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Health Belief Model and Reasoned Action Theory in Predicting Water Saving Behaviors in Yazd, Iran

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ABSTRACT

Background: People's behaviors and intentions about healthy behaviors depend on their beliefs, values, and knowledge about the issue. Various models of health education are used in determining predictors of different healthy behaviors but their efficacy in cultural behaviors, such as water saving behaviors, are not studied. The study was conducted to explain water saving behaviors in Yazd, Iran on the basis of Health Belief Model and Reasoned Action Theory.
Methods: The cross-sectional study used random cluster sampling to recruit 200 heads of households to collect the data. The survey questionnaire was tested for its content validity and reliability. Analysis of data included descriptive statistics, simple correlation, hierarchical multiple regression.
Results: Simple correlations between water saving behaviors and Reasoned Action Theory and Health Belief Model constructs were statistically significant. Health Belief Model and Reasoned Action Theory constructs explained 20.80% and 8.40% of the variances in water saving behaviors, respectively. Perceived barriers were the strongest Predictor. Additionally, there was a statistically positive correlation between water saving behaviors and intention.
Conclusion: In designing interventions aimed at water waste prevention, barriers of water saving behaviors should be addressed first, followed by people's attitude towards water saving. Health Belief Model constructs, with the exception of perceived severity and benefits, is more powerful than is Reasoned Action Theory in predicting water saving behavior and may be used as a framework for educational interventions aimed at improving water saving behaviors.
Keywords: Predictor, water saving behaviors, Health Belief Model, Reasoned Action Theory

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Introduction

In global view, water is a socio-economic product, which is considered a basic need of the human being. Although water is a renewable resource, its amount is limited [1]. Water and competition for domination of its limited resources will be one of the most challenging areas of the third millennium. Population growth, socio-industrial development, and climate changes have reduced the limited resources of safe water, especially in the arid Middle East. Additionally, mismanagement of population growth,

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climate changes, and a drastic reduction in capitation of available water resources will likely cause serious international challenges which may adversely affect the sustainable development of the region [2].

In the studies conducted by the United Nations in Singapore, the lowest water consumption per person was determined to be 99 liters per day in order to maintain healthy community [3]. According to estimates of the Islamic Republic of Iran's budget and planning organization in 1992, water consumption pattern for Iranian households must be 75-150 liters per person daily in 2016 [4]. Unfortunately, Due to uncontrolled growth of urbanization in Iran, recent statistics show that, on average, capitation of water consumption has been 250 to 300 liters daily. In 1994, the daily average capitation of urban water consumption had been 242 liters per person [5].

The management of water consumption includes a range of techniques and tools that can be divided into four groups, namely, socio-cultural, technical-engineering, economic, and legal–procedural. Of the four, the socio-cultural approach is the only one that may be implemented with the participation of people and without a high cost. This approach includes techniques and tools that are needed to promote public awareness and influence consumer behavior change in an attempt to make the optimal use of the water likely [2].

Health educators should be aware of the factors that may influence the learning capacity of the people in order to succeed in changing or maintaining a healthy behavior and to do so, the implementation of appropriate theories and models is instrumental. Theories are useful in suggesting what, how, when, and why health education programs may be instructive [6]. Health Belief Model (HBM) is the most popular theoretical model that focuses on the beliefs of people about their decisions and includes five constructs, namely, (1) perceived susceptibility to a disease or illness, (2) perceived severity of a particular condition, (3) perceived barriers, which may prevent action, (4) perceived benefits of the recommended behavior, and (5) cues to action [7]. According to the Reasoned Action Theory (RAT), the immediate predictors of behavior are intentions, which are determined by attitudes and subjective norms [8].

Several studies have been conducted to compare HBM and RAT constructs in the prediction of behavior and intention in a wide range of topics. For example, the HBM and RAT were employed in predicting behaviors such as dieting [9] and use of seat belts [10]. Results of the first study showed the two models were useful in predicting a significant proportion of the variance in dieting and fasting, however, the variance explained in fasting increased when intention was added to the HBM model. Attitudinal measures were the strongest predictors of behavioral intention and intention was the strongest predictor of dieting and fasting in the TPB and modified HBM [9]. The second study revealed that the basic Theory of Planned Behavior (TPB) model (i.e., attitudes and subjective norms) predicted seatbelt use intention better than did extended TPB and the HBM [10]. Some studies have also been conducted to examine separate application of each of these two models, such as consumption of milk [11], oil [12] and salt [13]; however, only two studies were conducted on water saving by means of educational models. First the TPB-based study by LAM in 1995 [14] and second the RAT based study by Marandu et al. in 2010 [15].

Considering that no study has been done on the effectiveness of educational models in predicting cultural behaviors, such as water saving behavior, this study was conducted to compare HBM and RAT in determining factors associated with water saving behaviors among households in Yazd. Yazd Province in central Iran; latitude: 29 degrees and 48 minutes to 33 degrees and 30 minutes north and longitude: 52 degrees and 45 minutes to 56 degrees and 30 minutes east of the meridian, is classified as a dry region [16].

Methods

Subject Selection

The participants consisted of heads of households living in the city of Yazd. In order to estimate the required sample size, a pilot study was carried out on 10 families and the data were used to calculate the parameters. The sample size was determined to be 182, which was increased to 200 to account for potential missing cases. A cluster sampling was conducted. Yazd's health centers were divided into 10 clusters and 20 families from each cluster were randomly selected and invited to participate in the study. A survey questionnaire was used to collect the data.

Instrumentation

Water Saving Behavior (WSB) was measured, using two scales: 1) individual behaviors and 2) familial behaviors and activities. There were 16 items (e.g., closing tap when shampooing or washing the body) which measured individual water saving behaviors. A 3-point Likert-type scaling was used: 1 = never, 2 = sometimes, and 3 = always. Familial behaviors and activities were measured by 11 binary items design to assess the status of using devices that reduce water consumption at the household level (e.g., use of standard valves; periodic maintenance). The responses were coded as either 1 = no or 2 = yes. The theoretical range for WSB was from 27 to70.

Health Belief Model (HBM) components were assessed separately. There were six items which measured perceived susceptibility (e.g., what is the chance for sever water deficiency in the country due to overconsumption of water in the near future?) and perceived severity of water deficiency (e.g., how dangerous and sever would it be if the country encounters sever water deficiency in the near future?). A 4-point Likert-type scaling was used: 1 = none, 2 = low, 3 = high, 4 = very high.

A 12-item scale was developed to measure the perceived barriers to water saving behaviors (e.g., water pressure is low and I have to open the valve completely). A 3-point Likert-type scaling was used: 1 = agree, 2 = neither agree nor disagree, and 3 = disagree.

Perceived benefits of water saving behaviors were measured with a 4-item scale (e.g., when I do water saving behaviors, water will be accessible to other people). A 3-point Likert-type scaling was used: 1 = agree, 2 = neither agree nor disagree, and 3 = disagree. Cues to action measure included 5 yes/no questions (e.g., have you ever watched on TV any programs about water saving practices?). The responses were coded as either 1 = no or 2 = yes.

Reasoned Action Theory (RAT) components were assessed separately. Intention of water saving behaviors construct included 6 questions in the context of water saving behaviors in relation to five hypothetical situations. The possible responses were "0 to 5 times" which were coded from 1 to 6.

Attitude toward water saving behaviors scale consisted of 6 items (e.g., water saving behaviors is a useful action). Subjective norms for water saving scale was also consisted of 6 items (e.g., the majority of people who are important to me think I should do water saving behaviors). A 3-point Likert-type scaling was used to measure both scales: 1 = disagree, 2 = no comment, 3 = agree).

Additionally, the participants were asked to provide demographic information on the type of home residence, education level, gender, family size, occupation and income.

A panel of experts approved the content validity of the instrument. Cronbach's Coefficient Alpha was used to estimate the reliability of the various scales. All reliability coefficients were greater than 0.70. The participants were met in their homes by a member of the research team who 1) explained to them the purpose of the study, 2) briefed them on the voluntary nature of the participation, and 3) used face-to-face interviews to collect the data.

Results

The majority of the study participants (55.0%) were female (mothers). The majority of the participants (82.50%) were homeowners and 17.50% were tenants. Most of the participants (59.50%) had university education. Nearly 42.50% were employed and 35.00% had an income between 3,000,000 and 5,000,000 Rials (Official rate: 1$=12260 Rls).(Table 1).

Data pertaining to familial behaviors and activities showed that 71.00% of the participants used standard valves during construction or periodic maintenance or overhaul. Nearly 82.00% reported that they refused to buy toys that require a constant flow of the water, which was the highest reported behavior. Only 12.50% stated that they used modern water flow devices, such as electronic sensors, which was the lowest reported behavior.

Regarding individual water saving behaviors, 83.60% stated that they only used the cloth washing machine when it was in its full capacity, which was the highest reported behavior, and 81.00% stated that they used cold water in the refrigerator instead of holding water valve open to make water cool. The result showed that 50.00% never used a full glass of water for teeth brushing, which was the lowest reported individual behavior (Table 2 and 3).

Correlational analyses showed that the simple correlation between water saving behaviors and all HBM and RAT constructs were statistically significant; the direction of the association with perceived barriers was negative and it was positive for all other correlations. The intention of water saving behaviors had a statistically significant correlation with all constructs with the exception of the subjective norms. Additionally, there was a statistically significant positive correlation between water saving behaviors and intention ($P < 0.01$) (Table 4).

Two stepwise hierarchical multiple linear regression analyses were performed to examine the importance of the HBM and RAT constructs in explaining the variation in water saving behaviors.

Table 1: Demographic Characteristics of participants

Variable	Labels	N	%	SD ±M
Gender	Man	90	45	
	Woman	110	55	
Type of Home Residence	Homeowner	165	82.50	
	Tenants	35	17.5	
Education Level	Illiterate	1	0.50	
	Diploma or less	80	40	
	University education	119	59.50	
Family Size	2-3	80	40	3.67±0.98
	4-5	114	57	
	6-7	6	3	
Occupation	Housewife	53	26.50	
	Employee	85	42.50	
	Teacher	29	14.50	
	Services	2	1	
	Professional	14	7	
	Self Em-	17	8.50	
Monthly Income	Less than 300,000	27	13.50	
	300,000 to 500,000	70	35	
	500,000 to 700,000	44	22	
	More than 700,000	19	9.50	
	Unknown	40	21	

Nearly 15.20% of the variation in water saving behaviors was explained by perceived barriers, which was statistically significant at the 0.01 level. Nearly 17.90% of the variation in water saving behaviors was explained by perceived barriers and perceived susceptibility. The unique contribution of perceived susceptibility to water deficiency was 2.70% ($P < 0.05$). Nearly 20.10% of the variation in water saving behaviors was explained by perceived barriers, perceived susceptibility, and cues to action.

Table2: Frequency distribution of responses to questions of individual water saving behaviors scale

Questions of individual water saving behaviors scale	Never		Sometimes		Always		Mean *
	N	%	N	%	N	%	
Closing water valve when shampooing or washing the body	8	4	92	46	100	50	2.46
Closing water valve when ablutions	15	7.5	88	44	97	48.50	2.41
Closing water valve when brushing	5	2.5	34	17	161	80.50	2.78
Using a glass of water for brushing	100	50	68	34	32	16	1.66
Checking water valves every 6 months	60	30	78	39	62	31	2.01
Repairing leaking valve water	1	0.50	39	19.50	160	80	2.79
using cold water in the refrigerator instead of holding water valve open to make water cool	5	2.50	33	16.50	162	81	2.78
Washing and disinfecting fruits and vegetables in a pan of water and then washing it with low flow of water	15	7.50	44	22	141	70.50	2.63
Closing the valve when washing dishes with dish washing liquid	4	2	37	18.50	159	79.50	2.77
Washing the car with a bucket and cloud when the car is washed at home	27	12.20	89	45.20	84	42.60	2.30
Watering the garden in the chill air, Attending to the seasons(Before 7 AM and after 8 PM)	10	6.40	52	33.30	94	60.30	2.53
Using cloth washing machine when its capacity is filled	4	2.10	28	14.40	163	83.60	2.81
Setting the clock or timer to control the time of filling water to prevent water wasting such as water source of cooler	51	25.50	57	57	92	46	2.20
Using water that has washed the fruit and vegetable for watering the garden or in pots	58	29	98	98	44	22	1.93
Teaching children not to waste water by closing faucet in time	6	3	54	54	140	70	2.67
Diluting dish washing liquid with water to reduce water consumption when washing dishes	47	23.50	80	80	73	36.50	2.13

*1= Never, 2= sometimes, 3=always

Table 3: Frequency distribution of responses to questions of familial behaviors and activities of water saving scale

Questions of Family Behaviors and Activities of water saving scale	Yes		No		Mean
	N	%	N	%	
Using of low-flow water epaulet	120	60	80	40	1.60
Using showers that could cut water flow without changing temperature	60	30	140	70	1.30
Using flash tanks with low volume or stroke	57	28.50	143	71.50	1.28
using new devices to connect and disconnect flow of water in valves such as electronic sensors	25	12.50	175	87.50	1.12
Using standard valves in during construction or periodic maintenance or overhaul	142	71	58	29	1.71
Using drip irrigation system for watering the garden	30	20.10	119	79.90	1.20
Using wall heater	72	36	128	64	1.64
Avoid buying toys that require a constant water flow	36	18	164	82	1.82
Changing taps washers every 6 months	113	56.50	87	43.50	1.56
Installing the cooler in the shade and using appropriate coverage such as putting mat for shade to prevent water evaporation	133	66.50	67	33.50	1.66
If you use the flash tank, putting a bottle of sand or gravel in it	17	14	104	86	1.14

*1= Yes, 0= No

Table4: The correlation matrix of HBM and RAT constructs about water saving behaviors

Constructs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Mea**	**SD**
1.Attitude	–									17.69	0.80
2.Subjective Norms	0.16*	–								13.80	2.30
3.Cues To Action	0.20**	0.17*	–							8.85	1.10
4.Perceived Benefits	0.46**	0.26**	0.245**	–						11.57	0.90
5.Perceived Barriers	0.24**	0.0-	0.053-	0.21**-	–					18.99	4.70
6.Perceived Susceptibility	0.34**	0.25**	0.064	0.26**	0.24**-	–				19.37	3.40
7.Perceived Severity	0.34**	0.19**	0.094	0.26**	0.24**-	0.87**	–			19.55	3.60
8.Intention	0.32**	0.13	0.144*	0.32**	0.46**-	0.26**	0.24**	–		27.49	5.70
9.Behavior	0.20**	0.24**	0.177*	0.23**	0.39**-	0.25**	0.24**	0.38**	–	54.95	5.2

$P < 0.05$, **$P < 0.01$

The unique contribution of cues to action was 2.20% ($P < 0.05$). There was 20.80% of the variation in water saving behaviors which was explained by perceived barriers, perceived susceptibility, cues to action, and perceived benefits. The unique contribution of perceived benefits was 0.80%, which was not statistically significant. Perceived severity did not explain any variation in water saving behaviors. Results are summarized in Table 5. Regarding RAT constructs, 8.40% of the variations in water saving behaviors were explained by attitude and subjective norms. The unique contribution of attitude and subjective norms was 5.60% and 2.80% respectively. These two variables explained 10.80% of variations in water saving intention; the unique contribution of attitude was 10.1% ($P <$ o.01) and the unique contribution of subjective norms was 0.7% which was not statistically significant (Table 6).

Table 5: Regression analysis of the health belief model constructs as predictors of water saving behaviors

Predictor	**R**	**R^2**	**R^2 Change**	**F Change**	***P***
Perceived Barriers	0.39	0.15	0.15	35.45	< 0.01
Perceived Susceptibility	0.42	0.18	0.037	6.43	< .05
Cues to Action	0.45	0.20	0.02	5.34	< .05
Perceived Benefits	0.46	0.21	0.01	1.94	0.16 5
Perceived Severity	0.46	0.21	0.00	0.005	0.94 2

Table 6: Regression analysis of the theory of reasoned action constructs as predictors of water saving behaviors and intention

Dependent Variables	**Predictors**	**R**	**R^2**	**R^2 Change**	**F Change**	***P***
Water Saving Behaviors	Attitude	0.24	0.05	0.05	11.73	< .01
	Subjective Norms	0.29	0.08	0.03	6.05	< .05
Water Saving Intention	Attitude	0.32	0.10	0.10	22.26	< .01
	Subjective Norms	0.33	0.11	0.01	1.48	0.22

Discussion

Factors associated with water saving behaviors among households in Yazd, Iran were investigated. Specifically, the study focused on 1) individual behaviors and 2) familial behaviors and activities.

The results showed that "Turning on cloth washing machine when its capacity is filled" (83.60%); "using cold water in the refrigerator instead of holding water valve open to make water cool" (81.00%); and "closing the water valve when brushing" (80.50%) were the most frequently employed individual water saving practices. "Avoid buying toys that require a constant water flow" (82.00%) and "using standard valves during construction or periodic maintenance or overhaul" (71.00%) were reported to be family behaviors and activities used the most in an attempt to reduce water consumption.

Glig reported that the most behaviors that led to wasting water are routine behaviors such as washing dishes and brushing [17]. Washing dishes, washing clothes, and bathing are the most water-consuming activities; and that water-saving behaviors seem to be more effective than are various devices in reducing water consumption [18]. However, there are studies which promote the use of devices that may reduce water consumption. The study conducted in Kashan, Iran by Water and Environment Research Center of Sharif University in 2004 showed that with the installation of valves and showers that reduce water consumption, there was a 22.00% reduction in water consumption as well as a cost-benefit ratio of 5.8 to 1 [19]. Installation of timer valves in schools, educational centers, and mosques in Yazd, Iran resulted in 20- 80% reduction of water consumption in these places [20]. Consumers' awareness of devices that reduce water consumption is an effective strategy in reducing water consumption [14].

ur study found a statistically significant positive correlation between water saving behaviors and attitude and subjective norms, which is consistent with the study by Lan and Marandu et al. [14-15]. Additionally, we found a statistically significant positive correlation between perceived benefits and cues to action and water saving behaviors; and that increase in water saving behavior is associated with a decrease in perceived barriers. Furthermore, our results showed that people who had higher perceived susceptibility and severity were more likely to practice water saving behaviors, which is consistent with the HBM [21]. Floyd et al., in a meta-analysis of 65 studies in 20 health fields, found that increase in perceived susceptibility and severity was associated with increase in healthy behaviors [22]. Consistent with Azjen and Fishbein propositions in RAT and theory of planned behavior, which is a modified model of RAT [23], the results showed that the higher intention of water saving would result in more water saving behaviors.

With respect to the HBM constructs in explaining water saving behavior, perceived barriers was the strongest predictor, while perceived severity of water deficiency and perceived benefits of water saving behaviors did not predict the behavior significantly. Of RAT constructs, attitude was a stronger predictor than was the subjective norms, suggesting that interventions aimed at water waste prevention should focus on barriers of water saving behaviors first, followed by people's attitude. In comparing the HBM and RAT constructs in predicting water saving behavior, the results indicated that HBM was more powerful than RAT in predicting behavior and could be used as a framework for educational interventions aimed at improving water saving behavior and optimal management of water consumption. With respect to RAT constructs, attitude was a statistically significant predictor of water saving intention. Attitudes can positively predict water saving intention and the desire to use the devices that may reduce water consumption [14-15]. The complexity of behaviors that are considered a habit may be so low that the subjective norm may not take place, even though the degree of complexity may be different among individuals [11]. The RAT and the theory of planned behavior are suitable for studying behaviors that are under less control of individuals [24]. Whereas, water saving behavior is a behavior that is greatly under the control of individuals; thus, people's attitude towards water saving behaviors should be addressed in interventional programs.

Limitations

There were two limitations in the study. First, the consumed water rate of families as an important variable was not measured. Second, the study took place in a region where water shortage is very well known among the people. Due to non-experimental nature of the study, no causal inferences may be drawn.

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