

Understanding Adherence to 5 Servings of Fruits and Vegetables per Day: A Theory of Planned Behavior Perspective

Chris M. Blanchard, PhD¹; Janet Fisher, PhD²; Phillip B. Sparling, PhD³; Tiffany Hunt Shanks, PhD⁴; Eric Nehl⁵; Ryan E. Rhodes, PhD⁶; Kerry S. Courneya, PhD⁷; Frank Baker, PhD⁸

ABSTRACT

Objective: The primary purpose of the present study was to examine the utility of the Theory of Planned Behavior (TPB) in explaining the 5-A-Day intentions and behavior of college students. A secondary purpose was to determine whether any of the TPB relationships were moderated by gender or ethnicity.

Design: A prospective design that asked college students to complete a baseline TPB 5-A-Day questionnaire and a fruit and vegetable consumption measure 1 week later.

Setting: Undergraduate fitness and health classes at 2 universities in the southern United States.

Participants: 511 college students with a mean age of 19.8 years (standard deviation = 2.71).

Main Outcome Measures: TPB variables and fruit and vegetable consumption.

Analyses: Path analyses and invariance (ie, to examine ethnic and gender moderated) analyses.

Results: Affective attitude ($\beta = .16, P < .05$) and perceived behavioral control ($\beta = .59, P < .05$) were significant predictors of intention, which in turn was a significant predictor of behavior ($\beta = .32, P < .05$). Follow-up invariance analyses showed that none of the TPB relationships was moderated by gender or ethnicity.

Conclusions and Implications: The TPB may be a useful framework on which to base a 5-A-Day intervention for male and female college students of different ethnic backgrounds.

Key Words: 5-A-Day, Theory of Planned Behavior, gender, ethnicity (*J Nutr Educ Behav.* 2009;41:3-10.)

INTRODUCTION

The World Health Organization has identified low fruit and vegetable consumption as a significant risk factor for negative health consequences.¹

Global estimates reveal that low fruit and vegetable consumption is responsible for 31% of ischemic heart disease, 11% of stroke, and 19% of gastrointestinal cancer. Moreover, the majority of Americans (approx-

mately 77%) fail to consume the recommended 5 servings of fruits and vegetables per day (5-A-Day),² with consumption being particularly low among college students (only 7% meet the 5-A-Day recommendation).³ Consequently, college students are in need of a 5-A-Day health promotion intervention.

Although the 5-A-Day guideline is widely accepted within the US and abroad, no studies have specifically examined the correlates of 5-A-Day in a college population, which may be a useful step in the development of a 5-A-Day behavioral intervention.⁴ Different theoretical approaches, such as the stages of change^{5,6} and social cognitive theories,^{7,8} have been employed to explain general fruit and vegetable consumption in noncollege samples; however, one theory that has received increased attention is the Theory of Planned Behavior (TPB).⁴ According to the TPB,⁹ a central predictor of behavior is an individual's intention to perform the behavior. Intention is said to be influenced by 3 factors: attitude, subjective norm,

¹Dalhousie University, Halifax, Nova Scotia, Canada

²Health and Physical Education, School of Education, Clark Atlanta University, Atlanta, Georgia

³School of Applied Physiology, Georgia Institute of Technology, Atlanta, Georgia

⁴School of Psychology, University of Ottawa, Ontario, Canada

⁵Department of Applied Health Science, Indiana University, Bloomington

⁶Behavioral Medicine Laboratory, Kinesiology Program, School of Physical Education, University of Victoria, British Columbia, Canada

⁷Faculty of Physical Education, University of Alberta, Edmonton, Alberta, Canada

⁸Department of Behavioral Sciences and Community Health, School of Public Health, New York Medical College, Valhalla, New York

This project was supported by a Research Centers in Minority Institutions award, #G12RR03062, from the National Center for Research Resources, National Institutes of Health.

Address for correspondence: Chris M. Blanchard, Dalhousie University, Department of Medicine, QEII Health Sciences Centre, Room 205, Centre for Clinical Research, 5790 University Avenue, Halifax, Nova Scotia, Canada B3H 1V7; Phone: (902) 473-3789; Fax: (902) 473-6869; E-mail: Chris.Blanchard@dal.ca

©2009 SOCIETY FOR NUTRITION EDUCATION

doi:10.1016/j.jneb.2007.12.006

and perceived behavioral control. Attitude reflects a person's appraisal of the behavior to be performed. Subjective norm reflects the perceived social pressure to engage or not engage in a behavior. Perceived behavioral control reflects the perceived ease or difficulty of engaging in a behavior, which can be influenced by both past successes and foreseen barriers with the selected behavior.

To date, the limited research examining fruit and vegetable consumption within the TPB has consistently shown that attitudes, subjective norm, and perceived behavioral control are significant predictors of intention in youth¹⁰ and adults.¹¹⁻¹⁶ In terms of behavior, some studies have shown that either intention^{12,13} or perceived behavioral control^{11,14} was the sole predictor of fruit and vegetable consumption, whereas other studies^{10,15,16} found both to be significant predictors. At any rate, the aforementioned studies provide preliminary support for the TPB in explaining fruit and vegetable intake intentions and behavior in noncollege samples.

In addition to the clarification issue surrounding the interrelationships among intention, perceived behavioral control, and fruit and vegetable consumption, there are other limitations that need consideration. First, to date no studies in a college sample have been published. Given the importance placed on context within the TPB,⁹ it would be premature to make generalizations from existing TPB research in other contexts to the college population. Second, there is international acceptance for the 5-A-Day guideline, yet only 1 fruit and vegetable study in a noncollege sample¹⁵ actually used the term "5-A-Day" in the item stems to measure the TPB constructs specific to this behavior. Consequently, developing a potential 5-A-Day campaign for college students based on the general fruit and vegetable consumption literature may not be optimal. Third, previous TPB research pertaining to fruit and vegetable consumption used a singular attitude scale. However, it may be more informative to differentiate affective (eg, eating 5 servings of fruits and vegetables per day is enjoyable) and instrumental (eg, eating 5 servings of fruits and vegetables per day is beneficial) attitudes, as they have

been shown to have differential relationships with intention in the physical activity context.¹⁷⁻¹⁹ Finally, few fruit and vegetable consumption TPB studies have examined potential moderating variables within the theory, and there are none from a 5-A-Day perspective. Identifying potential moderating variables will be very important to better tailor a potential 5-A-Day intervention to the needs of multiple demographic groups simultaneously. Two moderator variables that researchers have suggested to examine when addressing fruit and vegetable consumption are gender and ethnicity.^{10,14,20} Unfortunately, the aforementioned studies produced inconclusive results pertaining to gender, suggesting the need for further examination, particularly within the TPB. Additionally, no studies have examined the role of ethnicity within the TPB from a fruit and vegetable perspective. However, physical activity studies in the college population have shown that the affective attitude/intention relationship is significantly stronger for black students when compared to white students, and the instrumental attitude/intention relationship is significantly stronger for white students when compared to black students.^{17,21} Additionally, the strength of the intention/PA relationship has also been shown to be moderated by ethnicity (ie, the relationship was significantly stronger for white students compared to black students).²¹ Therefore, examining the moderating role of gender and ethnicity within the TPB is warranted.

The primary purpose of the present study was to examine the utility of the global TPB constructs in explaining fruit and vegetable consumption from a 5-A-Day perspective in a college sample over a 1-week period. Based on the research outlined above, it was hypothesized that subjective norm and perceived behavioral control would significantly predict 5-A-Day intentions. However, as previous TPB studies related to fruit and vegetable consumption have not differentiated affective and instrumental attitude, it was hypothesized that affective attitude would be the dominant attitudinal predictor of 5-A-Day intention based on physical activity research. Finally, given the contradictory results pertaining to the relationships

between fruit and vegetable consumption and intention/perceived behavioral control, it was hypothesized that both would significantly predict 5-A-Day consumption.

The second purpose of the present study was to determine whether any of the TPB relationships regarding 5-A-Day were moderated by gender and ethnicity. As previous research has been inconsistent regarding the role of gender and ethnicity within the TPB from a fruit and vegetable perspective,^{10,14} the null hypothesis was tested (ie, gender and ethnicity would not moderate the TPB relationships).

METHODS

Participants

The initial sample (N = 511) was obtained from a variety of undergraduate fitness and health classes from 2 universities. They had a mean age of 19.8 years (SD = 2.7 years) and a mean body mass index (BMI) of 24.0 (SD = 4.7). Additionally, 49.7% were female, and 29.0% were employed. The students were primarily black (47.2%) or white (39.1%), and the remaining 13.5% were Asian and Hispanic students. The majority (64%) lived in a dorm, whereas the remaining students lived in an off-campus apartment (20.6%) or house (14.7%). Finally, 49.7% were freshmen, 23.4% were sophomores, 15.4% juniors, and 11.6% seniors.

Procedure

Students were recruited from 2 universities located in a major city in the United States. Ethical approval was obtained from the Institutional Review Boards of both universities. The TPB questionnaire was administered following a standardized procedure (ie, the study was explained, the students were informed orally and in writing that they were not required to participate, written consent was obtained, and the TPB questionnaire was implemented) in a variety of undergraduate health and fitness classes. After completion of the questionnaire, they were given an American Cancer Society t-shirt. One week later, students were given a 1-page questionnaire that contained 6 questions from the behavioral risk factor

surveillance system (BRFSS)²² to measure the past week's fruit and vegetable consumption, after which they were given a \$10.00 grocery coupon. To ensure the students' anonymity and allow the researchers to match the Time 1 and Time 2 questionnaire, the last 4 digits of the students' social security numbers were used. All data were collected within the same 1-week time period at both universities.

Measures

Demographics. These were assessed by self-report and consisted of age, gender, ethnicity, height, weight, residence (on or off campus), employment status, and year in school.

Prior to completing the TPB questionnaire, students were provided numerous examples of a serving size for fruit (1 medium piece of fruit, $\frac{1}{2}$ cup of fruit salad, etc.) and vegetable (1 medium carrot or other fresh vegetable, $\frac{1}{2}$ cup of fresh or cooked vegetables, etc.), and any ambiguities were clarified.

Attitude. This was measured with four 7-point, semantic, differential adjective scales that tapped both instrumental (harmful-beneficial, bad-good) and affective (boring-fun, unenjoyable-enjoyable) aspects of attitude.⁹ The verbal descriptors were extremely (points 1 and 7), quite (points 2 and 6), and slightly (points 3 and 5). The statement that preceded the list of adjectives was: "During the next week, for me to eat 5 servings of fruits and vegetables each day will be . . ." Internal reliability was good for the instrumental ($\alpha = .79$) and affective ($\alpha = .69$) scales.

Subjective norm. This was measured by 3 items suggested by the TPB⁹ and were rated on 7-point scales that ranged from 1 (strongly disagree) to 7 (strongly agree). The 3 items were embedded within the following stem: "During the next week, most people important to me (*insert item here*) eat 5 servings of fruits and vegetables each day." The 3 items were (1) think I should, (2) approve of me, and (3) support me. Internal reliability was good ($\alpha = .77$).

Perceived behavioral control. This was measured by 3 items suggested

by the TPB.⁹ The items were: (1) "During the next week, how confident are you that you can eat 5 servings of fruits and vegetables each day?" rated on a scale from 1 = not at all confident to 7 = extremely confident; (2) "During the next week, for me to eat 5 servings of fruits and vegetables each day will be . . ." rated on a scale from 1 = extremely difficult to 7 = extremely easy; and (3) "During the next week, if I wanted to, I could easily eat 5 servings of fruits and vegetables each day," rated on a scale from 1 = strongly disagree to 7 = strongly agree. Internal reliability was good ($\alpha = .81$).

Intention. This was assessed by 2 items suggested by the TPB.⁹ The items were: (1) "During the next week, I intend to eat 5 servings of fruits and vegetables each day," rated on a scale from 1 = strongly disagree to 7 = strongly agree; and (2) "During the next week, my goal is to eat 5 servings of fruits and vegetables (*insert a number from 0 to 7*) ____ days per week." Given the different scaling formats, the items were converted to z scores prior to aggregation. Internal reliability was good ($\alpha = .74$).

Fruit and vegetable consumption. This was measured by slightly modifying the 6 items taken from the nutrition module of the behavioral risk factor surveillance system (BRFSS),²² which is an annual data collection program designed to measure behavioral risk factors in the adult population 18 years of age or older living in households across the United States. Specifically, students were asked, "During the past week, on average, how many times per day did you (1) drink fruit juices (eg, orange, grapefruit); (2) eat fruit; (3) eat green salad; (4) eat potatoes, not including fries, fried potatoes, or potato chips; (5) eat carrots; and (6) eat vegetables, not counting carrots, potatoes, or salad?" to which the participants responded via an open-ended scale. The 6 items were summed to obtain an overall score that represented the total number of fruit and vegetable servings per day. The current modification was used to ensure measurement congruence from a time interval perspective between the TPB predictors and behavior (ie, that all

variables were measured using a "1-week" time frame). The original BRFSS questions did not allow the authors to follow this procedure, given that it provides options to answer the aforementioned 6 questions using per day, per week, per month, and per year time frames.

Analytical Strategy

Prior to conducting the main analyses, preliminary analyses were conducted to determine recruitment rates and the pattern of missing data using the SPSS missing value analysis (SPSS version 15.0, SPSS Inc., Chicago, IL, 2007). Specifically, the authors examined the Little's chi-square test to determine whether the follow-up data were missing completely at random (the probability that X_i is missing is unrelated to the value of X_i or other variables in the data set) and the separate variance t test to determine whether the data were missing at random (the data meet the requirement that missing data do not depend on the value of X_i after controlling for another variable).²³ Once determined, descriptive and zero-order correlations among the TPB constructs overall and by gender and ethnicity were calculated. Next, path analyses were conducted using maximum likelihood procedures in Linear Structural Relations, version 8.8 (Scientific Software International, Inc., Lincolnwood, Ill, 2006). The comparative fit index (CFI) and incremental fit index (IFI) were used to determine the adequacy of model fit, which had a model acceptability cut point of > 0.94 .²⁴ The first path analysis tested the TPB (Figure 1) for the entire sample (ie, for black, white, Asian, and Hispanic students) (Purpose 1). To determine whether the TPB was moderated by gender and ethnicity (Purpose 2), the structural coefficients were subjected to an invariance analysis.²⁵ Specifically, an unconstrained model (eg, the baseline structural coefficients for male and female students) was compared to a model that constrained the structural coefficients to be equal between groups. To determine moderation, the change in the CFI was used (ie, a change $> .01$ is recommended to reject the invariant null hypothesis and argue for moderation).²⁶ The same analysis was conducted for

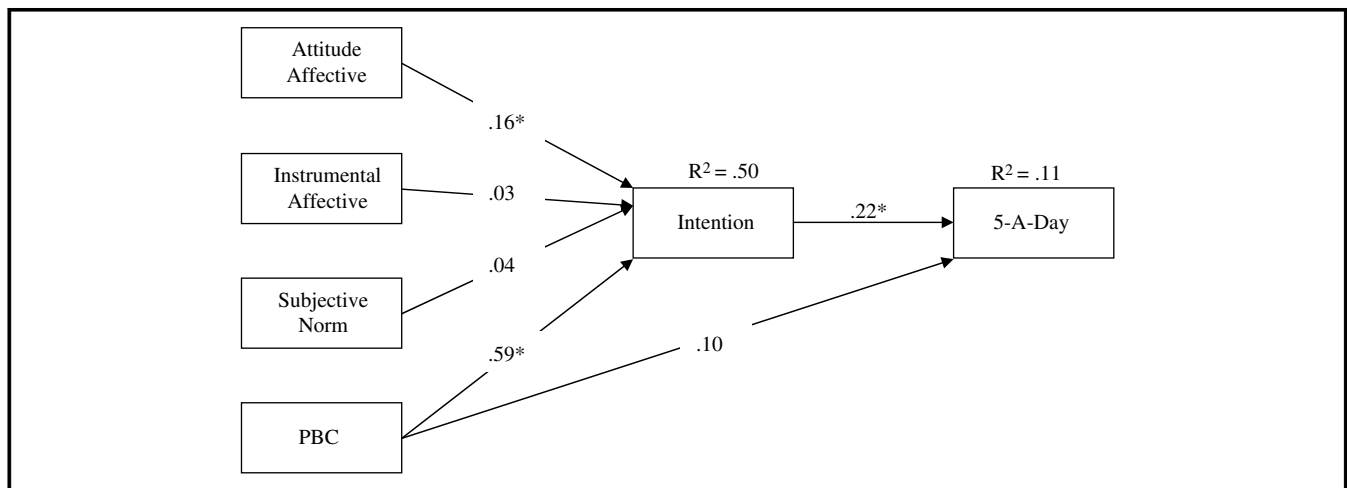


Figure 1. Theory of planned behavioral structural coefficients for the combined sample.

PBC indicates perceived behavioral control.

Note. * $P < .05$; R^2 = variance explained.

ethnicity. Finally, given the potential measurement incongruity between the TPB predictor stems (ie, which used a dichotomous-graded scaling format) that focused specifically on 5-A-Day and behavior (ie, which was measured using an open-ended scaling format), the behavior measure was rescaled into 0 = did not meet 5-A-Day guideline versus 1 = met 5-A-Day guideline. A binary logistic regression was then conducted separately for males and females using intention and perceived behavioral control as the predictors of behavior followed by a combined model examining potential gender interactions. The same analysis was conducted for ethnicity.

RESULTS

In total, 541 students were invited to participate, and 511 (94.5%) agreed to do so. The reasons provided for nonparticipation pertained to lack of time and interest. Although complete data were available at baseline for all 511 participants, 95 participants (18.6%) did not complete the 1-week fruit and vegetable assessment because of nonattendance at follow-up. The missing value analysis showed that the follow-up fruit and vegetable assessment was missing at random. Unfortunately, using listwise deletion when one has data missing at random may lead to biased estimates. Therefore, missing values were imputed using the expectation maximization algorithm in SPSS, version 14.²³ Basic

descriptive and zero-order correlations among the TPB constructs overall and by gender/ethnicity are presented in the Table. One-way analyses of variance (ANOVAs) showed that females had significantly higher affective attitudes ($F[1,503] = 13.08$, $P < .001$); instrumental attitudes ($F[1,503] = 15.59$, $P < .001$); subjective norms ($F[1,503] = 24.49$, $P < .001$); and intentions ($F[1, 503] = 7.37$, $P < .01$) compared to males. For ethnicity, results showed that black students had significantly higher affective attitudes ($F[1,433] = 9.78$, $P < .002$); instrumental attitudes ($F[1,433] = 5.11$, $P < .03$); subjective norms ($F[1,433] = 11.45$, $P < .001$); perceived behavioral control ($F[1,433] = 4.29$, $P < .04$); and fruit and vegetable intake ($F[1,433] = 31.71$, $P < .001$) compared to whites.

In terms of the path analyses, results showed that the model had an adequate fit for the combined sample (CFI and IFI = .99). As can be seen from Figure 1, 50% of the variance was explained in intention, which was significantly predicted by affective attitude and perceived behavioral control. Furthermore, intention significantly predicted fruit and vegetable consumption and accounted for 11% of its variance. The invariance analyses showed that the unconstrained and constrained models had CFIs and IFIs of .99, suggesting the TPB was invariant by gender (Figure 2) and ethnicity (Figure 3).

Frequency counts showed that 81% of males and 83% of females,

and 88% of black and 78% of white students, met the 5-A-Day recommendation. The binary logistic regressions showed that intention significantly predicted 5-A-Day in males ($\beta = .58$, $P < .001$) and females ($\beta = .41$, $P < .001$), whereas perceived behavioral control did not (Hosmer and Lemeshow $\chi^2 [8] = 4.92$, $P > .05$ for males and $\chi^2 [8] = 6.45$, $P > .05$ for females, suggesting the models adequately fit the data). The follow-up analysis showed that gender did not moderate any of the relationships. For ethnicity, 5-A-Day was also significantly predicted by intention for black ($\beta = .66$, $P < .001$) and white ($\beta = .50$, $P < .001$) students (Hosmer and Lemeshow $\chi^2 [8] = 6.04$, $P > .05$ for blacks and $\chi^2 [8] = 4.74$, $P > .05$ for whites, suggesting these models also adequately fit the data); however, ethnicity did not moderate these relationships. As such, the path analysis and logistic regressions produced the same results. Finally, the analyses were also conducted using the nonimputed fruit and vegetable consumption variable as the dependent variable, and the same predictors emerged and the invariance results were replicated in all cases.

DISCUSSION

The primary purpose of this study was to determine whether the TPB explained intentions and consumption of 5 servings of fruits and vegetables per day in a college sample over a 1-week period. The hypothesis that

Table. Descriptives and Zero-order Correlations Among the Theory of Planned Behavior Model Constructs Overall and by Gender

Construct	2.	3.	4.	5.	6.	Mean	SD
<i>Combined</i>							
1. Attitude - Affective	.36***	.35***	.49***	.47***	.21***	4.98	1.23
2. Attitude - Instrumental		.46***	.26***	.26***	.12**	6.49	.69
3. Subjective Norm			.34***	.31***	.17**	6.08	.99
4. PBC				.69***	.30***	5.65	1.21
5. Intention					.32***	5.06	1.52
6. 5-A-Day						7.29	3.29
<i>Males</i>							
1. Attitude - Affective	.39***	.29***	.49***	.45***	.19***	4.79	1.28
2. Attitude - Instrumental		.43***	.31***	.25***	.19***	6.37	.72
3. Subjective Norm			.32***	.27***	.16***	5.86	1.08
4. PBC				.67***	.28***	5.57	1.26
5. Intention					.31***	4.88	1.56
6. 5-A-Day						7.33	3.34
<i>Females</i>							
1. Attitude - Affective	.29***	.39***	.46***	.47***	.24***	5.18	1.16
2. Attitude - Instrumental		.45***	.20***	.24***	.06	6.61	.66
3. Subjective Norm			.35***	.33***	.18**	6.29	.85
4. PBC				.68***	.32***	5.74	1.17
5. Intention					.33***	5.25	1.46
6. 5-A-Day						7.31	3.25
<i>Blacks</i>							
1. Attitude - Affective	.39***	.45***	.47***	.44***	.12	5.15	1.26
2. Attitude - Instrumental		.50***	.21***	.19**	.09	6.57	.73
3. Subjective Norm			.38***	.31***	.07	6.24	.95
4. PBC				.69***	.23***	5.78	1.16
5. Intention					.26***	5.14	1.39
6. 5-A-Day						8.22	3.47
<i>Whites</i>							
1. Attitude - Affective	.28***	.25***	.47***	.48***	.28***	4.79	1.15
2. Attitude - Instrumental		.42***	.28***	.30***	.09	6.43	.65
3. Subjective Norm			.30***	.33***	.16*	5.92	1.01
4. PBC				.69***	.35***	5.54	1.24
5. Intention					.41***	5.05	1.59
6. 5-A-Day						6.47	2.90

PBC indicates perceived behavioral control; SD, standard deviation; 2, Attitude-Instrumental; 3, Subjective Norm; 4, Perceived Behavioral Control; 5, Intention; 6, 5-A-Day.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

affective attitude would be the dominant attitudinal predictor was supported. Although this finding is novel to the TPB literature from a fruit and vegetable perspective, it is consistent with a growing body of TPB/physical activity literature.¹⁷⁻¹⁹ Such a finding suggests the importance of reinforcing the affective component of attitude if the goal in college students is to change an intention to eat 5 servings of fruits and vegetables per day. This point is reiterated by the fact that examination of the means and standard deviations in

the Table shows that a ceiling effect is present for the instrumental attitude scale. Interestingly, this finding may suggest a measurement problem with the scale, or it emphasizes the point that college students who participate in health and fitness classes may already be well aware of the benefits of eating 5 servings of fruits and vegetables per day and that focusing on promoting the benefits of 5-A-Day is unnecessary. Given the preliminary nature of this study, however, replicating the independent effects of affective and instrumental

attitude on a 5-A-Day intention is warranted.

Given that previous literature consistently found a significant relationship between subjective norm and intention from a fruit and vegetable perspective,^{11-13,15,16} it was a bit surprising that this relationship was not significant in the current study. However, this result may be a result of sampling differences (eg, the age and ethnic make-up of the sample compared to previous studies), the different time intervals examined across studies, a potential ceiling effect of

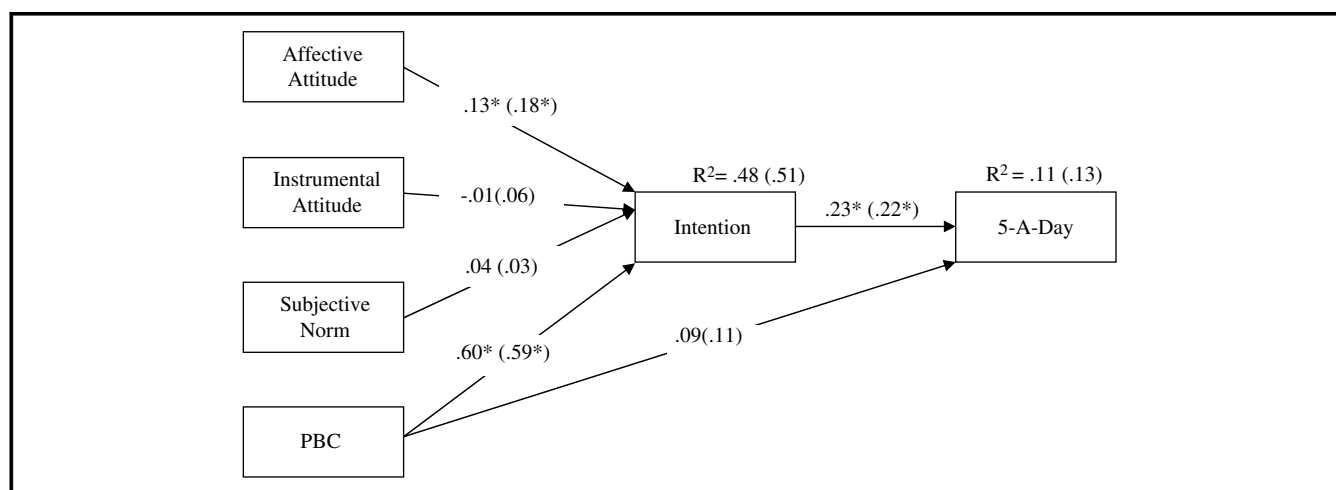


Figure 2. Theory of planned behavior structural coefficients by gender.

PBC indicates perceived behavioral control.

Note. * $P < .05$; R^2 = variance explained; female structural coefficients are in parentheses and the male coefficients are not.

the subjective norm variable, or the fact that attitude was differentiated via the affective/instrumental distinction that previous studies did not take into account. Whatever the case may be, perceived social pressure to consume 5 servings of fruits and vegetables per day appears to have little effect, in college students, on forming an intention to do so. However, this statement does not negate the fact that other, more “direct” measures of social support may play a significant role in influencing such an intention.^{11-13,15,16,27} Future studies should explore this issue before concluding that a social component may not be

needed in a 5-A-Day intervention for college students.

Perceived behavioral control was the strongest predictor of intention, which is consistent with previous literature.^{11,12,14} Of note, however, is the fact that perceived behavioral control's association with intention was $3\frac{1}{2}$ times larger than the association between affective attitude and intention. Therefore, it is clear that an intervention aimed at increasing intentions to eat 5 fruits and vegetables per day needs to include strategies to increase the students' sense of control to engage in this behavior as a central component. Of particular importance

will be identifying the key barriers (cost of fruits and vegetables, not having a place to store or prepare fruits and vegetables in a dorm room, etc.) and facilitators (increasing fruit and vegetable access across campus, providing a variety of fruits and vegetables in cafeterias, etc.) from a 5-A-Day perspective in college students to maximize the potential to alter the student's perceived control to perform the behavior.⁹

From a behavioral perspective, results showed that intention was the sole predictor of fruit and vegetable consumption in the college sample in the path and logistic analyses.

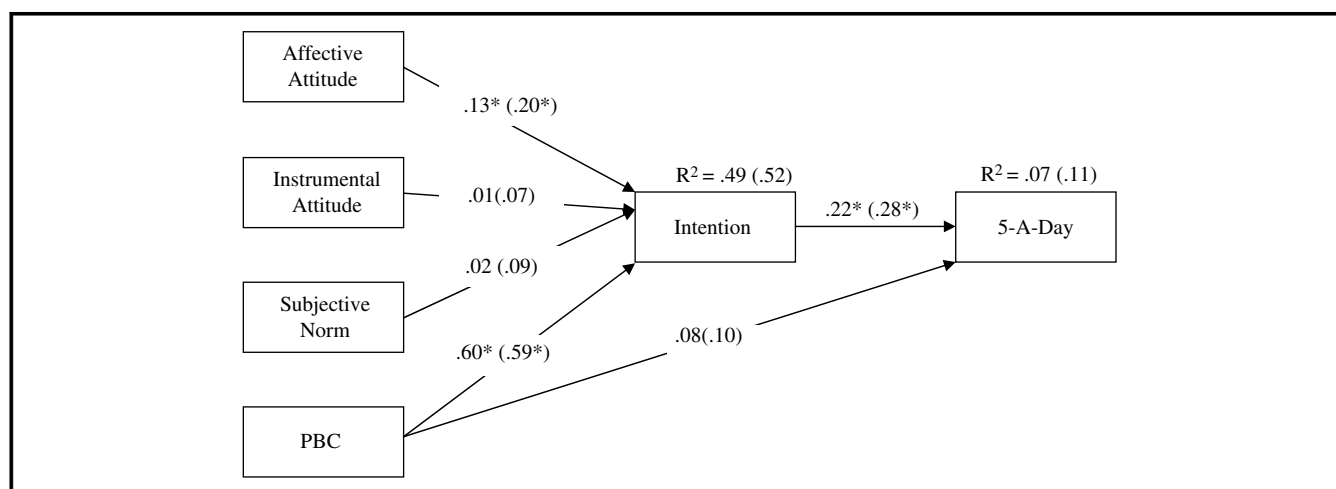


Figure 3. Theory of planned behavior structural coefficients by ethnicity.

PBC indicates perceived behavioral control.

Note. * $P < .05$; R^2 = variance explained; white structural coefficients are in parentheses and the black coefficients are not.

This finding is consistent with Brug et al,¹² however, it is inconsistent with Kvaavik et al¹⁴ and Bogers et al,¹¹ who showed that intention did not predict fruit and vegetable consumption. Within these studies, perceived behavioral control was the lone predictor. This is an interesting finding, because the TPB suggests that intention will be the strongest predictor of fruit and vegetable consumption when it is perceived to be under the students' volitional control, whereas perceived behavioral control will be the strongest predictor when it is not perceived to be under their volitional control.⁹ Therefore, the current finding is potentially promising, because an intervention aimed at increasing fruit and vegetable consumption will more likely be met with success when students believe they have actual control over changing their behavior versus believing they have no control in doing so. However, given the inconsistencies in the literature regarding this issue, which may be partly owing to the lack of measurement congruency for fruit and vegetable intake across studies, replication is warranted using similar fruit and vegetable intake questionnaires.

Based on recent calls to examine moderating variables when examining fruit and vegetable consumption, the current study examined the potential effects of gender and ethnicity. Although gender has been found to moderate the attitude/intention relationship¹⁰ and PBC/behavior relationship¹⁴ in previous fruit and vegetable research, there were no studies that examined the potential moderating effect of ethnicity. In the current study, results showed that neither gender nor ethnicity moderated any TPB relationships. Importantly, this finding may be interpreted in one of 2 ways. First, one could argue that the TPB measures were not gender and/or ethnic specific enough to capture potential differences within the theory. However, the gender TPB studies outlined in the above sentences used the same global item approach as used in the current study and found moderating effects for both variables. Furthermore, the ANOVAs in the current study showed significant gender and ethnic differences for attitudes, subjective norms, perceived behavioral control, and intentions. Therefore,

this argument may not hold true. Second, the current finding could be viewed very positively from an intervention standpoint, because the development of a gender- and/or ethnic-specific 5-A-Day intervention would be more costly and time consuming compared to the development of a more global intervention. Nonetheless, the role of gender and ethnicity within the TPB from a fruit and vegetable perspective remains in its infancy, and further research is needed.

Despite the inherent strengths of the current study (ie, the novelty of assessing 5-A-Day in a college population, moderating role of gender and ethnicity, differentiating affective and instrumental attitude), there are limitations that need to be considered. First, there may have been a selection bias in the sample resulting from the convenience sampling of fitness and health classes, as evidenced by the very positive beliefs and high rate of fruit and vegetable consumption. Therefore, it will be important that future studies attempt to randomly select students to increase the representativeness of the sample. Second, the current study used the fruit and vegetable consumption items modified from the BRFSS.²² Although validated, the modification of these items likely led to an overestimation of actual fruit and vegetable intake that future studies could resolve by using a food frequency questionnaire or dietary records. Third, the underlying accessible beliefs were not included in the present study. Given that the TPB suggests that attitudes, subjective norms, and perceived behavioral control are assumed to be based on these underlying accessible beliefs, behavioral interventions must try to change the beliefs that ultimately guide the performance of the behavior.⁹ Therefore, identifying common and gender- and ethnic-specific beliefs in future studies that are statistically associated with the global constructs will provide invaluable information when developing a 5-A-Day intervention in college students. Finally, student and/or family income was not assessed in the current study. Given the costs associated with meeting the 5-A-Day recommendation, this is something that should be considered in future studies.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Notwithstanding the above limitations, the present study demonstrated that affective attitudes and perceived behavioral control are significant predictors of 5-A-Day intention, which in turn is a significant predictor of 5-A-Day behavior in a college sample. Furthermore, the magnitude of these effects was the same for male versus female and black versus white students; however, females and blacks had much more positive beliefs than males and whites about fruit and vegetable consumption. Given that Baranowski et al²⁸ emphasize the importance of using theory to develop nutrition-based interventions, the present study's results suggest that the TPB may be one theory that can be used to guide the development of a 5-A-Day intervention in college students. Importantly, researchers in future studies should pay particular attention to identifying the key behavioral and control beliefs that underlie affective attitude and perceived behavioral control to further inform a 5-A-Day intervention for college students.

ACKNOWLEDGMENT

This project was supported by a Research Centers in Minority Institutions award, #G12RR03062, from the National Center for Research Resources, National Institutes of Health.

REFERENCES

1. World Health Organization. Diet and physical activity: a public health priority. Available at: <http://who.int/dietphysicalactivity/en/>. Accessed October 15, 2008.
2. National Center for Chronic Disease Prevention and Health Promotion. Behavioral risk factor surveillance system: trends data, nationwide, not enough fruit and vegetables. Available at: <http://apps.nccd.cdc.gov/brfss/list.asp?cat=FV&yr=2007&qkey=4415&state=All>. Accessed January 18, 2008.
3. American College Health Association. American College Health Association National College Health Assessment (ACHA-NCHA) spring 2005 reference

- group data report. *J Am Coll Health*. 2006;55:5-16.
4. Baranowski T, Cullen KW, Nicklas T, Thompson D, Baranowski J. Are current health behavioral change models helpful in guiding prevention of weight gain efforts? *Obes Res*. 2003;11(suppl):23S-43S.
 5. Beech BM, Rice R, Myers L, Johnson C, Nicklas T. Knowledge, attitudes and practices related to fruit and vegetable consumption of high school students. *J Adolesc Health*. 1999;24:244-250.
 6. Cullen K, Bartholomew LK, Parcel GS, Koehly L. Measuring stage of change for fruit and vegetable consumption in 9 to 12 year old girls. *J Behav Med*. 1998;21:241-254.
 7. Baranowski T, Davis M, Resnicow K, Baranowski J, Doyle C, Lin LS. Gimme 5 fruit, juice and vegetables for fun and health: outcome evaluation. *Health Educ Res*. 2000;27:96-111.
 8. Resnicow K, Davis-Hearn M, Smith M, Baranowski T, Lin LS, Baranowski J, et al. Social cognitive predictors of fruit and vegetable intake in children. *Health Psychol*. 1997;16:272-276.
 9. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50:179-211.
 10. Lien N, Lytle LA, Komro KA. Applying theory of planned behavior to fruit and vegetable consumption of young adolescents. *Am J Health Promot*. 2002;16:189-197.
 11. Bogers RP, Brug J, van Assema P, Dagnelie PC. Explaining fruit and vegetable consumption: the theory of planned behavior and misconception of personal intake levels. *Appetite*. 2004;42:157-166.
 12. Brug J, de Vet E, de Nooijer J, Verplanken B. Predicting fruit consumption: cognitions, intention, and habits. *J Nutr Educ Behav*. 2006;38:73-81.
 13. Conner M, Norman P, Bell R. The theory of planned behavior and healthy eating. *Health Psychol*. 2002;21:194-201.
 14. Kvaavik E, Lien N, Tell G, Klepp K. Psychosocial predictors of eating habits among adults in their mid-30s: the Oslo Youth Study follow-up 1991-1999. *Int J Behav Nutr Phys Act*. 2005;2:1-11.
 15. Povey R, Conner M, Sparks P, James R, Shepherd J. Application of the theory of planned behavior to two dietary behaviors: roles of perceived control and self-efficacy. *Br J Health Psychol*. 2000;5:121-139.
 16. Sjoberg S, Kyungwon K, Reicks M. Applying the theory of planned behavior to fruit and vegetable consumption by older adults. *J Nutr Elder*. 2004;23:35-46.
 17. Blanchard CM, Rhodes RE, Nehl E, Fisher J, Sparling P, Courneya KS. Ethnicity and the theory of planned behavior in the exercise domain. *Am J Health Behav*. 2003;27:579-591.
 18. Rhodes RE, Blanchard CM. Conceptual categories or operational constructs? Evaluating higher order theory of planned behavior structures in the exercise domain. *Behav Med*. 2006;31:141-150.
 19. Rhodes RE, Blanchard CM, Matheson DH. A multicomponent model of the theory of planned behavior. *Br J Health Psychol*. 2006;11:119-137.
 20. Weber Cullen K, Baranowski T, Owens E, et al. Ethnic differences in social correlates of diet. *Health Educ Res*. 2002;17:7-18.
 21. Blanchard C, Fisher J, Sparling P, Nehl E, Rhodes R, Courneya K, et al. Understanding exercise behavior in African-American and Caucasian college students: an application of the theory of planned behavior. *J Am Coll Health*. 2008;56:341-346.
 22. Centers for Disease Control and Prevention. *Behavioral Risk Factor Surveillance System Survey Questionnaire*. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention; 2002.
 23. Allison PD. *Missing Data Series: Quantitative Applications in the Social Sciences*. Thousand Oaks, CA: Sage Publications; 2002.
 24. Hu L, Bentler PM. Cutoff criteria for fit indices in covariance structure analysis: conventional criteria versus new alternatives. *Struct Eq Model*. 1999;6:1-55.
 25. Byrne BM, Shavelson RJ, Muthen B. Testing for the equivalence of factor covariance and means structures: the issue of partial measurement invariance. *Psychol Bull*. 1989;105:456-466.
 26. Cheung G, Rensvold R. Evaluating goodness-of-fit indexes for testing measurement invariance. *Struct Eq Mod*. 2002;9:233-255.
 27. Armitage CJ, Conner M. Efficacy of the theory of planned behavior: a meta-analytic review. *Br J Soc Psychol*. 2001;40:471-499.
 28. Baranowski T, Cullen K, Baranowski J. Psychosocial correlates of dietary intake: advancing dietary intervention. *Ann Rev Nutr*. 1999;19:17-40.