	2	3	4	Mean	SD	Range
1-behavior	-				81.07	7.9	15-99
2-subjective norms	0.15	-			9.36	1.7	0-10
<i>P</i> value	0.04						
3- Perceived Behavioral Control	0.38	0.14	-		7.6	2.1	2-8
<i>P</i> value	0.001	0.04					
4- attitude	0.35	0.15	0.26	-	12.5	1.5	4-16
<i>P</i> value	0.001	0.02	0.02				
5- intention	0.35	0.47	0.37	0.21	15.05	5.5	0-21
<i>P</i> value	0.001	0.001	0.001	0.003			

With regard to the correlations between food safety behaviors and its dimensions with the TPB constructs, the obtained results indicated that the women with a history of food poisoning had lower scores of perceived behavioral control and attitude comparatively ( $P = 0.001$ ). In addition, the married women had higher scores of attitude ( $P = 0.02$ ) and intention ( $P = 0.01$ ) compared to the single women. The results of the present study also demonstrated that the scores of perceived behavioral control ( $P = 0.04$ ) and intention ( $P = 0.02$ ) increased with higher education level. The women who were educated in healthcare, paramedical, and medical sciences achieved higher scores of attitude ( $P = 0.01$ ) and intention ( $P = 0.02$ ) compared to the single women.

The current research aimed to investigate food safety behaviors based on the TPB, which was relatively effective in the prediction of the intention behavior. According to the other findings, 31% of the intention variance was explained by the TPB constructs; which was slightly lower than the rate reported in the meta-analysis of the studies regarding TPB [15]. In the studies by Clayton and Mitton, the TPB was reported to predict 19% and 26.3% of the intention variance, respectively [11, 12].

According to the findings of the current research, subjective norms and perceived behavioral control could significantly predict intention, while attitude could not explain the intention variance. On the other hand, attitude was reported to be a significant predictor of intention in the study by Wang, which was conducted on adults in Australia. According to the mentioned research, the TPB predicted 32.8% of the intention variance to produce healthy food [16]. Furthermore, the results obtained by Mullan et al. indicated that subjective norms and perceived behavioral control could predict the intention to perform food safety behaviors. In the mentioned study, attitude could not predict intention [17].

In the present study, subjective norms were the strongest predictor of intention, which is consistent with the study conducted in Australia [17]. In another research, Chow and Mullan reported that the addition of subjective norms to the health action process approach model caused subjective norms to significantly predict the intention to

repeat food safety behaviors [18]. In addition, Clayton added the construct of the perception of others' action (descriptive norms) to the TPB model, and the model could predict the intention to wash hands before preparing food. They believed that the social concerns of consumers, social pressures, and mental norms provide a comprehensive view of explaining the intention of individuals to provide safe food [11].

Quine believes that subjective norms have a greater impact on the behaviors related to the health of others or those that are practiced in public places [19]. This has also been confirmed for the food safety behaviors that are associated with the health of others. For instance, the concerns of food producers regarding food poisoning in consumers could be an incentive for hygiene observance in the production of healthy foods. Therefore, the impact of the expectations of important individuals (e.g., parents, friends), the media, and healthcare professionals on this behavior cannot be overlooked. In terms of health and food safety, the influence of subjective norms is considered to be more important than the attitude of individuals.

In the present study, the TPB predicted 27% of the variance of the food safety behavior, and significant correlations were observed between food safety behavior and subjective norms, perceived behavioral control, and intention. Meanwhile, perceived behavioral control was observed to be a stronger predictor; the ease or difficulty of performing this behavior had a direct effect on performing the behavior, and the impact was even greater than intention. In other words, if one intends to observe hygiene in cooking food but does not have the necessary abilities and tools to face the obstacles, the behavior loses its effect.

In a similar study, knowledge alone predicted 1.4% of the behavior variance, while adding the TPB constructs to the model caused the model to predict 23.3% of the variance of food safety behaviors. Furthermore, perceived behavioral control was reported to be a stronger predictor in the mentioned study. In the viewpoint of the researchers, increased awareness was essential to food safety behavior although not sufficient for behavioral changes, and the gap could be bridged with the addition of the TPB constructs to the model [17].

**Table 5:** Multiple linear regression analysis of TPB constructs as predictors of food safety behavior and intention

Predictor	$\beta$ Standardized Coefficients	$\beta$ Unstandardized Coefficients	t	<i>P</i> value	f	<i>R</i> <sup>2</sup>
Behavior						
Constant	-	52.06	9.66	0.001		
Subjective norms	0.13	0.033	0.37	0.7		
Perceived behavioral control	0.3	1.2	3.85	0.001	14.04	0.27
Attitude	0.26	1.33	3.43	0.001		
Intention	0.18	0.26	1.94	0.04		
Intention						
Constant	-	6.34	1.99	0.04		
Subjective norms	0.41	6.56	6.56	0.001	27.35	0.31
Perceived behavioral control	0.27	4.23	4.23	0.001		
Attitude	0.08	1.28	1.28	0.2		

This is consistent with the previous studies in this regard [20, 21].

Most of the interventions that have been performed to improve food safety behaviors have been mainly focused on increasing knowledge without using a specific model. In a study conducted in the United States, although the implemented intervention could enhance knowledge, it could not result in behavioral changes regarding food safety [22]. Meanwhile, some studies have used specific models or theories in order to instigate behavioral changes, the results of which have been favorable in this regard [16, 23]. For instance, Mullan et al. conducted a research in Australia, in which an intervention was designed based on the TPB to investigate food safety behaviors. According to their findings, perceived behavioral control was a stronger predictor, and the frequency of the health behaviors increased after the intervention in the intervention group [16]. On the other hand, a similar study involved the use of the health belief model to predict food safety behaviors, and 18% of the variance of the food safety behaviors could be predicted by the model [4].

One of the limitations of the present study was the large number of the questions regarding behaviors, which might have reduced the accuracy of the responses. In addition, since we were not able to directly observe the behaviors of the participants, we relied on self-reports. It is suggested that some constructs be added to the TPB and the ability of the TPB to predict food safety behaviors be evaluated in further investigations.

#### 4. Conclusion

According to the results and similar findings, the TPB is an effective model for the prediction of food safety behaviors and could be used as a framework for the educational interventions aimed at health observance in food preparation. In the designing of such interventions, perceived behavioral control should be addressed initially, followed by the assessment of the attitude of individuals toward food safety behaviors. Similar to the studies that have used the TPB to predict behaviors, our findings indicated that the TPB is more effective in the prediction of intention rather than behaviors.

#### Authors' Contributions

M. M., Z.H., F.A.M., and H.F., conceived and developed the idea for the article and revised the manuscript; M.H., and S.H.S.H., contributed to data collection; M.M., prepared numerous drafts; M.M., and H.F., contributed to the statistical analysis. All the authors read and approved the final manuscript.

#### Conflict of Interest

The Authors declare that there is no conflict of interest.

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