The impact of a theory-based web-intervention on the intention to use prescription drugs for non-medical purposes among college students: a randomized controlled trial

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Abstract

The non-medical use of prescription drugs (NMUPD) among college students is escalating at an alarming rate. A limited number of studies have utilized a theoretical framework to influence this behavior. To utilize the reasoned-action approach theory to design and evaluate a web-based intervention to influence students' attitudes, perceived norms (PNs), perceived behavioral control (PBC) and intentions toward NMUPD. Using a two-group post-test only controlled trial, students were randomized to view either a general health website or a web-based intervention focused on NMUPD. The intervention was presented in multiple sections to address each component of the reasoned-action approach. Subsequently, respondents completed a web-survey. Independent *t*-tests were used to compare responses between the two groups. Of 391 respondents, 112 (28.9%) students indicated previous NMUPD. The intervention group had significantly ($P = 0.04$) more negative attitudes toward NMUPD. No significant differences were found in PNs ($P = 0.11$), PBC ($P = 0.68$) or intentions to NMUPD ($P = 0.97$). The intervention was successful in changing attitudes toward NMUPD. Targeting the intervention

toward college students regardless of previous experiences of NMUPD might have led to insufficiency of the intervention to influence intentions. Additional research is needed to improve the intervention dissemination and utilization.

Introduction

Non-medical use of prescription drugs (NMUPD) is an emerging epidemic in the United States [1], ranked second after marijuana use among persons aged 12 years and older [2]. According to the National Survey on Drug Use and Health (NSDUH), NMUPD is defined as the deliberate or non-deliberate utilization of medication without a prescription, or for purposes other than for what it was prescribed such as for recreational purposes or to reduce stress and anxiety [3, 4]. The most misused prescription drugs are stimulants (i.e. amphetamines and methylphenidate), opioid analgesics (i.e. codeine and hydrocodone), sedatives (i.e. phenobarbital and triazolam) and tranquilizers (i.e. alprazolam and diazepam) [1].

According to the 2016 NSDUH report, 6.2 million people aged 12 years and older were current non-medical users of psychotherapeutics (pain relievers, stimulants, sedatives and tranquilizers).

Specifically, 3.3 million were current non-medical users of pain relievers, 2.0 million of tranquilizers, 1.7 million of stimulants and 497 000 of sedatives [5]. The most recent report of the Drug Abuse Warning Network (DAWN) in 2011 indicated there were almost a million and a half emergency department visits related to NMUPD in the United States [6]. These visits could be attributed to drug abuse, adverse drug events or other drug-related issues. More than half a million of these cases were related to sedatives and tranquilizers. In 2013, of the 22 769 deaths related to pharmaceutical medications overdose, more than 70% involved opioid analgesics, and almost 30% of deaths were related to benzodiazepines [6]. More often, however, people who died from prescription drug abuse had a combination of two or more drugs; most notably, a combination of benzodiazepine and opioid analgesics.

Among college students, in particular, NMUPD has grown rapidly to become a major public health concern [4, 7]. Recent national data shows that there is a significant number of college students who are using prescription drugs for non-medical reasons or without medical supervision [8, 9]. Most notably, college students are more likely than their non-college counterparts to misuse prescription stimulants, particularly Adderall® (amphetamine), and Ritalin® (methylphenidate). This trend may be explained by the fact college students are using stimulants as study aids [9]. NMUPD by college students has been associated with binge drinking, illicit drug abuse, poor academic performance and risky sexual behaviors [8, 10, 11]. Brief educational interventions to prevent NMUPD are more likely to be successful at the early stages of drug misuse before the development of serious complications such as addiction [12–15].

Behavioral theories can help in simplifying, explaining and predicting complex health behaviors such as NMUPD. In addition, theory-based interventions specifically designed to address constructs within a health behavior theory are more successful at influencing behavioral changes compared with interventions that lack a theoretical framework [16]. With respect to NMUPD, several health behavior theories have been used to explain various

aspects of prescription drug misuse among college students such as the theory of triadic influence (ecological level) [17, 18], social learning theory (interpersonal level) [19–22] and the theory of planned behavior (intrapersonal level) [23–25].

One of the most prominent theoretical frameworks, in the social and behavioral sciences, is the reasoned action approach which is the most updated version of the theory of planned behavior by Fishbein and Ajzen [26]. The reasoned action approach has been applied for predicting and influencing human behavior for more than 45 years. According to this framework, intentions are the most important determinants of the likelihood of performing a certain behavior. Intentions are guided by attitudes, perceived norms (PNs) and perceived behavioral control (PBC). The more favorable one's attitudes toward the behavior in question, the higher peer pressure (PNs) from important others and the greater control over internal and external perceived barriers (PBC); the stronger the individual's intentions are to carry out a particular behavior [26] (Fig. 1).

Theory-based interventions to address NMUPD are limited. For example, a randomized controlled intervention based on the expectancy theory was successful in modifying expectancies related to non-medical prescription stimulants effects among college students [27]. Although several studies have explored motives and attitudes toward NMUPD among college students [11, 28, 29], researchers have not applied the reasoned-action approach to design and evaluate an intervention to influence college students' attitudes, PNs, PBC and intentions toward NMUPD. Web-based interventions and surveys are especially convenient for college students because of their flexibility with regard to completion time. Web-based interventions also offer the possibility of using multimedia such as videos and interactive programs, thus making them attractive to college students [30, 31]. The aim of this study was to design and evaluate the impact of a web-based intervention on the intention to use prescription drugs for non-medical purposes among college students. The intervention and survey tool were designed using the theoretical framework of the reasoned-action approach [32].

Fig. 1. Schematic presentation of the conceptual model of the study*.

*Source: Fishbein and Ajzen [32].

Materials and methods

Study design

The effectiveness of the web-based intervention versus a general health website was tested using a two-arm parallel group, randomized controlled trial (RCT). This study included only a post-test of the intervention. Potential advantages of post-test only design (RCTs) are ease of implementation, decreased response burden, improved response rate and lower administrative effort. Compared with pre-/post-test designs, this design protects against testing effect as a threat to internal validity. Specifically, the act of completing a pre-test may influence responses on the post-test [33, 34]. Since respondents completed the post-test immediately after the intervention, a pre-testing effect may have been likely in this study and response burden would have been doubled since the survey was lengthy. We used an RCT because random assignment of the intervention helped assure the two groups were equivalent and avoid several other threats to internal validity (history, differential selection and selection interactions). The study sample was drawn from college students at the University of New Mexico (UNM) and included undergraduate, graduate, professional, part-time and full-time

students. Students were randomly selected and assigned to view either the web-based intervention (the experimental group): <http://www.rxoutofcontext.org/> or a general health website (the control group): <http://www.cdc.gov/family/college/>. The impact of the intervention was assessed using a survey administered immediately after viewing the website. The study was reviewed and approved by the UNM's Institutional Review Board (IRB).

Inclusion/exclusion criteria

Students who were currently enrolled at the UNM during the study period (30 November 2015 to 19 January 2016), were 18 years and older, and had access to Internet were eligible for the study. Any student not meeting the criteria was excluded. Students were not required to have used prescription drugs for non-medical purposes to be considered in the study.

Sampling frame and the method of randomization

The study's target population included college students attending the University of New Mexico between 30 November 2015 and 19 January 2016, and appearing on the email list provided by the UNM

registrar's office. Two random samples of students' emails were requested (4000 emails); one list was randomly assigned to receive a link to the intervention and the other list received a link to a general health website. The two lists were compared, before the dissemination of the invitation emails, to verify that each student was listed in only one group. Both groups received the same evaluation survey.

First, an invitation email was sent which included a brief description of the study along with links for the website and the survey. The email described the study's objectives, purpose and importance. Four reminder emails were sent at varying time intervals over the next 50 days. The reminder emails also had links for the website and survey. As an incentive to participate in the study, the invitation and reminder emails informed sampled students that they were eligible to be included in a drawing for one of 20 gift cards for \$20 each. To maintain anonymity of respondents, the administration of the drawing enrollment and selection of winners was handled by an honest agent who was not involved in any other aspect of the study.

Components of the intervention

The web-based intervention was designed according to the guidelines provided by the Office of Disease Prevention and Health Promotion (ODPHP), which is a part of the U.S. Department of Health and Human Services (HHS) [35]. These guidelines were reported in a document known as 'Health Literacy Online: A Guide for Simplifying the User Experience' and can be accessed via their website: <http://health.gov/healthliteracyonline/>. These guidelines aimed to provide evidence-based strategies to write and design health promotion websites that are engaging and easy-to-use, particularly, for people with limited health literacy. The study used interactive tools, audio and visual components, and a quiz to make the website more engaging. Some of the strategies that were used to improve users' experience while navigating through the website included placing the most important information first; making health information specific, direct and actionable; using positive tone and realistic

goals and focusing on the benefits of health behaviors rather than barriers and risks [35]. Additional aspects included using bullets and short text, multiple headings, a font size of at least 12, images, white spaces and centering the content on the screen.

This brief, online, intervention was presented in multiple sections to address each construct of the reasoned action approach (intentions, attitudes, PNs and PBC). The persuasive communication approach was used to deliver messages related to the NMUPD [36, 37]. Additional components of the intervention included correcting misinformation and utilizing multimedia, such as educational and dramatic videos about NMUPD. Behavioral beliefs were addressed by challenging inaccurate beliefs and perceptions regarding NMUPD using a persuasive communication technique. In this approach, a narrative was provided in a persuasive manner to support the argument that NMUPD is not safe, not an effective study aid and can be as addictive as other illicit drugs. To enhance the message's persuasiveness and maximize the acceptance of the message, each paragraph provided scientific evidence with a logical flow of ideas without using jargon. Normative beliefs were addressed in the intervention by emphasizing the fact that NMUPD by college students is not as common as they might think. The exact percentages of NMUPD were provided in the intervention to support the fact that only a small percentage of students use prescription medications for non-medical purposes. Control beliefs were addressed by increasing self-efficacy of students' ability to improve their academic performance and manage their stress without using prescription medications. In addition, the intervention promotes refusal skills of students to resist NMUPD offers. Supplementary data A summarizes the key components of the intervention. The full website can be visited at: <http://www.rxoutofcontext.org/>.

Evaluation of the effectiveness of the intervention

To evaluate the effectiveness of the intervention, a survey was designed based on the reasoned-action approach to evaluate students' intentions, attitudes,

PNs and PBC regarding NMUPD. In addition, the number of sessions, the mean session duration and page views of the website were tracked using Google Analytics® [38]. A session was defined as the period of time a user is actively engaging with the website. This may have included page or screen views or interaction with activities provided on the website.

The survey instrument

The survey used in this study included items to measure demographic variables, and previous NMUPD. NMUPD was defined to participants as ‘using medications without a prescription, or for purposes other than prescribed by doctors such as to get high, to relief stress or to increase concentration. These include painkillers (e.g. Codeine & Oxycodone), stimulants (e.g. Adderall & Ritalin), and depressants (e.g. Valium & Xanax).’ The survey instrument included items related to background characteristics, history of tobacco, alcohol and Marijuana use. In addition, the survey included items related to the reasoned action approach. Each of the three predictors of intentions (attitudes, PNs and PBC) was assessed using two measures: direct and belief-based. Belief-based measures (previously known as indirect measures) are helpful in understanding the determinants of attitudes, PNs and PBC. The items found in the current survey were based on literature review of studies that assessed NMUPD by college students and specifically those that utilized a theoretical framework [19, 20, 23–25].

Attitudes

Attitudes were measured directly through six items. The first three items represented experiential attitudes (affective aspect) and the next three items were instrumental attitudes (cognitive aspect) (Table I). The mean score from these six items reflects the college students’ overall evaluation (negative or positive attitude) of the NMUPD behavior. Belief-based measures of attitudes were assessed by summation of the product of the belief’s strength (b_i) by outcome evaluation (e_i). Eight behavioral

beliefs were used to assess students’ attitudes on a 7-point scale ranging from 1 to 7 (Table II).

Perceived norms (PNs)

Stronger perceived social pressure (perceived norms) usually leads to stronger intention to perform certain behaviors. Similar to attitudes, PNs were measured through direct and belief-based measures. PNs were assessed directly using four items. Responses for each item were assessed on a 7-point scale ranging from -3 to $+3$. The first two items represent injunctive norms (reflect what important others think about NMUPD). The second two items represent descriptive norms (reflect whether important others are or not using prescription drugs for non-medical reasons) (Table I). The mean score from these four items reflects the overall social pressure to engage in NMUPD. Normative beliefs measures and motivation to comply were measured in association with specific referent individuals rather than general people or agents (Table II). Injunctive norms (N_i) measured through normative beliefs was produced by the summation of injunctive normative beliefs (n_i) each multiplied by motivation to comply (m_i) with referent individuals.

Perceived behavioral control (PBC)

The capability of performing certain behavior in the absence of environmental constraints was also measured directly and through control-beliefs measures. PBC was measured directly by two questions regarding college students’ perception of control over the NMUPD using a bipolar scale of 7-point alternatives ranging from -3 to $+3$ (Table I). Measuring PBC through control beliefs was produced by the summation of control belief strength (c_i) each multiplied by control belief power (p_i) to facilitate or impede the performance of behavior (Table II).

Intention

College students’ intention not to use prescription drugs for non-medical purposes was assessed using three questions, with a 7-point scale anchored by two extremes ranging from -3 to 3 . Higher scores

Table I. Survey response differences between the intervention and control groups within the constructs of the reasoned-action approach (direct measures)

Construct	Survey item	Intervention group mean (SD) <i>n</i> = 176	Control group mean (SD) <i>n</i> = 192	<i>P</i> -value
Attitude	<i>I consider the use of prescription drugs for non-medical purposes to be:</i>			
	Irritating–relaxing	−0.92 (1.7)	−0.65 (1.7)	0.14
	Unpleasant–Pleasant	−1.0 (1.7)	−0.64 (1.7)	0.03*
	Unenjoyable–enjoyable	−1.0 (1.7)	−0.56 (1.7)	0.007*
	Bad–good	−1.7 (1.5)	−1.3 (1.7)	0.036*
	Harmful–not harmful	−1.9 (1.5)	−1.7 (1.4)	0.21
	Irresponsible–responsible	−1.9 (1.4)	−1.7 (1.4)	0.52
	<i>Overall mean for attitude</i>	−1.4 (1.4)	−1.1 (1.4)	0.04*
Perceived norms	Most people who are important to me think I should NOT use medications for non-medical purposes	2.2 (1.3)	2.0 (1.4)	0.26
	Most people whose opinions I value would NOT approve my using of medications for non-medical purposes	2.0 (1.4)	1.9 (1.4)	0.48
	Most people whom I respect and admire DO NOT use medications for non-medical purposes	2.1 (1.3)	1.8 (1.5)	0.11
	Most people, like me, DO NOT use medications for non-medical purposes	1.5 (1.5)	1.2 (1.6)	0.065
	<i>Overall mean for perceived norms</i>	1.9 (1.2)	1.7 (1.2)	0.11
Perceived behavioral control	It is completely up to me whether or not I use medications for non-medical purposes over the next 3 months	2.6 (0.9)	2.6 (1.0)	0.84
	For me, using medications for non-medical reasons over the next 3 months is under my control	2.7 (0.92)	2.6 (0.81)	0.58
	<i>Overall mean for perceived behavioral control</i>	2.6 (0.8)	2.6 (0.8)	0.68
Intention	I intend to AVOID using prescription drugs for non-medical purposes	2.3 (1.4)	2.3 (1.4)	0.7
	I am NOT willing to use prescription drugs for non-medical purposes	1.9 (1.8)	2.0 (1.7)	0.8
	I plan to NOT use prescription drugs for non-medical purposes	2.3 (1.4)	2.3 (1.4)	0.96
	<i>Overall mean for intention</i>	2.2 (1.4)	2.2 (1.4)	0.97

Scales ranges from −3 (strongly disagree) to +3 (strongly agree).

*Statistically significant result.

indicated a higher intention to avoid using prescription drugs over the next 3 months (Table I).

Pilot testing

The clarity and comprehension of both the brief intervention and the survey were pre-tested using a representative sample of 23 students consisting of undergraduate, graduate and professional degree students. One group of students was asked to view the educational website (<http://www.rxoutofcontext.org/>)

and fill out the survey. The other group was asked to fill out the survey only. Comments and feedback provided by respondents were used to refine the intervention and the survey. Two types of validity verification were conducted; namely face and content validity. Reliability was assessed by Cronbach's alpha, a measure of internal consistency, using responses from the pilot testing. Cronbach's alpha was measured for all theory of reasoned action constructs to test the stability of the instrument. For our

Table II. Survey responses differences between the intervention and control groups within the constructs of the reasoned-approach (belief-based measures)

	Belief strength ^a × evaluation ^b ($b_i e_i$)		
	Intervention (SD) $n = 179$	Control (SD) $n = 193$	<i>P</i> -value
Behavioral belief			
Help me stay focused and improve my grades	14.0 (11.0)	15.2 (11.6)	0.31
Cause me physical health problems	11.5 (7.6)	12.3 (9.2)	0.36
Cause me mental health problems	10.5 (7.7)	11.0 (8.8)	0.52
Cause me to be addicted	9.4 (7.3)	9.7 (8.8)	0.73
Get me arrested	8.2 (6.4)	8.9 (8.0)	0.32
Help me lose weight	12.1 (9.3)	13.5 (9.3)	0.16
Help me get high and party	9.9 (9.1)	11.2 (9.6)	0.16
Make me feel more socially accepted by my group	8.2 (7.7)	9.1 (7.7)	0.22
Normative referents	Normative belief strength ^c × motivation to comply ^d ($n_i m_i$)		
	Intervention (SD) $n = 175$	Control (SD) $n = 189$	<i>P</i> -value
Partner (spouse, girlfriend or boyfriend)	1.6 (1.7)	1.5 (1.7)	0.69
Close friends	1.5 (1.8)	1.2 (1.8)	0.18
Doctor, nurse or pharmacist	2.3 (1.6)	2.3 (1.5)	0.86
Family members	2.1 (1.7)	2.3 (1.4)	0.22
Control belief	Control belief strength ^e × power ^f ($c_i p_i$)		
	Intervention (SD) $n = 174$	Control (SD) $n = 187$	<i>P</i> -value
Having a legitimate prescription for the medication	31.5 (13.4)	30.9 (13.0)	0.67
Having a friend with a prescription for the medication	23.0 (12.8)	21.5 (11.3)	0.23
Having easy access to prescription medications	28.3 (12.6)	26.1 (12.5)	0.09
Being offered a prescription medication by a friend or a family member	26.6 (13.4)	24.9 (12.5)	0.21
Having a health insurance	24.3 (10.4)	24.3 (10.1)	0.99
Getting behind in school work	23.1 (10.7)	23.5 (10.3)	0.73
Facing a stressful personal situation	24.7 (9.5)	25.8 (9.9)	0.31
Being a member of social fraternity/sorority group	25.9 (11.5)	24.8 (11.7)	0.38

^aBehavioral belief strength can range from 1 to 7. The question for these items was ‘Using prescription drugs for nonmedical purposes will: ...’.

^bOutcome evaluation can range from 1 to 7. The question for these items was ‘Generally speaking, how good or bad do you feel about the following outcomes?’

^cPossible range for the normative belief strength is from −3 to +3. The question was ‘How likely would each of the following individuals *disapprove* your use of prescription drugs for nonmedical purposes?’

^dPossible range for motivation to comply is from 1 to 7. The question for these items was ‘When it comes to matters of health, how likely are you to do what the following individuals recommend?’

^ePossible range for control belief strength is 1–7. The question for these items was ‘How much control do you feel you have over the following factors’

^fPossible range for control belief power is 1–7. The question for these items was ‘How do you think the following factors make using medications for nonmedical purposes easy or difficult?’

SD, standard deviation.

study, a Cronbach’s value of more than 0.7 was considered acceptable [39, 40]. The readability of the website’s texts was evaluated using Flesch–Kincaid grade level and Flesch reading-ease tests [41, 42].

Sample size calculation

A priori power analysis was conducted to determine the required sample size to achieve the goals of the study. The G*Power version 3.1.9.2 software was used [43].

The effect size of 0.35 was calculated from the weighted mean effect sizes extracted from 10 RCTs and quasi-experiments that utilized the reasoned-action approach to design and evaluate interventions to influence students' intentions to perform certain health behaviors [13, 44–52]. A *priori* computation with alpha level of 0.05, power of 0.8 and an allocation ratio (N_2/N_1) of one, yielded an estimated sample size of 260 (130 in each group). The total initial sample size of 4000 students' emails was based on the expected response from web-based surveys.

Data analysis

Stata[®] statistical software version 14 was used to clean and analyze the collected data [53]. The significance level was set as $P < 0.05$. Descriptive statistics, such as the mean and standard deviation, were calculated for demographic factors that are continuous such as age. Frequencies were calculated for categorical data such as gender and living arrangement. Independent *t*-tests were used to compare attitudes, PNs and PBC between the intervention and control groups. In addition, *t*-tests were used to compare behavioral beliefs, normative beliefs and control beliefs between the intervention and control groups.

Results

Survey dissemination and response rate

A total of 4000 participants were randomized in the study, 2000 in the intervention and control groups, respectively. After excluding uninterested students ($n = 23$) and undelivered emails ($n = 21$), the number of invitees in the intervention group was 1990 and in the control group was 1966. A total of 188 invitees responded in the intervention group and 203 responded in the control group. The intervention group response rate was 9.4% (188/1990); the control group was 10.3% (203/1966). The overall survey response rate was 9.9% (391/3956).

Characteristics of respondents

In the overall sample, the majority of respondents was female ($n = 234$, 61.4%) and the mean age was 28.6 years ($SD = 10.7$), with a range from 18 to 71.

The number of students who indicated ever-using prescription drugs for non-medical purposes was 112 (28.9%). Among those who reported NMUPD, the prevalence of each specific prescription drug use was as follows: 60% reported using a painkiller, 44.0% reported using a stimulant and 35.3% reported using a depressant. Most respondents identified themselves as Non-Hispanic White ($n = 184$, 48.3%), were undergraduate students ($n = 235$, 61.7%) and were living off-campus ($n = 335$, 87.9%). Only 66 (17.3%) were students in the Health Sciences Center (HSC), and 18 (4.7%) students were members of a fraternity/sorority group. Sample characteristics by group assignment are presented in Table III.

Most students ($n = 283$, 73.8%) were non-tobacco users. Regarding alcohol consumption, 216 (56.7%) were occasional drinkers and 28 (7.4%) were frequent drinkers. As for marijuana use, 44 (11.6%) were occasional users and 33 (8.7%) were frequent users. Assessment of students' demographics by group assignment demonstrated no statistically significant differences between the control and intervention groups for any variable (Table III). This was an indication of successful randomization process.

Psychometric properties of the survey

Table IV provides Cronbach's alpha/Spearman correlation coefficients for the different scales based on responses for pilot testing. All the scales had internal consistency values of more than 0.7, which suggested a high internal consistency. The results of the Flesch–Kincaid Grade Level test indicate that a 9th to 10th school grade level is required to read and understand the educational website. The Flesch reading-ease readability tests score was 49.6, which indicated that the written materials of the website are fairly difficult to read by the public. However, given that the target population is composed of college students, it is expected that they would be able to read and understand the website.

Differences between the control and intervention groups in the reasoned action-approach variables

Table I presents differences between intervention and control groups with regard to the reasoned-

Table III. Sample characteristics by group assignment

Characteristic	Total # of respondents	Intervention group (%)	Control group (%)	<i>P</i> -value
Total	391	<i>n</i> = 188	<i>n</i> = 199	
Ever used Rx non-medically (NMUPD)	112	53 (28.2%)	59 (29.7%)	0.75
Female (%)	234	112 (60.9%)	122 (61.9%)	0.83
Age—mean (SD)	28.6	28.2 (10.6)	28.9 (10.8)	0.56
Race/ethnicity				0.67
Non-Hispanic/White	184	87 (47.3%)	97 (49.2%)	
Non-Hispanic/African American	8	2 (1.1%)	6 (3.1%)	
Hispanic	117	59 (32.1%)	58 (29.4%)	
Native American/American Indian	23	10 (5.4%)	13 (6.6%)	
Asian	24	14 (7.6%)	10 (5.1%)	
Other	25	12 (6.5%)	13 (6.6%)	
Type of UNM degree seeking				0.06
Undergraduate	235	103 (56.0%)	132 (67.0%)	
Graduate	108	62 (33.7%)	46 (23.4%)	
Professional degree	38	19 (10.3%)	19 (9.6%)	
Student at any HSC colleges—yes	66	27 (14.7%)	39 (19.8%)	0.19
Years at UNM	3.1 years	3.1 (2.6)	3.0 (2.5)	0.75
Member of fraternity/sorority group—yes	18	10 (5.4%)	8 (4.1%)	0.53
Live on-campus—yes	46	23 (12.5%)	23 (11.7%)	0.81
Tobacco use				0.21
Non-tobacco user	283	142 (77.2%)	141 (71.6%)	
Former tobacco user	63	24 (13.0%)	39 (19.8%)	
Current tobacco user	35	18 (9.8%)	17 (8.6%)	
Alcohol consumption				0.57
Non-drinker	113	53 (28.8%)	60 (30.5%)	
Former-drinker	24	10 (5.4%)	14 (7.1%)	
Occasional drinker	216	110 (59.8%)	106 (53.8%)	
Frequent drinker	28	11 (5.9%)	17 (8.6%)	
Marijuana user				0.34
Non-marijuana user	238	119 (64.7%)	119 (60.4%)	
Former marijuana user	66	31 (16.9%)	35 (17.8%)	
Occasional marijuana user	44	16 (8.7%)	28 (14.21%)	
Frequent marijuana user	33	18 (9.8%)	15 (7.6%)	

HSC, Health Science Center; Rx, prescription drug; SD, standard deviation; UNM, University of New Mexico.

action approach constructs. Significant differences were found in attitudes between the two groups ($P = 0.04$); students in the intervention group have more negative attitudes (mean = -1.4 , SD = 1.4), post-intervention, toward NMUPD compared with the control group (mean = -1.1 , SD = 1.4). On average, students in the intervention group were more likely to view NMUPD as unpleasant, unenjoyable and bad compared with students in the control group. No significant differences were found in mean intention, PNs or PBC between the intervention and control groups (Table I). The underlying

primary behavioral, normative and control beliefs were not significantly different between the intervention and control groups (Table II).

Analysis of students' intentions showed that both the intervention and control groups had high intentions to avoid NMUPD (intervention: mean = 2.2 , SD = 1.4 , control: mean = 2.2 , SD = 1.4 , possible range -3 to $+3$). The difference in descriptive norms between the two groups showed a clear tendency toward significance ($P = 0.052$); i.e. students in the intervention group were more likely to think that people like themselves, or people they respect

Table IV. Reliability of the survey's scales

Scale	Number of items	Cronbach's alpha		Spearman coefficient	
		Pilot testing	Full sample	Pilot testing	Full sample
Attitude (direct measure) ^a	6	0.94	0.94		
Attitude (belief-based measure) ^b	8	0.81	0.75		
Subjective norms (direct measure) ^c	4	0.70	0.86		
Subjective norms (belief-based measures) ^d	4	0.88	0.87		
Perceived behavioral control (direct measure)	2	N/A	N/A	0.83	0.73
Perceived behavioral control (belief-based measures) ^e	8	0.85	0.83		
Intention	3	0.99	0.88		

^aBased on semantic differential scale.^bBased on behavioral belief by evaluation products.^cIncluding both the descriptive and injunctive norms.^dBased on normative belief by motivation to comply products.^eBased on control belief strength by power products.

and admire do not use medications for non-medical reasons (mean = 1.8, SD = 1.3) compared with the control group (mean = 1.5, SD = 1.4). Students in the intervention and control groups had positive injunctive norms (Intervention: mean = 2.1, SD = 1.3, Control: mean = 2.0, SD = 1.3, $P = 0.34$), i.e. both agreed that their important referents would not approve their NMUPD. Students in the intervention and control groups have high PBC over NMUPD (Intervention: mean = 2.6, SD = 0.8, Control: mean = 2.6, SD = 0.8, $P = 0.68$) (Table I).

Analysis of behavioral beliefs showed that students in both the intervention and control groups did not believe that NMUPD would help them stay focused and improve their grades, lose weight, get high or feel more socially accepted. On the other contrary, they feared that the NMUPD could cause them physical problems, mental health problems, addiction and get them arrested. Analysis of normative beliefs revealed that the majority of students in both the intervention and control groups agreed that their healthcare professionals, family members, partners and close friends would not approve their NMUPD. Finally, with regard to control beliefs, students believed that the following factors would make it easy for them to use prescription drugs for non-medical reasons: having a legitimate prescription for the medication, having a friend with a prescription medication, having easy access and being

offered a prescription medication. However, the following factors would only make it slightly easier to use prescription drugs for non-medical reasons: having health insurance, facing a stressful situation, getting behind in schoolwork and being a member of fraternity/sorority groups (Table II).

Discussion

In this study, the reasoned-action approach was utilized to design and evaluate an educational intervention to influence students' intentions, attitudes, PNs and PBC of the NMUPDs. In this study, almost 30% of respondents indicated NMUPD at least once in their lifetime. This rate is higher compared with the rate (19.4%) in a recent study conducted among 21 771 college students over 6-year period [54].

Analysis of students' intentions showed that both the intervention and control groups had high intentions to avoid NMUPD (Intervention: mean = 2.2, SD = 1.4, Control: mean = 2.2, SD = 1.4, possible range -3 to +3). These results are positive and encouraging, as they suggest that most students in both the intervention and control groups had low intention of NMUPD in the future. The results may also reflect the fact that most respondents (70%) never used prescription drugs for non-medical purposes in the past, and, therefore, may have no intentions to do so in the future.

The intervention did not cause differences in NMUPD intention between the intervention and control groups. We identified three potential reasons for the lack of statistically significant differences in intentions between the intervention and control groups. First, the overall sample comprised primarily of students who never used prescription drugs for non-medical reasons in the past (70%), and consequently may have no intentions to do so in the future. An analysis to evaluate the effectiveness of the website was restricted only to those who reported previous NMUPD ($n = 106$) showed that students in the intervention group have higher intentions to avoid NMUPD in the future (mean = 1.3, SD = 1.7, $n = 50$) compared with students in the control group (mean = 1.0, SD = 1.7, $n = 56$). However, this difference was not statistically significant ($P = 0.43$, effect size [Cohen's $d = 0.18$]). A power analysis conducted based on this effect size ($d = 0.18$) and power of 70% showed that at least 382 students are needed in each group to find statistically significant differences between the two groups. Recruiting a larger sample and restricting the intervention only to those who have a history of NMUPD might have led to significant differences between the two groups.

Second, tracking utilization of the website showed that the bounce rate (the visits in which a person left the website from the home page without engaging with the page) was as high as 77%. We noted, however, that respondents likely returned to the website, because the number of visits (764) was four times the number of respondents (188). The mean session duration was 3:48 min. This may have been insufficient time to view the entire website at one visit. Therefore, the effectiveness of the website in influencing students' intentions may have been diminished.

Third, there is inconsistent evidence regarding the usefulness of theory-based interventions in modifying behavior [55–58]. Challenges of applying theories in behavior-change interventions, as suggested by Brug *et al.* (2005), include the lack of a strong empirical foundation for some of these theories, and failing to use theories in the most effective way in the development of interventions [59]. Furthermore,

most of the commonly used theories 'provide at best information on *what* needs to be changed to promote healthy behavior, but not on *how* changes can be induced' (Brug *et al.*, 2005). However, the reasoned action-approach provides guidance on how to make theory-based interventions more effective by providing structure for impacting attitudes and motivations related to health behaviors [59]. The evidence for the efficacy of the reasoned-action approach comes mainly from cross-sectional studies [60]. Moreover, most cross-sectional studies show that the theory's main constructs can predict intentions but not confirmed with measuring actual behaviors. The intervention used in this study only measured intentions to NMUPD in the future but was not confirmed by measuring actual behavior in the future. Ideally, intentions and behavioral performance should be done at two distinct points in time. A number of studies have found that intention predicts behavior quite well [47, 61]. Therefore, we suggest using the reasoned action approach in designing interventions and measuring health behaviors longitudinally to validate behavioral changes associated with attitudinal changes.

The intervention was successful in influencing attitudes in the intervention group. Students in the intervention group had significantly greater negative attitudes score toward NMUPD compared with the control group. No significant differences existed between the two groups with regard to PBC or PNs. This may be related to the manner by which the website was utilized. The number of students who viewed pages related to influencing student norms and PBC was probably low because these pages were at the end. Therefore, the effectiveness of that portion of the website may have been reduced. Due to the anonymity of the survey, it was not possible to correlate responses with number of pages viewed or identify which pages were viewed.

Although some studies have utilized the reasoned-action approach to understand NMUPD among college students [23–25], to our knowledge no studies used this framework to develop an intervention to influence students' intentions or behavior regarding NMUPD. More empirical research is needed to identify the best strategies to reach

students who reported NMUPD, and the best ways to influence their intentions and ultimately their behavior. The findings from our study have several important implications for guiding future interventions and preventive strategies. First, future interventions should consider tailoring and targeting interventions to the appropriate audience. Clearly, there were two substantially different segments of population in this study, those who previously used prescription drugs non-medically, and those who never did. A secondary analysis showed significant differences in attitudes, norms and intentions between those who reported NMUPD and those who did not. The information presented in our intervention appeared to be more relevant to those who previously used prescription drugs non-medically. This limitation could be addressed by an initial question regarding previous NMUPD and stopping the intervention among those who responded negatively. A disadvantage to this approach is that individuals at risk for NMUPD might not have had the opportunity to view the content of the website.

Second, future design of websites targeted toward students might focus more on strategies that make websites more engaging at the entry page and reduce the number of pages that a student has to navigate. Our website may have been too long to be viewed by college students. Students have short attention spans that can range from 10 to 15 min [62]. Unfortunately, over years the mean attention span of students is getting shorter [63].

Limitations

There are several limitations of this study. The low-response rate limits the generalizability of the results and increases the possibility of non-response bias. Reasons for low-response rate may include lengthy survey and website, using an online survey (rather than mail or face-to-face survey), sending some of the reminders to participate in the study during the exam's week, and asking about a sensitive topic. We performed a wave analysis to evaluate non-response bias, in which early responders were compared with late responders (who are assumed to be more similar

to non-responders) [34]. No significant differences were found in demographic characteristics, including gender ($P=0.82$), age ($P=0.8$), lifetime NMUPD ($P=0.2$), degree pursued ($P=0.5$), being a student in a health sciences college ($P=0.16$), years spent at the university ($P=0.06$), sorority/fraternity group affiliation ($P=0.17$), race ($P=0.48$) and living on-campus ($P=0.20$). Therefore, early responders are similar to late responders, and consequently the concern for non-response bias is reduced. We also compared demographic characteristics of respondents versus the overall UNM student body in 2015. The results for respondents versus UNM student body, respectively, were: female gender 61.4% versus 55.2%, mean age 28.6 versus 25.6 years, Hispanic ethnicity 30.7% versus 42.1%, Native American 6.0% versus 5.1% and undergraduate education level 61.7% versus 72.7%. These comparisons suggest that our sample was similar to the UNM student body but some differences existed. Another factor limiting generalizability is that the sample was drawn only from one university.

Also, asking about topics that are associated with social stigma make the results from the study vulnerable to social desirability bias. Accordingly, students may under-report their lifetime NMUPD and other substance of abuse to provide more socially desirable responses. However, given the voluntary nature of the study, the absence of face-to-face contact, and informing the respondents of the measures taken to preserve the confidentiality of their responses, the possibility of social desirability bias is minimized.

In addition, information obtained from the survey were based on self-report and were not confirmed by other objective measures. However, evidence exists from other studies indicating high validity and reliability of illicit drug's self-report use by students if asked under the anonymous circumstances [64].

We note that the low utilization of the website reduces the effectiveness of the website in influencing intentions. Therefore, it is difficult to truly assess the success of the website, when not all the pages were viewed by all participants and the mean time spent per session was less than 5 min.

A potential limitation is that we chose not to include a pre-test. Although, a pre-/post-test design may have helped to identify more differences in responses after the intervention, it suffers from the bias of a testing effect, since the study participation was short (less than 1 h), a testing bias would likely be strong. Features attributing to the strength of the study design were random selection from the study body of UNM and random assignment of the intervention. Those features address most concerns of internal validity.

Conclusion

This study is the first to utilize the reasoned-action approach as a theoretical framework to design an intervention to influence students' intentions regarding NMUPD. The intervention was successful in influencing attitudes in the intervention group but no differences were observed in PNs, PBC or intentions to avoid NMUPD. Using prescription drugs non-medically is not a trivial behavior; it may lead to addiction, serious mental health and physical problems. Therefore, collaborative efforts are needed from college administrators, healthcare professionals and parents to identify, prevent and combat NMUPD among college students.

Supplementary data

Supplementary data are available at *HEAL* online.

Conflict of interest statement

None declared.

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