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Development and validation of HIV prevention scale for Historically Black College students

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This paper reports the development and initial validation of scores obtained from the socio-cognitive determinants of HIV prevention measures. Series of scales developed to identify HIV prevention are knowledge, motivation and behavioral skills of HIV/AIDS and other sexually transmitted infections. The study was carried out among college students attending Historically Black Colleges and Universities (HBCU). In the first study, the findings of exploratory factor analyses using 297 HBCU students suggest a 23-item scale with four correlated factors: HIV prevention education motivation (3 items), HIV prevention knowledge (6 items), HIV prevention personal motivation (5 items) and HIV prevention behavioral skills (3 items). Initial estimate of convergent validity for the HIV prevention measures scores were reported. The psychometric properties of the four-factor structure of HIV prevention measures derived from the first study were confirmed by confirmatory factor analyses in a second study.

Key words: HIV/AIDS prevention, college health, exploratory factor analysis, confirmatory factor analysis, safe sex practices, information motivation-behavioral skills model (IMB Model), Historically Black Colleges and Universities (HBCUs).

INTRODUCTION

Recent data from the Centers for Disease Control and Prevention (CDC) and studies by independent researchers indicate that the incidence and spread of HIV/AIDS and other sexually transmitted diseases among heterosexual college students attending Historically Black Colleges and Universities continue to rise at an alarming rate, despite increase investment in HIV prevention programs aimed at reducing engagement in risky sexual behavior among students on college campuses (CDC, 2004a, b, c, 2006, 2008, 2008a; Thompson-Robinson, 2009; Owen et al., 2006; Foreman, 2003; Yee, 2004; Hightow et al., 2005; Leone et al., 2004). Qualitative studies suggest that the most salient barriers to HIV prevention among black college students are negative views of condoms, trust issues, spontaneity, young age, non-monogamous relationships and, perhaps most

importantly, fewer behavioral skills relating it (Duncan et al., 2002; Bazargan et al., 2000; Opt and Loffredo, 2004; Leone et al., 2004). Other researchers found that black college students are for the most part, quite knowledgeable about HIV/AIDS but this knowledge is not a predictor of avoiding risk among the college students (Mongkuo et al., 2010; Anastasi et al., 1999; Bates and Joubert, 1993; CDC, 2004c; Gupta and Weiss, 1993; Lewis et al., 1997; Opt and Loffredo, 2004). Despite increased investments in HIV prevention programs on college campuses, high risk sexual behavior continues to occur among college students (Netting and Burnett, 2004; Opt et al., 2007).

Research indicates that HIV prevention programs are more likely to succeed when they are based on empirical evidence and theory (Fisher and Fisher, 1992; Choi and Coates, 1994; Leviton, 1989; Kelly, 2002). Most prevention education programs aimed at reducing the incidence of HIV and other sexually transmitted infections (STIS) among college students attending Historically

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Black Colleges and Universities (HBCUs) have been ineffective. This may be due to lack of valid and reliable, research-driven, socio-cognitive systematic, and psychometric measures used to assess and identify the key constructs that influence safe sex practices among specific groups, such as HBCU students. While there exist a plethora of measurement instruments used to assess HIV prevention programs but a very few (Anderson et al., 2006; Fisher et al., 2003) were developed and systematically validated, based on comprehensive, advanced and contemporary theories for predicting health outcomes, such as Fisher and Fisher's (1992) Information-Motivation-Behavioral Skill (IMB) model or utilizing advanced statistical procedures like Confirmatory Factor Analysis (CFA). Rather, most of the scales used in most of these studies were constructed with sole reliance on exploratory factor analysis (EFA).

Several scholars have argued that EFA is insufficient in establishing the validity of a measurement scale because it allows statistics rather than theory to determine the structure of the score and does not adequately assess error (Gorsuch, 1983; Thompson and Daniel, 1996; Hair et al., 2006). Dickey (1996) asserts that, EFA itself cannot be used as the basis for a final determination regarding an underlying construct because the analysis is designed to maximize the amount of variance within the current variable set, and subsequent analyses with other data sets may reproduce the same factor structures. Hence, reliance on findings from studies with measures derived from EFA to design HIV prevention programs at HBCUs may not produce the desired outcome of improving safe sex practices among the students. A number of studies have been conducted using confirmatory factor analysis (CFA) to test the psychometric properties of HIV prevention measures used to assess HIV prevention (Anderson et al., 2006; Coates et al., 1994; Jemmott and Jemmott, 1991; Jemmott and Jones, 1993). However, the units of analysis of these tests represented the general population, not specifically college students attending HBCUs.

Considering the limited number of theory-driven, valid and reliable measurement instruments for assessing HIV prevention among college students attending HBCUs, the goal of this research project was to develop and validate a scale for obtaining valid and reliable socio-cognitive information that can be used to assess the level of HIV prevention knowledge, motivation and behavioral skills among students attending HBCUs. This research project is important because recent data published by the CDC and other independent research findings indicate the rapid and disproportionate incidence and spread of HIV and other STDs infection among college students, especially those attending HBCUs. Hence, this research project was intended to provide information that can be used by administrators to develop an effective HIV and STDs prevention curriculum for college students at

HBCUs and other similar institutions of higher education.

The purpose of the present study is of two-fold. First, to examine the factor structure of an HIV prevention measure (HPM) by using exploratory factor analysis (EFA), to identify the key measures of the latent constructs of HIV prevention knowledge and motivation. Second, to perform a confirmatory factor analysis (CFA) to validate or test the optimal fit of the measurement model derived from the EFA. Specifically, the study was aimed at addressing the following two research questions:

1. What are the variables that measure HIV prevention knowledge, HIV prevention motivation, and HIV prevention behavioral skills among students attending Historically Black College?

2. What is the optimal fit measurement model structure of HIV prevention knowledge, HIV prevention motivation, and HIV prevention behavioral skills among Historically Black College students?

THEORETICAL FRAMEWORK

The theoretical framework used to identify and develop the predictive measures of HIV prevention among college students attending HBCUs was based on Fisher and Fisher's (1992) information-motivation-behavioral skills (IMB) model. This model has been proven useful in explaining HIV risk prevention and other health-promoting behavior (Fisher and Fisher, 1992; Fisher and Fisher, 2000; Fisher et al., 2003; Misovich et al., 2003), as well as for providing a useful framework for developing promotion programs (Fisher and Fisher, 2000; Fisher et al., 2003). The framework is appropriate for this study because it is considered to be parsimonious, its constructs are operationally defined and it specifies the causal linkages between its theoretical determinants and their relation to prevention behavior (Kelly, 2002; Fisher et al., 1994). In particular, the model states that HIV prevention information and motivation works through prevention behavioral skills to influence risk reduction behaviors, such as safe sex practice (Fisher and Fisher, 1992). The model considers information and motivation to be independent constructs, which may relate to the practice of behavioral skills relevant to risk behavior change. In effect, the model proposes that to practice safe sex, it is necessary for an individual to possess the information or knowledge about how to prevent HIV infection and the motivation to prevent HIV infection.

Previous research on information pertaining to HIV prevention has shown information to be an inconsistent predictor of HIV preventive behavior (Anderson et al., 2006; Mongkuo et al., 2010). However, when assessed within the framework of the IMB model, information has been a consistent predictor of HIV preventive behavioral skills (Fisher et al., 1994, 1999). Motivation is theorized

to include both personal motivation (that is, personal attitudes towards performing preventive behavior), as well as social motivation (that is, perceived social support for engaging in safe sex practice). In this sense, the IMB model suggest that an individual's motivation to engage in preventive behavior is determined not only by his or her own personal feelings about whether preventive behavior is good but also whether friends and other referents provide social support for such preventive behavior. According to the IMB model, information and motivation influence risk prevention independently and in large part, indirectly through behavioral skills needed to perform HIV preventive behavior (Fisher and Fisher, 2000; Avants et al., 2000). In principle, behavioral skills refer to an individual's sense of self-efficacy necessary to engage in preventive behavior. Thus, an individual would need to perceive that he or she possesses the behavioral skills necessary for health risk prevention.

Using the IMB model, HIV and health promotion researchers have consistently found a strong association between motivation and behavioral skills (Misovich et al., 2003; Fisher et al, 1994, 1999). Other studies have shown that behavioral skills mediate the effects of motivation on preventive behavior and HIV prevention behavior (Fisher et al, 1999; Avants et al, 2000; Bryan et al., 2002). In summation, the IMB model suggests that knowledgeable and motivated individuals who enact the relevant behavioral skills are more likely to practice the recommended preventive behaviors, such as HIV prevention.

Over the years, researchers have drawn on various behavioral models to predict preventive behavior among college students with the goal of designing effective HIV/AIDS education and prevention programs. Unlike other models such as the theory of reasoned action (Ajzen and Fishbein, 2002) and theory of planned reason (Ajzen, 1985; Ajzen and Fishbein, 2005) used in the study of HIV/AIDS and its risk factors, the IMB model has been validated extensively as providing a more comsocio-cognitive prehensive model for identifying predictors of health behavior outcomes (such as HIV prevention) that are of theoretical and empirical importance (Carey et al., 1997; Fisher et al., 1999, Fisher and Fisher, 1992, 2000; Abraham and Sheehan, 1994; Fisher et al., 2003). In addition, the IMB model has been applicable to behaviors outside the HIV domain, including voting behavior (Glasford, 2008), breast self-examination behavior among women (Misovich et al., 2003), adolescence smoking behavior (Botvin et al., 1989) and oral rehydration behavior in developing countries (Foote et al., 1985).

Applying the IMB model to the present study, we hypothesize that at HBCU College, students' level of HIV prevention information or knowledge and HIV prevention motivation are fundamental determinants of HIV prevention behavioral skills, which in turn, leads to HIV prevention behavior among college students attending



Figure 1. Quasi-experimental one-shot case study design. X is exposure of a student to societal risk activities associated with HIV/AIDS infection at a selected HBCU campus located in South-eastern United States. O_2 is a measure of a HBCU college student's level of HIV prevention information or knowledge and HIV prevention motivation (personal and social).

HBCUs. In essence, if HBCU college students are well informed and motivated to practice HIV risk prevention and possess the skills required to effectively prevent HIV infection, they will likely be more willing to engage in HIV prevention behavior. Conversely, if they are poorly informed about HIV risk prevention, unmotivated to engage in HIV risk prevention, and lack the behavioral skills required to effectively prevent HIV infection, they will be less likely to engage in HIV prevention behavior.

MATERIALS AND METHODS

Research design

This study employed a quasi-experimental one-shot case study design (Isaac and Michael, 1997). The design involved using a selfadministered survey to obtain the perception of HBCU students about the requisite information and motivation required to enact HIV risk prevention behavioral skills and HIV preventive behavior. This design is generally considered to be most useful in exploring researchable problems or developing ideas for further research action (Isaac and Michael, 1997). Also, this design is considered to be appropriate when exploring individuals' perception of relatively new or less understood phenomenon, such as factors influencing the spread of HIV/AIDS among HBCU students attending HBCUs. A schematic representation of the design is displayed in Figure 1.

The study was conducted in two phases: The first phase involved EFA and initial validation of the HIV prevention measurement instrument (HPM). The purpose of this phase was to generate an initial pool of items to measure the predictive constructs of HIV prevention among HBCU students, and assess the convergent validity and internal consistency of the factor structure of the scale items. In the second phase, confirmatory factor analysis was performed to test how well the measured variable or items on the measurement instrument represent the latent constructs derived from EFA.

Scale construction

The data source for this study was a 41-item self-administered survey designed to obtain the students' opinion about HIV/AIDS and its risk factors. The items were extracted and modified from various survey instruments, which have been used in HIV/AIDS studies. The survey instruments included: The HIV Knowledge Questionnaire (Carey et al., 1997, Carey and Schroeder, 2002); the National Survey of Teen on HIV/AIDS (The Kaiser Family Foundation, 2000); The International AIDS Questionnaire (Davis et

al., 1999), The National Survey of the Public's Attitudes Toward HIV/AIDS in the United States and the World (The Kaiser Family Foundation, 2002); the AIDS Epidemic At 20 Years, The View From America (The Kaiser Family Foundation, 2001) and other independent studies on HIV/AIDS such as, the Family Health International Behavioral surveillance surveys, UNAIDS Measure Evaluation HIV/AIDS Prevention Indicator Survey, Tanzania Stigma Indicator and Community Endline Individual Questionnaire, FHI Behavioral Surveillance Surveys, and HIV/STD Prevention Indicator Survey.

A total of 26 items were extracted from these various survey instruments or questionnaires. Each statement on the developed survey had 5-ordered Likert scale response categories, ranging from strongly agree to strongly disagree. Content validity was established by giving the survey instrument to ten HIV prevention experts to review and suggest items to be modified or eliminated, that they considered irrelevant, redundant or peripheral to HIV/AIDS prevention. 19 items were identified by the experts as irrelevant, redundant or peripheral to HIV/AIDS prevention. These items were eliminated from the survey. Furthermore, prior to administering the survey, it was pilot-tested on a sample of 20 HBCU students for redundancy or unclear items. The students found three items to be redundant or unclear. These items were eliminated. Finally, redundant information and non-informative variables were removed by identifying bivariate relations with high correlation values, reviewing the theoretical foundation of the wording of each item and removing as many redundant items or variables as possible. With the remaining variables, a principal component factor analysis applying the varimax rotation was used to further reduce the remaining items' pool into a smaller number of interpretable factors.

The final survey instrument consisted of two parts. The first part contained demographic information such as race/ethnicity, enrollment status, academic class status and age group. The second part contained a battery of the 23 items designed to measure the respondents' level of HIV prevention information, HIV prevention motivation, AIDS prevention behavioral skills and intent to practice safe sex.

Participants and procedure

The HBCU selected for this study has a population of 6,217 college students enrolled. A breakdown of the population by race/ethnicity shows that approximately 70% is African American, 17% Caucasian and 4% Hispanic, 1% Native American and 4% other racial/ethnic groups. The age distribution of the student population ranges of 17 to 25 years old (55%), 26 to 40 years (31%), and above 40 (14%). Most of the students are females (68%) while males were 32%. The distribution of the population by academic class shows: Freshmen (19%), sophomore (15%), junior (18%), senior (32%), and graduate (11%). Most of the students attending the university are enrolled as full-time students (66%), while 34% were part-time.

Participants in the study include a purposive, convenient sample of students attending HBCU. After receiving Institutional Review Board's (IRB) approval, various professors were contacted and asked for permission to conduct the survey during a portion of their class time. Once the permission was granted; we met with the students during the class period and explained the purpose of the study to them. They were also informed that their participation was strictly voluntary and they may either opt not to participate in the study and leave, or not provide a response to any of statements. In addition, the students were informed that no incentive will be provided for their participation in the study. The students who agreed to participate in the survey were provided with a consent form for them to read, sign with date. The consent form explained to the students that their participation was voluntary and would not affect their grade and their identity will be kept strictly confidential and their names would not appear in any report. We adhered to all

American Psychological Association (APA) research guidelines.

This method varied from the traditional study in which researchers surveyed students in class during a 1-week period in 2003 (Opt and Loffredo, 2004). The survey was anonymous in that no identifying information was connected to individuals, or included in the data set. Participants completed the survey during class time and returned them before leaving the class. Non-participants were asked to remain quiet or were dismissed from the class early. The survey took less than 10 min to complete.

A total of 674 students agreed to participate in the survey. The sample was split by generating a uniform random number of each case, sorting the cases by the random number, selecting the first half of 297 of the cases for membership in the first study (exploratory factor analysis) and assigning the second half of 377 the cases to the second study (confirmatory factor analysis).

Exploratory factor analysis

The EFA include 297 participants whose response to each of the items showed no pattern of missing values. A breakdown of the sample by race/ethnicity was as follows: Blacks (79.4%), whites (9.8%), Hispanics (3.0%), Native Americans (1.0%) and other racial groups (6.8%). Most of the respondents were within the age range of 18 to 25 (7 6.1%), 26 to 34 (10.1%), 35 to 44 (8.4%) and above 45 years (4.4%). The sample distribution by enrollment status showed that majority of the participants were full-time students (97.6%) and only 2.4% were attending college as part-time students. A breakdown of the sample by academic class status indicated that most of the participants were seniors (37.6%), freshmen (20.0%), juniors (19.3%) and sophomores (15.3%). In general, the demographic breakdown of the study participants was similar to that of the student population of the HBCU under investigation, thus indicating a fairly representative sample of the student population. Once the survey was completed, the participants' responses were score on a 5-point Likert scale ranging from strongly disagree to strongly agree. The scores were reversed for negatively stated items. The responses were entered into a constructed SPSS Version 19.0 dataset for analysis.

Data analyses

Due to the large number of items on the survey instrument used in this study, the first step in data analyses involved conducting an exploratory factor analysis to remove redundant information and non-informative variables. This was accomplished by identifying bivariate relations with high correlation values, reviewing the theoretical foundation of the wording of each item and removing as many redundant items or variables as possible. With the remaining variables, a principal component factor analysis applying the varimax rotation was used to further reduce the remaining items' pool into a smaller number of interpretable factors.

The number of factors was determined by joint consideration of Cattell (1966) scree plot and residuals criteria. The latent root (eigenvalue) criterion was considered to be fairly unreliable since in this study the number of variables was close to 30 and several communalities were less than 0.70 (Mertler and Vannatta, 2005: 260). Thurstone's (1947) principle of simple structure using pattern coefficient of absolute value 0.3 as the lower bound of meaningfulness per factor and interpretability of the solution were used to determine the final solution (Lambert and Durant, 1975).

Finally, internal consistency estimates (Cronbach's alpha) were calculated for the items representing each factor retained from the exploratory factor analysis procedure. Cronbach's alpha of 0.60 was considered as the minimum acceptable level of internal consistency for using a factor (Price and Mueller, 1986; Hair et al., 2006). For factors with Cronbach's alpha below this minimum threshold, the internal consistency of the factor was improved by identifying and removing items with low item-test correlation and item-rest correlation (Nunnally and Bernstein, 1994). If no improvement of the reliability score occur, the factor was deleted.

RESULTS

Prior to the EFA, the data were evaluated to screen for missing values, outliers and assess normality and linearity. A simple independent sample t-test found three cases exhibiting patterns of missing values. The cases were eliminated reducing the sample size from 300 to 297 cases. Using Mahalanobis distance, no outliers were found. A scatterplot matrix revealed fairly normal distributions and linear relationship among the items. Principal component factor analysis was conducted utilizing a varimax rotation with Kaiser normalization.

The initial analysis produced a five factor solution. Internal consistency tests of the factors showed that one of the factors was below the lower bound threshold. Each of the items representing the factor had low item-test correlation and item-rest correlation. Hence, the factor was deleted; resulting in a final solution comprised four factors with 21 items that accounted for a total of 50.6% of the variance in the items. Examination of the correlation matrix indicated evidence of inter-item dependence $[\chi^2 (136) = 1475.244, p < 0.01]$, an acceptable Kaiser-Meyer-Olkin (KMO) sampling adequacy statistic (KMO = 0.787) and an anti-image matrix that demonstrated properties approximating the desired diagonal matrix with only 58 (42%), non-redundant residuals with absolute values exceeding the desired threshold of 0.05. Visual inspection of Cattell's (1966) scree plot also suggested retention of the four-factor solution for the survey responses (Table 1). Factor 1, which explained 23% of the variance, had 3 items with a pattern coefficient (factor loading) of absolute value 0.3 or higher with large pattern/structure effect size (Cronbach's $\alpha = 0.90$). This first factor was labeled "HIV Prevention Education Motivation". The second factor, labeled "HIV Prevention Knowledge" explained 13% of the variance had 5 items with acceptable pattern/ structure effect size coefficients (Cronbach's α = 0.66). Factor 3, labeled "HIV Prevention Personal Motivation" explained 8% of the variance had 6 items with adequate pattern/structure effect size coefficients (Cronbach α = 0.62). Factor 4, labeled "HIV Prevention Behavioral Skill" 7% of the variance had 7 items with large pattern/structure effect size coefficients (Cronbach's $\alpha = 0.60$).

Confirmatory factor analysis

Purpose

The main purpose of the second study was twofold:

1. To use confirmatory factor analysis (CFA) to test the

factor structure of the scores obtained from the 21-item HIV Prevention Measure (HPM) generated in Study 1 (via the EFA procedure), using an independent sample, through the use of CFA procedure;

2. To examine the stability of the HPM measurement model.

Participants

Participants in this study were a convenience sample 372 students attending the same Historically Black College as in the first study. A breakdown of the sample by race/ethnicity was as follows: African Americans (78.7%), Caucasians (11.4%), Hispanics (3.4%), Native Americans (1.0%) and other racial groups (6.6%). Most of the respondents (77.5%) were within the age range of 18 to 25, 26 to 34 (10.5%), 35 to 44 (8.3%) and above 45 years (3.7%). The sample distribution by enrollment status showed that majority of the participants were full-time students (97.3%) and only 2.7% were attending college as part-time students. A breakdown of the sample by academic class status indicated that most of the participants were seniors (36.2%), freshmen (23.9%), juniors (22.0%) and sophomores (17.3%). As in the first study, the aforementioned demographic breakdown of this study participant was comparable to that of the student population of the HBCU under investigation, thus indicating a fairly representative sample. Once the survey was completed, the participants' responses were score on a 5-point scale, ranging from strongly disagree to strongly agree. The scores were reversed for negatively stated items. The responses were entered into a constructed SPSS Version 19.0 dataset for analysis.

Measures and procedure

The four factors and their corresponding measures of 21 items retained in the EFA were used in the CFA. As in the EFA, each item was score on a 5-point Likert scale, ranging from strongly disagree to strongly agree, with the scores reversed for negatively worded items. The procedure was the same as in the first study.

Data analyses

Because the analysis was done on original data and not a data summary, missing data were handled by using the full information maximum likelihood (FIML) procedure. This allows maximum likelihood estimation to be based on a data set containing missing data while still making use of all remaining data, without any form of imputation (Blunch, 2010). The 21 items identified in the EFA were subject to a CFA using AMOS 17.0 (Arbuckle, 2007). A number of indices were used to evaluate the goodness of fit of the four-factor orthogonal HPM measurement model. The model absolute fit was assessed using Table 1. Exploratory factor analysis principal component loadings.

Items	Loading
Component 1: HIV prevention education motivation.	
HIV education in middle school is a waste of time	0.91
HIV education in high school is a waste of time	0.90
HIV education in college is a waste of time	0.85
Component 2: HIV prevention knowledge	
A person can get HIV from tears or saliva	0.68
A person can be infected with the AIDS virus from someone's cough or sneeze on them	0.68
Sharing cooking utensil with a person who has AIDS is not safe	0.63
A person can get the AIDS virus by using a public toilet	0.60
A person can be infected with the AIDS virus from mosquitoes	0.57
Component 3: HIV prevention personal motivation	
During sex, I would be insulted if my partner insisted we use condoms.	0.66
I would dislike asking a sex partner to get the HIV antibody test	0.63
I intent to talk about HIV prevention with a mate only after sex	0.57
I dislike the idea of limiting sex to just one partner	0.52
A person can be infected with the AIDS virus by attending college with a student who has AIDS	0.48
HIV is punishment for immoral behavior	0.44
Component 4: HIV prevention behavioral skill	
I will use condoms when having sex if I am not sure if my partner has HIV	0.61
I would openly promote others to get tested for HIV	0.52
HIV/AIDS education is needed on the college campus	0.58
I intent not to use drug so I can avoid HIV	0.59
A pregnant woman can give the virus that cause AIDS to her unborn baby	0.35
At the present there is no cure for AIDS	0.32
If I was HIV positive, I would tell my mate	0.47

chi-square statistics, χ^2 , with low χ^2 considered good fit (Hair et al., 2006). Incremental fit was evaluated using the Root Mean Square Errors of Approximation (RMSEAs) with a value less than 0.06 indicating a relatively good fit, along with Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) with values of 0 .95 or greater considered desirable (Hu and Bentler, 1999; Hair et al., 2006, Blunch, 2010; Brown, 2006).

The construct validity of the model was evaluated by examining convergent validity with completely standardized loading estimates of 0.50 or better and construct reliability equal or greater than 0.60 considered to be good. Also, parametric tests of the significance of each estimated (free) coefficient were performed. Insignificant loadings with low standardized loading estimates were deleted from the model. To assess problem with the overall model, the completely standardized loadings were also examined for offending estimates, such as loadings above 1.0 or below. The wording and scoring of items with offending loading estimates were examined in the dataset to ensure that they were consistent. Any inconsistencies identified were corrected by reversing the scoring scheme to make them consistent, with the way that items were stated on the measuring instrument and re-entering the data accordingly. If these corrective measures failed to eliminate the offending standardized loadings, then the item was dropped from the model. Finally, internal consistency estimates (Cronbach's alpha) were calculated for the items representing each factor retained from the confirmatory factor analysis. Cronbach's alpha of 0.60 was considered as the minimum acceptable level of internal consistency for using a factor (Price and Mueller, 1986: 6; Hair et al., 2006). For factors with Cronbach's alpha below this minimum threshold, the internal consistency of the factor was improved by identifying and removing items with low item-test correlation and item-rest correlation (Nunnally and Bernstein, 1994). If no improvement of the reliability score occurred, the factor was deleted.

Results

Initial CFA of the 21 items and four constructs

 Table 2. Standardized estimate for item loadings, confirmatory factor analysis.

HIV prevention measurement scale items	Estimate
HIV prevention education motivation (EMOT)	
HIV education in middle school is a waste of time (ED 1)	0.76
HIV education in high school is a waste of time (ED 2)	0.90
HIV education in college is a waste of time (ED 3)	0.76
HIV prevention knowledge (INFO)	
A person can get HIV from tears or saliva (KI1)	0.50
A person can be infected with the AIDS virus from someone's cough or sneeze on them (KI2)	0.70
Sharing cooking utensil with a person who has AIDS is not safe (KI4)	0.42
A person can get the AIDS virus by using a public toilet (KI5)	0.53
HIV prevention personal motivation (PMOT)	
During sex, I would be insulted if my partner insisted we use condoms (SS2)	0.30
I intent to talk about HIV prevention with a mate only after sex (SS4)	0.30
I dislike the idea of limiting sex to just one partner (SS1)	0.52
HIV Prevention HIV Prevention Behavioral Skills (BEHV)	
I would openly promote others to get tested for HIV (SE3)	0.43
If I was HIV positive, I would tell my mate (SE1)	0.68

measurement model produced fit indexes that indicated a relatively poor fit of the model to the data ($\chi^2 = 267.185$, p= 0.001; CFI = 0.865; ITI = 0.842; RSMEA = 0.08). To improve the model's test of the measurement theory, we performed a series of the diagnostic tests described previously. Nine items were found to be problematic, in that, their standardized loadings were too low and insignificant or their item-test and item-rest coefficients were too low. These six items were dropped from the model, leaving a final solution of 12 items and four latent constructs (Table 2) and the confirmatory factor analysis was conducted again. All measured items were allowed to load only on one construct each. Therefore, the error term were not allowed to relate to any other measured variable, making the measurement model congeneric. Two constructs (EMOT and PMOT) are indicated by three measured items, one (INFO) by four measured items, and one (BEHV) by two measured items. Every individual construct is identified and the measures are reflective. The overall model was over identified by placing constraints on the measurement paths for each construct.

The overall model's χ^2 is 58.905 with 48 degrees of freedom. The *p*-value associated with this result is 0.135, which is not significant using a Type I error rate of 0.05. Thus, the χ^2 goodness-of-fit statistic does indicate that, the observed covariance matrix matches the estimated covariance within sampling variance. The RMSEA = 0.025, lower (that is, better) than the standard rule of 0.06 for good models of this complexity (Hair et al., 2006; 753). The CFI = 0.99 and TLI = 0.98, both good for a model with 11 variables and a sample size of 372 (Hair et al., 2006).

al., 2006: 753). The CFA results suggest that the model underlying the HIV prevention measurement (HPM) scale indeed could produce the correlations and covariance we observed among the HPM subtests. Hence, the theoretical structure of the HPM is supported.

Focusing on the model itself, initial completely standardized estimates showed 24 loadings below the cut-off of 0.50 that were insignificant. The variables were dropped from the model leaving a final solution with 11 variables and four constructs. The first factor, named "Prevention Education Motivation" had three items and Crobach's alpha of 0.90. Factor 2, called "Prevention Knowledge" had four items and Cronbach's alpha of 0.677. Factor 3, named "Prevention Personal Motivation" had two items with Cronbach's alpha of 0.52. Table 2 and Figure 2; display the completely standardized loadings of the final HPM model. The factor loadings for each of the latent constructs ranged from reasonable (0.30) to substantive (0.90) and statistically significant. Within factors, most subtests items had fairly equivalent loadings on the latent construct they supposedly measure.

DISCUSSION

The purpose of this study was to develop and validate the psychometric properties of HIV prevention among college student attending HBCUs. The survey instrument for this study included items from previous HIV prevention studies and was subjected to exploratory and confirmatory factor analyses. Using Fisher and Fisher's



Figure 2. HIV Prevention measurement CFA model for historically black college students.

(1992) Information-motivation-Behavioral Skills (IMB) model of preventive behavior, three constructs (HIV Prevention Information, HIV Prevention Motivation, and HIV Prevention Behavioral Skills) were identified as predictors of HIV preventive behavior or safe sex practice among HBCU students. Exploratory factor analysis identified a total of four subscales, measuring the three IMB constructs. The EFA helped to determine the factor

structure for the underlying set of items hypothesized to measure HIV prevention. The construct of HIV prevention motivation had two subscales named "HIV Prevention Education Motivation" and "HIV Prevention Personal Motivation". HIV Prevention Information had one scale called "HIV Prevention Knowledge"; and HIV Prevention Behavioral Skills had one scale named "HIV Prevention Behavioral Skills." Each of the scales exhibited an acceptable internal consistency with Cronbach's a ranging from 0.60 to 0.90 (Price and Mueller, 1986; Hair et al., 2006). Confirmatory factor analyses (CFA) then validated the hypothesized factor structure bydetermining goodness-of-fit. Initial CFA excluded ten items with poor psychometric properties through this process, resulting in final HIV prevention scales with good goodness-of-fit indices and excellent Cronbach'salphas. The CFA results generally support a reasonably good measurement model (Hair et al., 2006). For example, the overall model χ^2 statistic is insignificant using Type I error rate of 0.05. Thus, the χ^2 goodness-of-fit does indicate that, the observed covariance matrix matches the estimated covariance matrix within sampling error. Additionally, the absolute fit index (RMSEA) and the incremental fit indices (CFI and ITL) exceed the lower bound guidelines for a good model of this complexity and sample size (Hair et al., 2006).

These findings suggest that through exploratory and confirmatory factor analyses, valid and reliable scales with sound psychometric properties were developed to quantify HIV preventive behavior at Historically Black Colleges and Universities. Overall, the fit statistics suggest that the estimated model reproduces the sample matrix reasonably well. covariance Furthermore, evidence of construct validity is present in terms of convergent and discriminant validity. In a sense, the HPM measures seem to behave as they should in term of unidimensionality of the four measures of the IMB model of HIV prevention behavior and the way the constructs relate conceptually to measures of HIV prevention behavior in previous studies (Fisher and Fisher, 2002; 2000; Fisher et al., 2003; Bryan et al., 2002; Carey et al., 1997; Abraham and Sheehan, 1994; Glasford, 2008; Misovich et al., 2003; Botvin et al., 1989; Foote et al., 1985; Avants et al., 2000, Osborne and Egede, 2010; Misovich et al., 2003). These scales could be used to conduct a more thorough assessment of HIV prevention programs at HBCUs, conduct future research to increase our understanding of HIV prevention behaviors at HBCUs, guide the design of research-driven HIV prevention programs at HBCU institutions and monitor and evaluate new HIV prevention programs at historically black college campuses.

There are limitations to this study that should be acknowledged. First, our study did not examine the psychometric structure of social prevention motivation, which is a key dimension of the motivation construct of the IMB model. Instead, this construct was replaced with education prevention motivation primarily because a goal of the study was to develop a valid HIV prevention measurement instrument, which can be used to assess education prevention programs on HBCU campuses. However, future studies should extend the validation process to include social prevention motivation. Second, while the results of this study suggest a good fit for the psychometric properties of the HIV prevention behavior measurement model, it did not cross-validate the results

using data from a different sample. Hence, the external validity of the measurement instrument is questionable.

To establish external validity of the HPM instrument, studies should extend the CFA to test for metric invariance using other HBCU samples (Cheung and Rensvolt, 2002).

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