Short Communication

Behavioral control is an important predictor of soy intake in adults in the USA concerned about diabetes

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The primary objective of this study was to determine the variables associated with intention to consume soy products and identify key variables that could be used as targets in soy nutrition education and consumption promotion. A pre/post-test survey was used during a three session class focused on diabetes that discussed and introduced soy foods. The Theory of Planned Behavior framed the questions and variables examined. Subjective norms and behavioral control were most important in predicting intention to consume soy foods. Specifically, health experts and providers were important subjective norms; accessibility and ability to prepare were key behavioural control determinants. While most participants tried soy during the program, taste and texture perceptions did not impact intention to buy soy in adults concerned about diabetes.

Key Words: soy, theory of planned behavior, taste, health, diabetes

INTRODUCTION

Soybeans and their products have been extensively consumed in many countries, and play an important role in the diets of many Asians. Over the past decade, they have become increasingly popular in many non-Asian countries presumably due to the public's increasing knowledge of their potential health benefits. Consumption of soy foods may contribute to a lower incidence of coronary artery disease, type 2 diabetes, decreased risk of certain cancers such as breast and prostate cancer, better bone health, relief of menopausal symptoms, as well as weight control.[1-8] Isoflavones, found predominantly in soybeans, are the compounds most likely to confer these health benefits.[9]

Currently the USA is the largest producer of soybeans in the world. However, the mean isoflavone intake of the United States (US) adults is only 1.0 mg/day, when considering both consumers and non-consumers of soy products.[10] Since the isoflavone content of 100 g of soymilk, or a little over 3 ounces, is 9.65 mg, this translates into about 2.5 ounces of soymilk each week. Consumers of isoflavone had an estimated intake of 3.1 mg/day, so this would be equal to about 8 ounces of soymilk each day.

In US, the popularity of soy as a functional food for specific health conditions has been increasing, especially after the approval of the food-labeling health claim for the relationship between soy protein consumption and reduced risk of coronary heart disease. In 1999, the Food and Drug Administration (FDA) approved the statement that a daily diet containing 25 g of soy protein, which is also low in saturated fat and cholesterol, may reduce the risk of heart disease.[11]

Most of the research regarding soy products has focused on its beneficial effects in humans. Despite some marketing efforts to increase human soy intake, few studies have been published concerning the mediating variables for soy intake behavior. Though nutrition knowledge is an important determinant for soy consumption, it may not be the only influencing factor. For instance, a systematic review of psychosocial predictors of fruit and vegetable intake in adults found knowledge to be important, but so were social support and self-efficacy, or the belief in one's ability to perform the activity; in this case, the ability to eat enough fruits and vegetables.[12]

Many theories and models have been developed to help identify and measure psychosocial predictors of behavior. The Theory of Planned Behavior (TPB) is one such theory that has been used in nutrition and food behavior studies.[13-17] In short, the theory purports that behavior is determined primarily by related intention. Intention, in turn, is predicted by a combination of behavioral attitudes (e.g., a person's beliefs about the behavior), subjective norms (norms based on important others within a person's social network and the relative value of their opinions), and perceived behavioral control (perceived

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ease or difficulty of performing the behavior).[18,19] The purpose of this project was to determine the variables associated with intention to consume soy products andidentify key variables that could be used as targets in soy nutrition education and promoting consumption by adults, specifically those concerned with diabetes.

MATERIALS AND METHODS

A diabetes education program was conducted at three sites by educators with the same session content.[20] The program addressed healthy eating in 3 sessions, reflecting main dishes, side dishes, and desserts. For this project, taste-testing of soy products was included at each session. An evaluation survey was constructed using the TPB for a pre- and post-test assessment of attitudes about soy products, subjective norms related to consumption of soy, and intention to consume soy products. In addition, information about behavior related to soy food consumption was collected pre- and post-test utilizing a survey that had been developed previously using elicitation interviews to determine the content for attitudes, subjective norms, and perceived behavioral control items as well as describing women's perspectives and consumption behaviors concerning soy.[21] The questionnaire contained 43 items, including those for behavioral beliefs regarding taste (four items) and texture (three items); health beliefs about soy (seven items); general health beliefs (three items); attitudes about choosing foods (two items); control beliefs (two items related to price, two items related to availability, one item related to skill); perceived knowledge of soy (three items); subjective normative beliefs (six items); intention (four items); and six for measuring actual soy food consumption. Items that related to soy consumption included consumption of tofu, miso or tempeh, soy baked products, soy dairy foods, soy veggie burgers or hot dogs, and soy nuts or beans. Items that related to taste queried three foods (tofu, soy dairy, soy veggie burgers) and a taste for soy in general. Items that related to texture queried two food items (tofu and soy baked products) and a general question. Items that related to health specified soy protein, except for one item asking about soy foods in general. Responses were framed on a Likert scale of 1 to 6, with 1 representing strongly disagree/highly unlikely and 6 representing strongly agree/highly likely. For items relating to health beliefs about soy and behavioral control items, an additional response for "have no idea" was included. For these items, Cronbach alpha reliability scores were not assessed due to the high "have no idea" responses. For the remaining items, those items with Cronbach alpha $\geq$0.70 were grouped into a single construct, namely subjective norms (0.76), intention (0.88), and perceived knowledge (0.70).

Participants in the community-based diabetes education programs at the three sites were asked if they would be willing to complete the surveys and invited to taste the soy products between June 2007 and March 2009. The study was approved by the Institutional Review Board and was exempt from signed consent.

Descriptive statistics characterized the sample. Bivariate correlations were employed to determine the association between each psychosocial variable and behavioral intention or behavior. Wilcoxon tests were used for comparison of pre- vs. post-data. Stepwise regression analyses were conducted to assess each psychosocial variable that predominantly affected consumption behavior and intention (SPSS, version 16, SPSS Inc., Chicago, IL, 2007).

Table 1. Demographics of participants (n=187)

	Group	(n), percentage
Age[†]		
	18-29	(1) 1
	30-44	(8) 4
	45-65	(86) 50
	>65	(77) 45
Education[‡]		
	<high school	(6) 4
	High school	(95) 60
	College	(57) 36
Income[§]		
	<$20 000	(30) 20
	$20 000-$50 000	(72) 50
	>$50 000	(43) 30

[†]Fifteen did not answer this question.
[‡] Twenty-nine did not answer this question.
[§] Forty-two did not answer this question.

RESULTS

From a total of 233, 187 completed both the pre- and post-surveys. Almost all participants were 45 years of age or older (95%). The last grade attended for most was high school (60%) (Table 1).

Consumption behavior towards soy products

In the pre-survey, over 90% answered that they rarely or never tried soy products: tofu (93%), soy dairy (90%), soy veggie (89%), soy baked products (91%), miso or tempeh (97%), and soy nuts (87%). In the post-survey, the frequency of rarely or never tried soy products still remained at a very high level: tofu (83%, z= -2.8, p=0.005), soy dairy (88%, z= -0.68, p=0.50), soy veggie (86%, z=-0.91, p=0.36), soy baked products (98%, -2.86, p=0.004), miso or tempeh (99%, z= -1.73, p=0.084), and soy nuts (83%, z= -0.95, p=0.34). Eighty-six percent of the participants said that they did try the soy products offered during the program.

Behavior attitude towards taste, texture and health

In the pre-survey, more than 90% of the respondents answered "never tried or have no idea" regarding the taste and texture of soy products. However, that percentage decreased at post-test and improvements in perceived taste and texture were significantly improved (p<0.001) for soy dairy, tofu, soy veggie burgers, and soy baked products (Table 2).

For the specific health benefits of soy products, most responded with "have no idea" (83% for stomach upset, 84% for osteoporosis,80% for diabetes, 87% for menopausal symptoms, 71% for heart disease, 93% for anemia). Only nine participants agreed with the statement that soy protein may relieve anemia symptoms, which was a question used to determine if participants were in general agreeing with all health attributes of soy. There was a significant difference (p<0.001) between pre and post-test distribution of responses for soy causing stomach upsets, soy preventing osteoporosis, soy preventing diabetes, soy

Table 2. Frequency of Responses Concerning Attitudes Towards Taste and Texture of Soy Products

Questions	n	Extremely Unpleasant	Very unpleasant	Slightly unpleasant	Neither pleasant nor unpleasant	Slightly pleasant	Very pleasant	Extremely pleasant	Never tried (%)	Inter-quartile range	$z^{\dagger\dagger}$, *p*
Taste of soy dairy											-4.5 <0.001
pre	155	12	5	9	6	15	11	1	96	4,7	
post	163	8	10	11	26	32	30	3	43	3,7	
Taste of tofu											-4.1 <0.001
pre	159	12	2	13	12	12	7	2	99	4,7	
post	166	8	4	12	27	34	22	5	54	3,7	
Taste of soy veggie burger											-4.3 <0.001
pre	160	1	3	11	7	17	18	4	99	5,7	
post		5	6	14	9	32	29	5	70	4,7	
Overall taste of soy products											-5.6 <0.001
pre	160	3	6	7	19	22	10	2	91	4,7	
post	165	1	7	9	33	55	23	2	35	3,5	
Texture of tofu											-3.9
pre	161	15	5	14	12	9	8	1	97	3,7	
post	168	8	9	20	25	24	21	6	55	3,7	
Texture of soy baked products											-6.3 <0.001
pre	157	1	1	3	9	13	6	2	122	7,7	
post	167	1	3	9	15	30	46	14	49	4,7	
Overall texture of soy food											-5.7 <0.001
pre	157	3	5	8	15	19	7	0	100	4,7	
post		1	7	9	33	55	23	2	35	3,5	

preventing heart disease, soy relieving anemia, and the healthfulness of soy in general. Of those not responding "have no idea", about half believed that soy plays a role in heart disease (52%), 45% believed soy may help prevent diabetes by keeping blood sugar at the right level, 30% believed soy may help relieve menopausal symptoms, and 28% thought soy may help prevent osteoporosis. There was no significant difference in pre- vs. post for the importance of preventing or relieving these conditions, nor for the importance of choosing healthful foods.

Subjective norms

In the pre-survey, nearly half of respondents neither agreed nor disagreed that the health expert, health care provider and family thought they should consume soy products (48%, 58%, and 66%, respectively). However, 38.5% felt that health experts "think I should consume more soy products"; 21% felt that their "health care providers think I should consume more soy products"; and 18.2% felt "my family or the people in my household think I should consume more soy products." In addition, most people wanted to follow the health expert's and health care provider's advice concerning food (90% for health expert, 91% for health care provider). There was no significant difference in the subjective norm between pre-survey and post-survey (z= -0.58, p=0.562).

Intention to consume and buy soy products

In the pre-survey, 45.4% thought it likely they would buy soy in the next month (slightly to extremely). There were significant differences between the pre- and post-surveys in the intention to buy and consume soy products (z= -4.9, p<0.001). In the post-survey, 63% intended to buy soy in the next month, and 63% intended to consume soy more often than now.

Perceived behavior control

There was no difference in the 3-item concept of perceived knowledge for pre vs post responses (z= -0.95, p=0.34). However, when analyzed individually, there were significant differences (Table 3).

In the pre-survey, 50% had no idea whether soy products were more expensive and 37% felt that soy foods were more expensive than other foods. However, 38% felt that price would not have an effect on purchasing more soy. In the post-survey, 35% had no idea whether the soy products were more expensive, 54% felt that soy foods were more expensive than other foods (z=-1.3, p=0.182), and 23% felt price had no impact on their purchasing soy (z=-4.4, p<0.001).

The pre-survey indicated that 59% did not know whether there were enough soy foods on the market, while the post-survey found that reduced to 35%, with more agreeing that there were not enough soy foods on the market (39% vs. 25%, z=-4.0, p<0.001). pre-survey found more believing that the availability of soy foods would make it likely that they would consume soy (44% vs 27% unlikely) while the post-survey found this more pronounced (67% more likely vs 14% unlikely, z=-3.1, p=0.002). Having soy recipes were found to make it more likely for participants to consume soy in the pre-survey, and more so in the post-survey (63% pre, 78% post, z=-3.7, p<0.001).

Association between variables in TRA concerning soy

In the pre-survey, subjective norms (r=.28, p<.001) and perceived knowledge (r=.37, p<.001) showed significant correlations with intention. Individual items significantly correlated with pre-survey intention included price (r=.52, p<0.001), availability (r=0.60, p<0.001), having soy recipes (r=0.87, p<0.001), while no correlation existed with taste and texture perceptions. In the post-survey, intention was also significantly related to subjective norms (r=0.40, p<0.001) and perceived knowledge (r=0.43, p<0.001), as well as price (r=0.52, p<0.001), availability (r=0.60, p<0.001), having soy recipes (r=0.73, p<0.001), while no

Table 3. Frequency of responses concerning perceived knowledge about soy

Questions	n	Extremely unlikely/ strongly disagree	Quite unlikely/ disagree	Slightly unlikely/ Slightly disagree	Neither pleasant (agree) nor unpleasant (disagree)	Slightly likely/ slightly agree	Quite likely/ agree	Extremely likely/ Strongly agree	Interquartile range, 25, 75%	z, p
Benefits[†]										-4.2 <0.001
pre	140	11	9	10	40	38	27	5	3,4	
post	160	9	3	4	25	48	50	21	3,5	
Don't know benefits[‡]										-3.8 <0.001
pre	154	7	4	2	19	24	56	42	4,6	
post	163	4	8	7	17	44	60	23	4,5	
Cooking[§]										-4.4 <0.001
pre	155	4	4	2	14	15	60	56	4,6	
post	164	4	4	14	13	27	71	31	4,5	

[†]Benefits indicates: What I know about the benefits would make it ___for me to consume more soy
[‡]Don't know benefits indicates: I don't know much about health benefits of soy
[§]Cooking indicates: I don't know enough about cooking with soy
[††]Wilcoxon signed rank.

correlation existed with taste and texture perceptions.

Stepwise multiple regression analysis at pre-survey revealed that 42% of the variance in intention to consume/buy soy (dependent variable) could be explained by the model -0.29 + 0.48 (availability) + 0.48 (recipes) ($p<0.001$); and at post-survey revealed that 59% of the variance in intention to consume/purchase soy (dependent variable) could be explained by behavioral control and subjective norms by the model 0.99 + 0.57 (recipes) +0.25 (availability) + 0.32 (subjective norms) ($p<0.001$).

DISCUSSION

Identifying those concerns that are most important to a person's decision about performing a specific behavior can lead to the development of interventions, products, and decision aids to promote desirable behaviors.[22] An important finding in our research was that while many had never tasted soy products, most were willing to do so within the education program. Meanwhile, participants in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) were found reluctant to consume soy foods, including soy milk.[23] Thus, it appears that our participants may have been more open to new foods than younger people.

However, while perceived taste and texture attitudes improved with taste testing, they were not significant in predicting intention to buy or consume. Instead, subjective norms and issues of behavioral control, namely recipes, price, and availability, were important determinants to intention to buy and consume soy products. Finding that subjective norms were significantly related to the intention to buy and consume soy products is consistent with reported findings in another study.[21] Rah et al. found that health care providers and family members were important others who may influence women's soy food intake. The present study did not find a large impact of family among the subjective norm variables, but did find beliefs that health care providers and health experts were important to the participants in terms of advice about soy. Educating these influential people about soy may improve soy consumption and acceptability. Indeed, describing the influence of health experts, health care providers and family as "cues to action", these subjective norms were important in predicting both attitudes and intention to buy iron-fortified soy sauce in China.[24]

Among the possible perceived behavior control factors, having soy recipes ranked as most important, followed by adequate soy health benefit knowledge, availability and price of soy products, both in pre- and post-surveys. Wenrich reported similar results, identifying major barriers to soy consumption as lack of knowledge on how to use soy (87%), cost (55%) and the availability of soy products in their area (45%).[25] Focus groups of consumers and non-consumers of soy (n=53) concluded that the largest barriers to soy consumption were perceived negative physical characteristics of soy foods and perception that soy was a "substitute" food for other more desirable choices.[26] Similar to our study, Schyver et al also found ability to prepare soy foods and availability to be barriers to buying or consuming soy.

As per the correlation and regression analysis, subjective norms and behavioral control were significantly related to soy consumption intention, similar to a previous study of black and white women but without an influence of attitudes towards taste and texture.[21] This is an important finding, as previous work has focused on improving the taste and texture of soy products.[27-29] As previously mentioned, perceived taste and texture were not important determinants in our study.

Though the benefits of soy products have aroused wide research interests, people's awareness of those benefits has remained at a very low level. In this study, we found that more than 80% of those surveyed were unaware of specific soy benefits. Of the 20% responding differently, fewer than half (44%) agreed that soy foods were generally healthy, with more people responding that soy was associated with heart benefits (52%) and diabetes prevention (45%). Similarly, in a mail survey of 770 adults, 39% of male and female subjects in their study did not know of any health benefits associated with soy, and only 4% cited associations with heart disease.[30] This was consistent with other research findings that people were not always sure of the specifics of why soy foods were healthy, though they generally regarded soy food that way.[26]

Though the overall trend of soy consumption is increasing, the results of this study show that people's soy consumption behavior and attitude can still be modified. In both pre-and post-surveys, soy consumption rates were very low, but there were significant changes in intake for tofu and soy baked products ($p<0.01$). This result is consistent with the US Soy Board's finding in 2008, which found that consumers reported the most familiarity with soy milk, soybean oil, soy veggie burgers and tofu.[31]

Several limitations of this research study need to be considered. Most of the participants in this study were of an older age group, which, to a certain extent, may not be representative of general soy consumption patterns. Additionally, those interested in diabetes education may have a different perception of soy foods than a general population, although we have no data to support their being different. Although this study did not have a control group, the findings may be helpful for future education and marketing efforts of soy products. As identified in this study, health benefits, recipes and cooking skills for soy products are important influential factors, and should be given more emphasis during soy food promotion and education. Meanwhile, the availability of soy foods at reasonable prices should be promoted in the market, especially with taste testing sessions.

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AUTHOR DISCLOSURES

There are no conflicts of interests.

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Short Communication

Behavioral control is an important predictor of soy intake in adults in the USA concerned about diabetes

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行為控制對於關注糖尿病的美國成年人的黃豆食品攝取是重要的預測因子

這個研究主要的目的為評估傾向攝取黃豆製品的相關變項，以及找出可能當做營養教育及促進攝取的標靶之主要變項。在三期的糖尿病課程之前後，分別作測試調查，課程重點放在討論及介紹黃豆食品。依照計畫性行為理論去架構問題及變項。主觀性規範及行為控制是預測攝取黃豆食品意圖最重要的因素。具體地說，健康專家及醫護者是重要的主觀規範；可獲性及製備能力是主要的行為控制因子。雖然大部分的參與者在課程中試吃了黃豆製品，味道及質地感覺並未影響關注糖尿病的成年人購買黃豆食品的意向。

關鍵字：黃豆、計畫性行為理論、味道、健康、糖尿病