



Psychiatry

Interpersonal and Biological Processes

ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/upsy20>

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To cite this article: Ardhys N. De Leon, Roselyn Peterson, Robert D. Dvorak, Angelina V. Leary, Matthew P. Kramer, Emily K. Burr, Ethan M. Toth & Daniel Pinto (2022): The Health Belief Model in the Context of Alcohol Protective Behavioral Strategies, *Psychiatry*, DOI: [10.1080/00332747.2022.2114270](https://doi.org/10.1080/00332747.2022.2114270)

To link to this article: <https://doi.org/10.1080/00332747.2022.2114270>



Published online: 14 Oct 2022.



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The Health Belief Model in the Context of Alcohol Protective Behavioral Strategies

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Objective: Alcohol use continues to be prevalent and problematic among young adult samples. Protective behavioral strategies (PBS), which are harm reduction strategies utilized while drinking, have been linked to decreased alcohol use and subsequent alcohol-related problems. An individual's likelihood of adopting PBS and other health behaviors, according to The Health Belief Model (HBM), is dependent on perceived susceptibility to and severity of adverse health outcomes, as well as perceived benefits and barriers related to implementing those behaviors. The present study examined whether the perceived effectiveness of PBS in the context of the HBM leads to an increase in PBS use.

Method: The analytic sample ($n = 694$ college students, $M_{\text{age}} = 20.21$, $SD = 4.37$, 63.26% female, 72.05% Caucasian) self-reported demographics, weekly alcohol consumption (i.e., frequency, intensity, and quantity), alcohol-related problems, use of PBS, and perceived effectiveness of PBS use. A latent variable model was used to test the effect

Ardhys N. De Leon is a fourth-year graduate student in the Clinical Psychology PhD program at the University of Central Florida. She is interested in investigating the relationship between protective behavioral strategies, mood, and sociocultural factors in the context of alcohol use. Furthermore, her aim is to develop a brief alcohol intervention for Hispanic/Latinx individuals. *Roselyn Peterson* is a sixth-year student in the Clinical Psychology PhD program at the University of Central Florida. Her specific research interests include the relationship between protective behavioral strategies and regretted sexual experiences in the context of substance use. *Robert D. Dvorak* received his PhD in Clinical Psychology from the University of South Dakota. He is currently an Assistant Professor in the Clinical Psychology program at the University of Central Florida. Dr. Dvorak's lab focuses on health-risk behavior through the lens of cognitive, emotional, and behavioral self-regulation. Most risky behavior involves strong proximal appetitive drives coupled with weaker distal avoidant drives. Understanding these drivers is important for the development of interventions to reduce risky/maladaptive behavior. *Angelina V. Leary* is a fourth-year graduate student in the Clinical Psychology PhD program at the University of Central Florida. She is interested in researching college student's alcohol use, particularly first-time-in-college (FTIC) students, and interventions that use technology. She is also interested in interventions that increase Protective Behavioral Strategies in this population. *Matthew P. Kramer, PhD*, is a psychologist at Sanford Health in Fargo, North Dakota. He received his PhD in Clinical Psychology from the University of Central Florida. His research interest involves investigating psychopathy, narcissism, how individuals with these traits utilize protective behavioral strategies, and how they influence peer's regarding device from norms and maladaptive behaviors. *Emily K. Burr* is a third-year doctoral student in the Clinical Psychology PhD program at the University of Central Florida. She is currently interested in investigating the role of poor self-regulation, particularly emotion regulation deficits, in maladaptive eating behaviors. More broadly, she is generally interested in compulsive behaviors associated with adverse health outcomes. *Ethan Toth* is a post-baccalaureate research assistant and project manager for the Reale-Time Lab at the University of Central Florida. His research interests include expectancy effects, technologically mediated addictive behaviors, and psychedelic-assisted therapy. *Daniel Pinto* is a fourth-year graduate student in the Clinical Psychology PhD program at the University of Central Florida. Overall, his research aims to investigate the specific factors that are implicated in one's decision to initiate and maintain substance use. Specifically, he is interested in the etiological role that impulsivity plays in substance dependency and related disorders.

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of perceived PBS effectiveness on PBS use, alcohol consumption, and alcohol-related problems.

Results: Perceived PBS effectiveness was associated with a higher likelihood of using PBS subtypes (Manner of Drinking, Stopping/Limiting Drinking, and Serious Harm Reduction), which in turn was associated with reductions in alcohol consumption and problems.

Conclusions: These findings suggest that increasing perceptions of PBS effectiveness may lead to more PBS use, decreased alcohol consumption, and fewer alcohol-related problems. Future research could implement longitudinal methodology to assess attempts to increase perceived effectiveness of PBS use and potentially establish a causal link between these perceptions, PBS use, and alcohol-related outcomes.

INTRODUCTION

College student alcohol use continues to be a significant public health concern (Dvorak et al., 2020). For many college students, moving away from home incurs inherent difficulties transitioning from adolescence to adulthood (Arnett, 2000), including increased academic demands, heightened vulnerability to stress, and navigating new social networks (Arria & Jernigan, 2018; White et al., 2005). When compared to non-college-attending same-aged peers, these factors are believed to place college students at a higher risk for engaging in problematic alcohol-use (Del Boca et al., 2004). Recent data from the National Survey on Drug Use and Health shows that 53.6% of college students consume alcohol monthly (Substance Abuse and Mental Health Services Administration [SAMHSA], 2018). Furthermore, 34.8% engage in monthly binge-drinking (i.e., four or more drinks for women and five or more drinks for men in one occasion), and 9.7% engaged in monthly heavy alcohol use (i.e., binge drinking five or more days in the past month; SAMHSA, 2018).

Several consequences are associated with excessive alcohol-use among college students. These consequences include poor academic performance (Engs et al., 1996; Wechsler et al., 2002; Presley and Pimentel, 2006; Singleton, 2007; Liguori and Lonbaken, 2015), memory impairment due to alcohol blackouts (Goodwin, 1995), alcohol overdose (Miller and

Gold, 1991; World Health Organization [WHO], 2009; Zagrosek et al., 2010), physical and sexual assault (Mohler-Kuo et al., 2004; Hingson et al., 2005; Kaysen et al., 2006; Krebs et al., 2007; Zinzow and Thompson, 2015), significant health problems (e.g., risk of heart attack, stroke, and insomnia; Popovici and French, 2013), driving under the influence (Terry and Terry, 2016), injuries, fatalities, (Hingson et al., 2009; White and Hingson, 2013) and suicide attempts (SAMHSA, 2018). Given the incidence of alcohol-related problems among college student populations, extensive research has focused on viable methods for reducing the occurrence of these consequences. One such method to reduce rates of negative alcohol-related problems is the incorporation of protective behavioral strategies (PBS) as an intervention component for college students (Martens et al., 2004). The present study considers the health belief model (i.e., the belief that the more effective we believe a behavior is the more likely we are to engage in it) in the context of PBS in order to determine whether perceived PBS increases the likelihood of actual PBS use.

PROTECTIVE BEHAVIORAL STRATEGIES

Protective behavioral strategies (PBS) are specific behaviors an individual can engage in to reduce both alcohol use, alcohol-related consequences, and other health risk behaviors (Borden et al., 2011; De Leon, Peterson et al.,

2022; Dvorak et al., 2015, 2016; Martens et al., 2007; Pearson, 2013). PBS are comprised of three subtypes: Manner of Drinking (MD; e.g., avoid mixing different types of alcohol), Stopping/Limiting Drinking (SLD; e.g., determine not to exceed a set number of drinks), and Serious Harm Reduction (SHR; e.g., use a designated driver). Research has shown that engaging in PBS is associated with reductions in both alcohol use and related consequences (Martens et al., 2004; Kenney and LaBrie, 2013), with each subcategory of PBS having unique associations with alcohol use and consequences. For example, MD PBS is inversely associated with alcohol use, while SHR PBS is inversely associated with alcohol consequences (Martens et al., 2011). This makes theoretical sense, as MD PBS address how one drinks (thus, directly in line with alcohol use), while SHR PBS address what one does while drinking (therefore, in line with consequences). Interestingly, SLD PBS have not been consistently linked to alcohol use or consequences (Martens et al., 2011; Peterson et al., 2019). This appears to be related to differences in sample characteristics, and exposure to interventions that may promote SLD PBS use (see Pearson, 2013). Given the efficacy of PBS in preventing alcohol use and consequences, it is important to identify theory-based mechanisms that may drive PBS use.

THE HEALTH BELIEF MODEL

The Health Belief Model (HBM) was originally conceptualized to understand why patients were unaccepting of prevention efforts and screenings for early detection of symptoms of disease (Rosenstock, 1974). The model conceptualized that individuals are more likely to engage in health beliefs when there is a desire to avoid illness (or if ill, to get better) and the belief that a specific health behavior will prevent such illness (Janz and Becker, 1984). Thus, the HBM predicts that health behaviors, (e.g., drinking alcohol

in moderation) are identified and decided on based on perceived susceptibility (i.e., one's perception of risk/susceptibility to illness), severity (i.e., perceived impact of contracting the illness in terms of medical and social consequences), benefits (i.e., perceived effectiveness of the health behavior), and barriers (i.e., perceived negative aspects of the health behavior; Janz and Becker, 1984). As a result, it is noted that the combined perceptions of susceptibility and severity increase the likelihood of engagement in the health behavior, with the perception of benefits (versus barriers) seen as the determinant of the chosen health behavior (Rosenstock, 1974; Janz and Becker, 1984). In other words, it has been argued that if one believes something to be effective, they will engage in it more to receive those benefits (e.g., taking vitamins to ward off sickness or applying sunscreen in order to prevent a sunburn; (Dillard and Ha, 2016). Thus, the HBM provides an organizational framework for understanding the link between perceived effectiveness of a behavior and behavioral engagement (Janz and Becker, 1984). The HBM has been used in a variety of studies as a foundation for alcohol research (Pearson and Hustad, 2014), however, no previous studies have examined beliefs about the perceived effectiveness of PBS use. The notion that effectiveness beliefs are malleable targets offers a potential avenue to increase actual use of PBS.

Study Overview

Given the high prevalence of alcohol use and alcohol-related problems among college students, along with the protective effects of PBS use, the present study examined the associations between alcohol outcomes and perceived PBS effectiveness in this population. This was done in order to determine whether perceived PBS effectiveness would increase actual PBS use, and in turn, lead to decreases in alcohol use and alcohol-related problems. Thus, we hypothesized that perceived PBS effectiveness would be positively linked to the use of each specific PBS subtype

(H1). Further, it was hypothesized that MD PBS and SLD PBS would be directly, and negatively, related to alcohol use (H2a), and indirectly (also negatively) related to alcohol-related problems via consumption (H2b). In contrast, we hypothesized that SHR PBS would have a direct negative path to alcohol-related problems (H3). Thus, we expected perceived PBS effectiveness to be indirectly related to alcohol-related problems via associations with PBS use. The theoretical model with hypotheses is depicted in Figure 1.

METHODS

Participants

The dataset contained information from $n = 1060$ participants. However, the analytic sample was limited to $n = 694$, excluding those who abstained from alcohol, were under the age of 18, or did not provide data on alcohol or PBS-related variables. Thus, the analytic

sample was primarily female (63.26%) and Caucasian (72.05%). Participants ranged in age from 18 to 59 years old ($M_{\text{age}} = 20.21$, $SD = 4.37$). Detailed demographic data is provided in Table 1. All participants were treated in accordance with American Psychological Association ethical guidelines for research (Sales and Folkman, 2000).

Procedures

Participants were recruited through a university research pool and completed a survey entitled “Counterfactual Thinking” from which the participants received course credit. The survey was a screen for a larger intervention study (De Leon, Dvorak et al., 2022). All data is from the pre-intervention phase. Participants were asked to provide information on alcohol-related perceptions and behaviors. The survey assessed information including demographics, weekly alcohol consumption, alcohol-related problems, use of

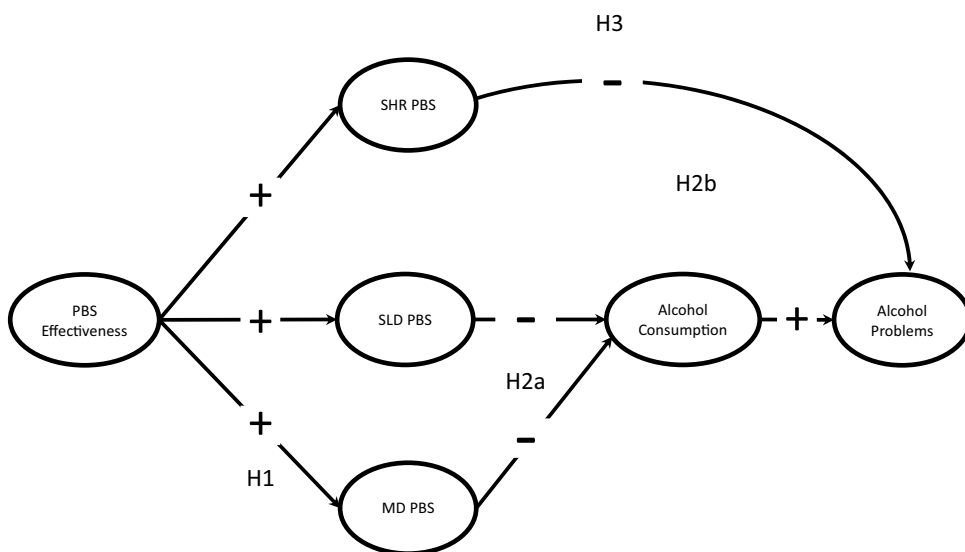


FIGURE 1. Theoretical model with hypotheses.

Note. PBS = Protective Behavioral Strategies. SHR PBS = Serious Harm Reduction Protective Behavioral Strategies; SLD PBS = Stopping/Limiting Drinking Protective Behavioral Strategies; MD PBS = Manner of Drinking Protective Behavioral Strategies.

PBS, and perceived effectiveness of PBS use in preventing adverse alcohol consequences. All procedures were approved by the university Institutional Review Board (IRB).

Measures

Demographics

Participants reported age, biological sex, gender, sexual identification/orientation, race and ethnicity. Age and biological sex were added as model covariates. Descriptive statistics are depicted in [Table 1](#).

AUDIT-C

Participants completed the Alcohol Use Disorders Identification Test—Consumption Scale (AUDIT-C) as a measure of alcohol consumption in the past year (Saunders et al., 1993). The AUDIT-C is a 3-item screen that assesses alcohol use frequency, quantity, and heavy episodic use. Response options are on a 5-point Likert scale that varies slightly across questions (e.g., Frequency: 0 = never, 4 = four or more times per week; Quantity: 0 = 1-2 drinks, 4 = 10 or more drinks; Heavy Episodic Use: 0 = never, 4 = daily or almost daily). Total scores range from 0 to 12, with higher scores indicating more hazardous drinking. Previous research suggests that AUDIT-C scores ≥ 3 are associated with more problematic consumption patterns (Bradley et al., 2007). The reliability and validity of the AUDIT-C is supported by previous research (DeMartini et al., 2013). The AUDIT-C showed reasonable internal consistency in the current study ($\alpha = .76$).

Daily Drinking Questionnaire—Revised (DDQ-R)

The Daily Drinking Questionnaire (DDQ-R) was used to assess the number of drinks typically consumed on each day of the week, for a typical week over the last 6 months (Dimeff et al., 1999). Participants

were provided with a series of text boxes for each day of the week. Under each day, participants reported the “typical” number of drinks they consumed on the given day and the number of hours they drank on that day. For example, for “Monday” participants reported the number of drinks they typically consumed on an average as well as the number of hours they typically spend drinking on Monday over the past 6 months. Lastly, participants reported their height/weight. This measure provides the number of drinks consumed on each day of the week and can be used to calculate a person’s typical Blood Alcohol Content (BAC) on drinking days (Hustad and Carey, 2005). For the current study, both number of drinks consumed per week and average BAC on drinking days were used as indicators of the latent alcohol consumption variable. Prior research supports the use of the DDQ-R as a measure of alcohol consumption in college students (Dvorak et al., 2013; Dvorak, Kuvaas, et al., 2015).

Alcohol-Related Problems

The Young Adult Alcohol Consequences Questionnaire (YAACQ) is a 48-item questionnaire that measures alcohol-related problems (Read et al., 2006). The items in the YAACQ contain eight domains of alcohol consequences: Social/Interpersonal ($\alpha = .78$; six items; e.g., “I have become very rude, obnoxious, or insulting after drinking”), Occupationa/Occupational ($\alpha = .73$; five items; e.g., “I have neglected my obligations to family, work, or school because of my drinking”), Risky Behavior ($\alpha = .77$; eight items; e.g., “I have taken foolish risks when I have been drinking”), Impaired Control ($\alpha = .79$; six items; e.g., “I often drank more than I originally had planned”), Poor Self-Care ($\alpha = .84$; eight items; e.g., “I have been less physically active because of drinking”), Diminished Self-Perception ($\alpha = .86$; four items; e.g., “I have felt badly about myself because of my drinking”), Blackout Drinking

TABLE 1. Descriptive statistics

Continuous Variables	Frequency (%)	Mean (SD)	Range	Skew
Age	-	20.21 (4.37)	18–59	4.57
AUDIT-C Score	-	3.52 (2.20)	1–11	0.76
Calculated BAC	-	0.03 (0.05)	0.00–0.32	2.22
Drinks per week	-	6.04 (7.01)	0–53	2.24
Alcohol Related Problems (YAACQ)	-	6.11 (7.87)	0–42	1.66
SHR PBS Use	-	5.23 (1.04)	1–6	–2.21
SLD PBS Use	-	3.71 (1.42)	1–6	–0.16
MD PBS Use	-	3.77 (1.50)	1–6	0.01
SHR PBS Effectiveness	-			
SLD PBS Effectiveness	-			
MD PBS Effectiveness	-			
Frequency Variables				
<i>Biological Sex</i>				
•Male	253 (36%)			
•Female	439 (63%)			
•Do not wish to respond	2 (<1%)			
<i>Gender Identification</i>				
•Male	252 (36%)			
•Female	438 (63%)			
•Agender	0			
•Pangender	0			
•Nonbinary	2 (<1%)			
•Other/Do not wish to respond	2 (<1%)			
<i>Sexual Orientation</i>				
•Heterosexual	581 (84%)			
•Gay/Lesbian	24 (3%)			
•Bisexual	73 (11%)			
•Pan Sexual	6 (<1%)			
•Other/Do not wish to respond	5 (<1%)			
<i>Racial Category</i>				
•Caucasian	500 (72%)			
•African American	71 (10%)			
•Native American/Alaska Native	1 (<1%)			
•Asian/Pacific Islander	37 (5%)			
•Multiracial	60 (9%)			
•Other/Do not wish to respond	25 (4%)			
<i>Ethnicity</i>				
•Hispanic/Latinx	179 (26%)			
•Other	515 (74%)			

Note. $n = 694$; SD = Standard Deviation; AUDIT-C = Alcohol Use Disorders Identification Test—Consumption Scale; SHR PBS = Serious Harm Reduction Protective Behavioral Strategies; SLD PBS = Stopping/Limiting Drinking Protective Behavioral Strategies; MD PBS = Manner of Drinking Protective Behavioral Strategies.

($\alpha = .89$; seven items; e.g., “I have awakened the day after drinking and found that I could not remember a part of the evening before”),

and Physiological Dependence ($\alpha = .58$; four items; e.g., “I have felt anxious, agitated, or restless after stopping or cutting down on

drinking”). Participants were asked if they experienced each consequence over the past 3 months (Yes, No, I do not wish to respond). Previous research supports the reliability and validity of the YAACQ in college students (Read et al., 2006). The YAACQ showed good overall internal consistency in the current study ($\alpha = .94$). YAACQ scores are a sum of responses.

Protective Behavioral Strategies

Protective behavioral strategies were measured using the Protective Behavioral Strategies Scale—20 (PBSS-20 (Treloar et al., 2015)). The 20-item survey assesses three subtypes of PBS: Manner of Drinking (MD; $\alpha = .88$; five items; e.g., “Avoid drinking games”), Stopping/Limiting Drinking (SLD; $\alpha = .91$; seven items; e.g., “Stop drinking at a predetermined time”), and Serious Harm Reduction Strategies (SHR; $\alpha = .89$; eight items; e.g., “Use a designated driver”). The PBSS-20 is a revised version of the PBSS survey (Martens et al., 2004) with an expanded SHR scale. Participants were asked the degree to which they engaged in each subtype of PBS in the past 3 months (Never, Rarely, Occasionally, Sometimes, Usually, and Always). Previous research supports the reliability and validity of the PBSS-20 in college students, as well as the test–retest reliability and criterion validity, with improved content validity for the SHR scale (Treloar et al., 2015). The PBSS-20 showed good internal consistency in the current study ($\alpha = .91$). Items within each subscale were combined to form three parcels to be used to form latent variables.

Effectiveness of Protective Behavioral Strategies

Effectiveness of PBS was assessed by three items, with each item specific to each PBS subtype. For example, for SHR, the question stated, “The above strategies are

called ‘Serious Harm Reduction’ types of strategies. How effective do you think ‘Serious Harm Reduction’ types of strategies are in preventing alcohol problems?” Responses ranged on a scale of: Extremely Effective, Very Effective, Moderately Effective, Slightly Effective, and Not Effective at all. These three items had adequate internal consistency ($\alpha = .77$).

Data Preparation and Analysis Overview

The dataset contained observations from $N = 1060$ participants. However, $n = 320$ participants reported that they abstain from alcohol and were therefore removed from the analysis. Twenty-seven individuals reported being under the age of 18, and thus were excluded. Nineteen individuals provided no information on any alcohol or PBS-related variables. These individuals were also omitted from the analysis, resulting in a final analytic sample of $n = 694$. We examined skew, kurtosis, and distributions of all analysis variables as well as residuals for each outcome. No outcome had residuals with skew >1 , and all residuals showed a relatively normal distribution. Mahalanobis Distance indicated six potential multivariate outliers. However, only one of these observations had a residual greater than the mean residual across all consequences. Removal of these observations had no effect on model sensitivity or specificity. Thus, no observations were removed for non-normality and/or data irregularity.

The primary hypotheses were tested using a latent variable path model in *Mplus* 8.5 (Muthén and Muthén, 2018). Missing data across measures ranged from 0.0 to 15.6%. Missingness was assumed to be missing at random, and was handled via full information maximum likelihood estimation (Enders and Bandalos, 2001). PBS effectiveness was a latent exogenous predictor of each PBS subtype. MD and SLD PBS served as latent predictors of alcohol use. SHR PBS was a latent predictor of alcohol-related problems. Alcohol

use and alcohol related-problems were also entered into the model as latent variables, with alcohol use predicting alcohol-related problems. Indirect effects were calculated using 95% bias corrected confidence intervals from 5,000 bootstrapped draws (MacKinnon et al., 2007). PBS use was allowed to covary across subtypes. Biological sex was added as a model covariate on all latent variables.

RESULTS

Descriptive and Bivariate Statistics

Descriptive statistics are in Table 1; bivariate correlations are in Table 2. Age did not differ by biological sex in the overall sample ($M_{\text{age}} = 20.21$, $SD = 4.37$, range 18 to 59). Men reported higher alcohol consumption rates ($M = 3.96$, $SE = 0.15$) than women ($M = 3.27$, $SE = 0.10$; $t(690) = -4.0069$, $p < .0001$, Cohen's $d = 0.30$). Interestingly, women used more PBS than men across all three PBS subtypes; MD $t(591) = 1.7199$, $p = .043$, Cohen's $d = 0.16$), SLD $t(597) = 1.7454$, $p = .041$, Cohen's $d = 0.15$), and SHR $t(591) = 2.8465$, $p = .002$, Cohen's $d = 0.24$). Subtypes of PBS effectiveness (MD, SLD, and SHR) were significantly correlated with their corresponding PBS. In addition, alcohol consumption was significantly correlated with alcohol-related problems, see Table 2.

Measurement Model

To examine the hypothesized effects focusing on perceived PBS effectiveness and its association with PBS use, alcohol consumption, and alcohol-related problems, a latent variable structural equation model was utilized. First, the measurement model was specified. The model showed reasonable fit, $\chi^2(138) = 418.03$, $p < .001$, RMSEA = .054, CFI = .942, SRMR = .049. Modification indices were examined and correlated errors greater than 20 within a given latent variable were iteratively freed. This resulted in three freed parameters (Daily Drinking with average BAC on drinking nights; MD PBS effectiveness with MD PBS; Sex with average BAC on drinking nights). Following this, the new model was re-estimated, $\chi^2(135) = 308.83$, $p < .001$, RMSEA = .043, CFI = .964, SRMR = .044. The model fit the data significantly better, Satorra-Bentler $\Delta\chi^2(3) = 109.20$, $p < .001$. Overall, the model accounted for 32% ($p < .001$) of the variance in alcohol consumption and 49% ($p < .001$) of the variance in alcohol-related problems (see Figure 2).

Latent Variable Path Model

The latent variable model was specified with PBS effectiveness serving as the exogenous variable, each PBS subtype and alcohol

TABLE 2. Bivariate correlations

Variables	1	2	3	4	5	6	7	8	9
1. Age	-								
2. Sex	.023	-							
3. SHR PBS	-.070	-.116*	-						
4. SLD PBS	.050	-.072	.443*	-					
5. MD PBS	.154*	-.071	.274*	.478*	-				
6. SHR Effectiveness	-.086*	-.059	.242*	.197*	.108*	-			
7. SLD Effectiveness	.016	-.024	.215*	.320*	.227*	.514*	-		
8. MD Effectiveness	.075	-.045	.075	.204*	.306*	.349*	.654*	-	
9. Alcohol Consumption	-.098*	.151*	-.073	-.309*	-.461*	-.055	-.161*	-.169*	-
10. Alcohol Problems	-.011	-.042	-.110*	-.193*	-.356*	-.012*	-.012*	-.012*	.473*

Note. SHR PBS = Serious Harm Reduction Protective Behavioral Strategies; SLD PBS = Stopping/Limiting Drinking Protective Behavioral Strategies; MD PBS = Manner of Drinking Protective Behavioral Strategies; Alcohol Consumption = Alcohol Use Disorders Identification Test—Consumption Scale (AUDIT-C); Alcohol-related problems = the Young Adult Alcohol Consequences Questionnaire (YAACQ); * $p \leq .05$ at $r \geq 0.08$.

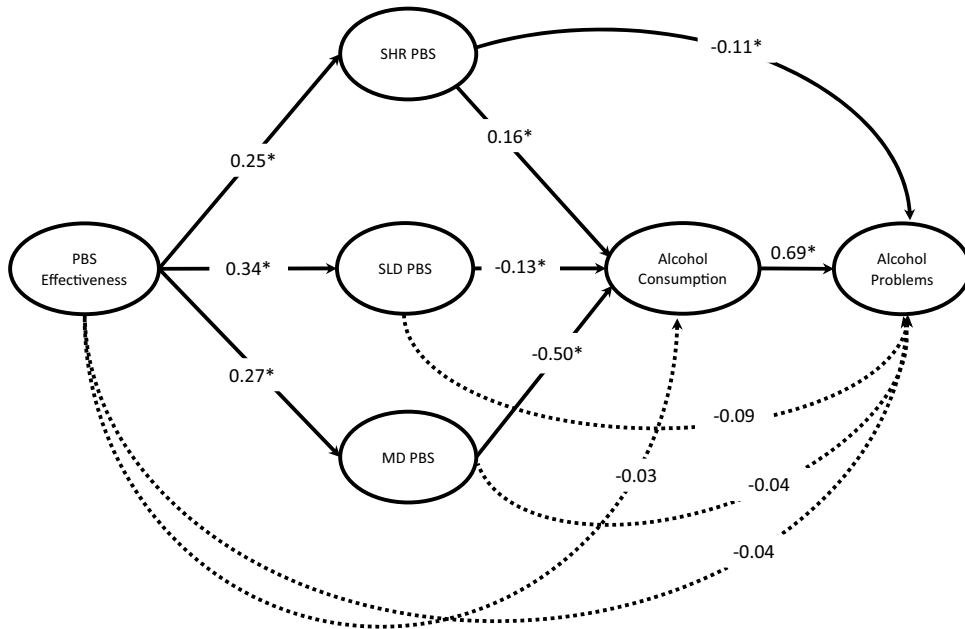


FIGURE 2. Latent variable path model of PBS effectiveness to alcohol outcomes via PBS use.

Note. PBS = Protective Behavioral Strategies. SHR PBS = Serious Harm Reduction Protective Behavioral Strategies; SLD PBS = Stopping/Limiting Drinking Protective Behavioral Strategies; MD PBS = Manner of Drinking Protective Behavioral Strategies. All paths are standardized. Sex was added as a covariate on all model variables. * $p \leq .05$.

consumption serving as the mediator variables, and alcohol-related problems serving as the endogenous variable. The model showed adequate fit to the data, $\chi^2(129) = 281.981$, $p < .001$, RMSEA = .041, CFI = .968, SRMR = .039. The model accounted for 32% ($z = 8.25$, $p < .001$) of the variance in alcohol consumption and 49% ($z = 9.258$, $p < .001$) of the variance in alcohol-related problems. PBS effectiveness was found to significantly predict SHR PBS ($B = 0.600$, $SE = 0.116$, $p < .001$), MD PBS ($B = 0.886$, $SE = 0.162$, $p < .001$), and SLD PBS ($B = 1.145$, $SE = 0.168$, $p < .001$); however, it did not directly predict alcohol consumption ($B = -0.151$, $SE = 0.220$, $p = .494$) nor alcohol-related problems ($B = -0.072$, $SE = 0.069$, $p = .291$). Alcohol consumption was significantly related to MD PBS ($B = -0.745$, $SE = 0.085$, $p < .001$), SLD PBS ($B = -0.183$, $SE = 0.091$, $p = .048$), SHR PBS ($B = 0.317$, $SE = 0.124$, $p = .012$), and sex ($B = 0.502$, $SE = 0.166$, $p = .003$). Additionally, alcohol-related problems were significantly related to

alcohol-consumption ($B = 0.238$, $SE = 0.035$, $p < .001$), SHR PBS ($B = -0.079$, $SE = 0.033$, $p = .028$), and sex ($B = -0.186$, $SE = 0.055$, $p = .001$).

Indirect and Total Effects

The indirect effects from PBS effectiveness to alcohol problems as well as from PBS effectiveness to alcohol consumption through each PBS subtype were calculated. Indirect effects were calculated using 95% bias corrected confidence intervals from 5,000 bootstrapped draws.

Indirect Effects to Alcohol Consumption.

First, we looked at the simple and total indirect effects from PBS effectiveness to alcohol consumption, through SLD PBS, MD PBS, and SHR PBS. The simple indirect effects between PBS effectiveness and alcohol consumption through MD PBS was negative and statistically significant, IND = -0.660 , 95% C. I. = -0.980 , -0.411 . The simple indirect effects

between PBS effectiveness and alcohol consumption through SLD PBS was also negative and statistically significant, $IND = -0.210$, 95% C.I. = $-0.463, -0.014$. In contrast, the simple indirect effects between PBS effectiveness and alcohol consumption through SHR PBS was positive and statistically significant, $IND = 0.190$, 95% C.I. = $0.045, 0.416$. However, the total indirect effect from PBS effectiveness to alcohol consumption through all three PBS was negative and statistically significant, $IND = -0.680$, 95% C.I. = $-1.015, -0.403$, as was the total effect (which accounts for the direct path from PBS effectiveness), $IND = -0.830$, 95% C.I. = $-1.347, -0.405$.

Indirect Effects to Alcohol-Related Problems. Next, we looked at the simple and total indirect effects from PBS effectiveness to alcohol-related problems, through SLD PBS, MD PBS, and SHR PBS. The simple indirect effect between PBS effectiveness and alcohol-related problems through SHR PBS (excluding the path to alcohol) was negative and statistically significant, $IND = -0.048$, 95% C.I. = $-0.105, -0.014$; however, the simple indirect effect that included alcohol was positive and significant, $IND = 0.045$, 95% C.I. = $0.011, 0.105$. This effectively removed any protective effects of SHR PBS on alcohol-related problems (total indirect effect from PBS effectiveness to alcohol-related problems via SHR PBS: $IND = -0.002$, 95% C.I. = $-0.060, 0.049$).

The relationship between PBS effectiveness and alcohol problems through SLD PBS and alcohol consumption was negative and statistically significant, $IND = -0.050$, 95% C.I. = $-0.116, -0.005$; however, the simple indirect effect that did not include alcohol consumption was not, $IND = 0.053$, 95% C.I. = $-0.006, 0.128$. Consequently, the total indirect effects through SLD PBS were not statistically significant, $IND = 0.003$, 95% C.I. = $-0.061, 0.069$.

The relationship between PBS effectiveness and alcohol problems through MD PBS and alcohol consumption was negative and statistically significant, $IND = -0.097$, 95%

C.I. = $-0.258, -0.152$; however, as with SLD PBS, the simple indirect effect that did not include alcohol consumption was not, $IND = -0.019$, 95% C.I. = $-0.074, 0.041$. Despite this, the total indirect effects through MD PBS were statistically significant, $IND = -0.176$, 95% C.I. = $-0.274, -0.106$.

Thus, SHR PBS had significant negative specific indirect effects that excluded alcohol and positive indirect effects that included alcohol. SLD PBS and MD PBS had significant negative specific indirect effects that included alcohol and non-significant indirect effects that excluded alcohol. The sum total of the indirect effects from PBS effectiveness to alcohol-related problems was significant, $IND = -0.127$, 95% C.I. = $-0.193, -0.065$; as was the total effect (accounting for the non-significant direct path from PBS effectiveness to alcohol-related problems), $IND = -0.170$, 95% C.I. = $-0.254, -0.084$. Thus, PBS effectiveness exerts a total protective effect that occurs exclusively via effects on PBS use.

DISCUSSION

Consistent with the Health Belief Model (HBM), the current study found support for the notion that, the more individuals believe PBS to be effective, the more likely they are to actually use PBS. Thus, the hypothesized effects were supported. This study found perceived PBS effectiveness significantly predicted use of each PBS subtype. Further, MD PBS and SLD PBS were found to be negatively related to alcohol consumption and indirectly with alcohol-related problems. Additionally, SHR PBS was found to have a positive direct path to alcohol consumption and a negative direct path to alcohol-related problems. Lastly, while PBS effectiveness was not directly related to alcohol consumption or problems, it was found to be negatively related to alcohol consumption and problems via MD and SLD PBS, as well as negatively related to alcohol problems via SHR PBS.

Of great importance is the fact that the latent PBS effectiveness variable was positively associated with each PBS subtype. This may be linked to an underlying belief that all forms of PBS are effective, which in turn seems to be predictive of engaging in PBS use. Thus, emphasizing the global effectiveness of PBS could theoretically increase use of all PBS subtypes. This association may be applied to alcohol prevention programs on college campuses, which already tend to emphasize the use of stopping/limiting campaigns grounded in social norms to try to influence drinking behaviors (Lewis and Neighbors, 2006). For example, it is possible that normative feedback regarding consumption rates on campus could enhance the perception of SLD PBS effectiveness by emphasizing reductions in drinking to ameliorate consequences, and thereby also emphasize the effectiveness of other PBS subtypes. This remains a question for future alcohol intervention research.

The paths from MD PBS and SLD PBS to alcohol consumption and alcohol consequences is noteworthy. This suggests that by targeting MD PBS and SLD PBS, one could attempt to reduce consumption, which could broadly reduce negative alcohol-related problems, especially for MD PBS (Linden-Carmichael et al., 2018; Peterson et al., 2019). Interestingly, SHR PBS had a positive direct relationship with alcohol consumption and a negative relationship to alcohol-related problems. This may be due to the nature of this PBS subtype, which is geared towards addressing what one does while drinking (e.g., use a designated driver, making sure to go home with a friend, making sure to drink with someone who can take care of you if you drink too much). Therefore, it is possible that by using this strategy college students may increase or maintain their regular level of consumption, and yet experience a reduction in alcohol-related problems. Nevertheless, it is important to note that the SHR PBS subtype has shown the greatest effects on alcohol-related problems in previous studies (Linden-Carmichael et al., 2018; Peterson et al., 2019).

Additionally, while PBS effectiveness was not directly linked to alcohol consumption nor alcohol-related problems, it was found to be indirectly related. PBS effectiveness was negatively and indirectly related to alcohol problems via SHR PBS. This suggests that perceived PBS effectiveness influenced SHR PBS use, which in turn led to a robust reduction in alcohol-related problems. Additionally, when alcohol consumption was added to the model, PBS effectiveness was negatively and indirectly related to alcohol-related problems via MD PBS. This suggests that perceived PBS effectiveness of MD PBS use could also be utilized to decrease alcohol consumption, and subsequently alcohol-related problems. In contrast, PBS effectiveness was found to be positively and indirectly related to alcohol problems via SHR when the path included alcohol consumption. Similarly, PBS effectiveness was positively and indirectly related to alcohol consumption via SHR PBS. This suggests that while PBS effectiveness can influence SHR PBS use, such that SHR PBS use can lead to a reduction in alcohol-related problems, when alcohol-consumption is included in the model, both consumption and alcohol-related problems were inversely related to SHR PBS use. This could be due to the nature of this strategy, which may involve certain behaviors (i.e., use a designated driver) that enable heavy drinking but minimize certain alcohol-related problems. Lastly, perceived PBS effectiveness was negatively and indirectly related to alcohol consumption via MD PBS. This also suggests that perceived PBS effectiveness influenced MD PBS, which led to a reduction in alcohol consumption. This, coupled with the fact that MD PBS was robustly associated with both consumption and alcohol-related problems, highlights the important nature of this PBS subtype. Previous research has suggested it may be the most broadly protective (see Janz and Becker, 1984), and the current results support these previous findings. Thus, future research should evaluate ways to specifically increase beliefs in the effectiveness of these sorts of strategies.

Clinical Implications

Given the main findings that perceived PBS effectiveness is associated with a higher likelihood of using all PBS subtypes, this begs the question of whether to target effectiveness perceptions of each PBS subtype individually or globally. It is important to take into consideration how each subtype is unique in addressing different aspects of adverse outcomes, as well as how the subtypes are related. However, targeting a more global belief about PBS effectiveness may increase perceived effectiveness for each subtype, which could be related to the impact of PBS use in reducing alcohol consumption and related consequences. This is of particular importance, as findings indicated men drank significantly more alcohol than women, yet women used more PBS across all three subtypes, which is consistent with previous studies (Miller et al., 2019; Pearson, 2013; Peterson et al., 2019; Treloar et al., 2015). These sex differences highlight the importance of augmenting perceived PBS effectiveness interventions among men, as this group has a higher rate of alcohol consumption and is thereby at a higher risk for adverse alcohol-related problems. However, it could be that men do not use as much PBS as women for other reasons, such as peer group influences (Taberero et al., 2019), which may warrant the need for interventions that target social norms to elicit perceived PBS effectiveness in the context of peer group influences. One interesting approach may be to use normative feedback about PBS effectiveness to influence beliefs about the protective effects of PBS among peers.

Limitations

This study is not without its limitations. First, the data is cross-sectional precludes causal inferences regarding the associations between alcohol, alcohol-related consequences, which and the use of protective behavioral strategies. Furthermore, the sample included in this study was recruited from a large,

predominantly Caucasian, Southeastern University in the United States, as such, generalization of findings to other populations should be made with caution. Similarly, the nature of data procurement utilized herein (i.e., self-report surveys) is subject to both self-report and memory (i.e., retrospective recall) biases. It is also worth noting that the correlations among variables were not particularly robust. Despite this, the model showed very good fit to the data. This increases our confidence in the overall findings, but does suggest some limitations in clinical significance of the results. Future research is needed to examine the clinical utility of PBS effectiveness as a potential mechanism of behavior change. Finally, we utilized a single item to assess perceived PBS effectiveness for each subtype. Developing a more comprehensive assessment of perceived PBS effectiveness is warranted.

CONCLUSION

In summary, the current study found support, in line with the Health Belief Model, that the more effective one believes PBS to be, the more one will report engaging in PBS. This may be linked to the implicit belief that perceptions of global effectiveness of PBS could comprehensively affect the use of all PBS subtypes. This in turn was associated with reductions in both alcohol consumption and alcohol-related problems. These preliminary findings suggest a basis for intervention studies to ascertain the efficacy of promoting PBS engagement via increasing beliefs regarding PBS effectiveness. Future research should incorporate more longitudinal, prospective studies to determine causal effects between PBS strategy implementation and alcohol consumption.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s).

FUNDING

This work was supported by the NSF [2035702]. RDD received funding from the NIH [1R15AA026420-01A1].

DATA AVAILABILITY


The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

DECLARATIONS

Ethics approval and consent; University of Central Florida IRB #CR00000126

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