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Transitions in Risk-Behavior Profiles among First-Year College Students

Katelyn F. Romm[1], **Aaron Metzger**[2], **Amy L. Gentzler**[2], **Nicholas A. Turiano**[2]

[1]Department of Prevention and Community Health, Milken Institute School of Public Health, George Washington University

[2]Department of Psychology, West Virginia University

Abstract

Objective: The current study utilized a longitudinal person-centered approach (latent transition analysis; LTA) to assess transitions into and out of risk-behavior profiles during the transition into and throughout the first year of college.

Participants: Participants included 579 first-year college students (M_{age}=18.13, SD=.94) from a large mid-Atlantic university.

Methods: Participants completed surveys at five points throughout their freshman year.

Results: LTA suggested that most individuals either abstained from engaging in risk behaviors or transitioned towards profiles of less risk over time. A smaller portion of individuals either began and ended the year in the same risk profile or transitioned into profiles of greater risk.

Conclusions: The findings highlight the importance of utilizing person-centered analyses to examine change in multiple health-risk behaviors.

Keywords

first-year college students; substance use; risky sexual behaviors; physical activity; latent transition analysis

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The transition from high school graduation to college matriculation has been identified as a time of increased engagement in a range of adverse health behaviors, such as substance use, risky sexual behaviors, and physical inactivity.[1,2] These behaviors frequently co-occur and predict accidental injury, crime, suicide, chronic disease and mortality.[3,4,5] Individuals may adopt lasting health behavior patterns in college that continue into adulthood, which can increase their long-term disease risk.[6,7] Although many students arrive to college with prior engagement in health-risk behaviors, students who did not engage in these behaviors in high school may initiate engagement during this time.[8,9] Rates of engagement in health-risk behaviors are often at their highest during students' first year of college.[10] Previous longitudinal research has examined patterns of change in single health-risk behaviors throughout college. However, examining risk behaviors in isolation may mask important variation in the timing and intensity of risk behavior initiation and escalation. Very little is known about how patterns of health-risk behaviors change as individuals move through college, which is necessary to inform prevention and intervention efforts. The current study

utilized latent transition analysis (LTA) to identify the prevalence, type, and timing of longitudinal transitions in patterns of health-risk behaviors in a sample of first-year college students.

During the transition from high school to college, individuals experience changes in residence, relationships, and supervision. These changes are often associated with engagement in health-risk behaviors. For example, approximately 50% of college students begin drinking alcohol during the first year of college, with 25% of these students engaging in binge drinking.[9] Similarly, many first-year college students begin using marijuana and nicotine,[13] engaging in risky sexual behaviors, including unprotected vaginal or anal intercourse,[14] and experiencing declines in physical activity.[15] Engagement in these behaviors is linked to longer-term problematic behavior, including poorer academic performance,[16] increased risk of injury, death, and motor vehicle crashes,[17] higher rates of job loss and criminal activity,[18] as well as increased physical health problems and mortality.[19]

Intraindividual Change in Health-Risk Behaviors

Along with a heavy academic workload, first-year college students experience an irregular lifestyle characterized by various gatherings (e.g., festivals, outings) that often involve meeting new people.[20] College students report engaging in higher levels of alcohol and substance use to form new interpersonal relationships at these events and to reduce stress related to these sudden changes in interpersonal relationships and academic expectations.[20] These increases in substance use are often associated with greater risky sexual behaviors.[21] Additionally, the increased demands that come along with starting college predict decreases in physical activity as many students report not having enough time to maintain an active lifestyle.[1] Existing research on substance use across college has mainly emphasized rank-order stability, demonstrating that health-risk behavior engagement during the transition to college positively predicts similar health-risk behaviors later in college.[22,23] Studies examining patterns of change indicate that individuals who engage in greater health-risk behaviors at the start of college experience steeper increases in health-risk behaviors over the first year of college.[24] Similarly, increases in binge drinking, marijuana use, and nicotine use were steeper among individuals who began using each substance at an earlier age.[24] Men have also been found to be at greater risk for increasing their alcohol and marijuana use throughout the first year of college compared to women.[25,26] However, these differences are relatively small and are thought to be a result of greater peer pressure and more powerful socialization effects among men compared to women.[26]

With regards to other indices of health risk, research has generally found that first-year college students' engagement in unprotected vaginal and anal intercourse increase over time.[27] Yet, recent findings suggest that there are individual differences in patterns of risky sexual behaviors with women displaying greater increases in risky sexual behaviors during the first year of college compared to men.[28] Individuals generally experience an increase in physical inactivity during the first year of college. However, this increase is steeper for men and individuals who have a higher body mass index (BMI) at the beginning of college.[29] Thus, although college students generally demonstrate an increase across a variety

of health-risk behaviors, there appears to be significant individual variability in patterns of risk behavior during the first year of college.[27,28,29]

Person-Centered Approach to Examining Health-Risk Behaviors

It remains important to distinguish college students who engage in multiple health-risk behaviors simultaneously, as these individuals are at greater risk for experiencing later problematic health outcomes.[30] Identifying students who are engaging in patterns of behaviors characterized by greatest amounts of risk is an important first step toward developing interventions targeting the multiple health-risk behaviors. Person-oriented methodological approaches allow researchers to empirically incorporate this multidimensional conceptualization, as they can identify qualitatively distinct typologies of health-risk behavior engagement.[7,31,32]

Studies suggest that some college students engage in low levels of multiple health-risk behaviors, others engage in high levels, and still others engage in high levels of only certain behaviors. For instance, young adults display distinctive patterns of substance use behaviors (i.e., cigarette use, marijuana use, binge drinking).[32] Patterns of substance use also intersect with unhealthy diet and exercise behaviors (i.e., overweight/obesity, unhealthy diet, physical inactivity) where college students vary in their combinations of unhealthy diet, physical inactivity, overweight/obesity, tobacco use, and binge drinking.[31] Additional research has found that college students vary in their patterns of a wider range of risk behaviors, including substance use (i.e., cigarette use, binge drinking), unhealthy weight control behaviors (e.g., taking diet pills, binge eating), physical activity, dietary intake, and engagement in risky sexual behaviors (i.e., unprotected oral, anal, or vaginal intercourse).[30] Taken together, the heterogeneity in risk behaviors is so varied that traditional variable-centered approaches are likely not representative of developmental trajectories during the first year of college and may mask important transitions in health-risk behavior engagement.

Latent Transition Model of Health-Risk Behaviors

It remains unclear how individuals change in their overall profiles of health-risk behavior engagement before and during the first year of college. A better understanding of changes in health-risk behaviors during this time requires a more holistic approach in which students' engagement in multiple risk behaviors are examined simultaneously. Previous research suggests that college students not only vary in their overall profiles of risk behaviors, but that they vary in their transitions into and out of these profiles over time. For instance, although the majority of college students remained stable in their low levels of use of various substances, others were found to transition from using cigarettes at baseline to engaging in binge drinking along with marijuana use two weeks later.[32] Among a sample of adolescents, individuals were found to remain relatively stable in their patterns of either alcohol use, alcohol and moderate marijuana use, and polysubstance use throughout three years, whereas a smaller portion were found to transition into a more harmful substance use class.[33] It remains important to understand how individuals transition in their engagement in a wider range of health-risk behaviors throughout a period of time characterized by a host of lifestyle changes that are associated with initiating and engaging in greater risk

behaviors. Utilizing longitudinal person-oriented methodology may provide insight into patterns of stability and change across multiple health-risk behaviors over time. Longitudinal person-oriented methods such as LTA can both identify distinct profiles of problem behavior use and also examine patterns of stability and change in profile membership over time. LTA builds upon traditional longitudinal modeling, such as growth curve models which examine mean-level change, by describing how membership in qualitatively different groups changes over time.[34] That is, LTA allows researchers to understand longitudinal change on multiple indicators of health-risk behavior simultaneously. Although researchers have used LTA to examine the probability of participants belonging to various substance use profiles across two waves of data,[34] this research has not identified how individuals transition into and out of profiles of a range of risk behaviors across multiple waves of data. Identifying transition patterns will provide greater insight into the timing of common profiles of health-risk behavior to inform interventions across various points of the first year of college.

The Current Study

The current study examined profiles of engagement in three substance use behaviors (i.e., binge drinking, marijuana use, nicotine use), two risky sexual behaviors (i.e., unprotected vaginal intercourse, unprotected anal intercourse), and physical activity in order to holistically understand change in typologies of health-risk behavior engagement among first-year college students. Because of gender differences in changes in single health-risk behaviors over time,[25,26,28] the current study also examined whether latent transition probabilities vary for men and women. By conducting latent transition analysis using five waves of data, the current study describes health-risk behavior typologies and transitions into and out of these typologies throughout the transition to and during the first year of college. Findings will better enable colleges and universities to target certain students at the start of the academic year who are at risk for increasing their risky behaviors.

Materials and Methods

Participants and Procedures

The current project was approved by the Institutional Review Board (IRB) at West Virginia University (IRB protocol number: 1602014279R003). Participants for the current study are from a large university in a mid-Atlantic state recruited via email from a list of incoming freshmen provided by the university's Office of Enrollment Management. An email was sent to all incoming freshmen in July 2016 asking students to consent to the study via survey monkey. A two-week window was used to recruit participants. After two weeks, a total of 579 participants consented to the study and completed all of the baseline measures. All participants were asked to complete four additional follow-up surveys throughout their freshman year. Baseline surveys were completed during the summer before participants arrived on campus for their first semester of college. Surveys for waves 2 (N = 492; mid-September) and 3 (N = 451; mid-November) were completed during the fall semester and waves 4 (N = 415; mid-February) and 5 (N = 384; mid-April) were completed during the spring semester of participants' first year of college. Participants received $20 for completing the survey at Wave 1. At each of the following waves, participants received $10

for completing the survey. Participants who completed all five waves received an additional $20. The full sample resulted in 579 participants at baseline (M_{age} = 18.13 years, *SD* = 0.94; *range* = 18–32 years; 69.62% female; 89.43% White). Although participants ranged from 18–32 years old, the majority of participants (i.e., 98.1%) reported falling between the ages of 18 and 19.

Measures

Alcohol use.—Participants indicated whether they used alcohol in their lifetime (baseline; 0 = *No*, 1 = *Yes*) or in the past 30 days (waves 2–5; 0 = *No*, 1 = *Yes*). Participants who indicated that they drank alcohol in the past were asked how often in the past 30 days they drank four or more drinks (if female) or five or more drinks (if male) containing any alcohol within a two-hour period on a six-point Likert scale (1 = *Never*, 6 = *Everyday*).[35]

Tobacco use.—At baseline, participants indicated whether they ever tried a cigarette, an electronic cigarette, or alternative tobacco products (i.e., large cigars, cigarillos or small cigars, waterpipe, smokeless tobacco) in their lifetime (0 = *No*, 1 = *Yes*). Participants who indicated that they had tried these substances were then asked separate questions pertaining to whether they used cigarettes, electronic cigarettes, or alternative tobacco products in the past 30 days (0 = *No*, 1 = *Yes*). At each of the following waves, participants were asked whether they used these same tobacco products in the past 30 days. At each wave, participants who indicated any use of any of the previously listed tobacco products in the past 30 days were assigned a 1; those who did not were assigned a 0.

Marijuana use.—At baseline, participants indicated whether they ever used marijuana (0 = *No*, 1 = *Yes*). Participants who indicated that they used marijuana were then asked to indicate whether they used marijuana in the past 30 days (0 = *No*, 1 = *Yes*). At each of the following waves, participants were asked to indicate whether they used marijuana in the past 30 days (0 = *No*, 1 = *Yes*). Participants who indicated that they used marijuana in the past 30 days were assigned a 1; those who did not were assigned a 0.

Sexual behaviors.—At baseline, participants indicated whether they engaged in anal or vaginal intercourse in their lifetime (0 = *No*, 1 = *Yes*). Participants who indicated that they had engaged in anal or vaginal intercourse in their lifetime reported how often in the past 30 days they used a condom/barrier during anal intercourse and during vaginal intercourse on a five-point Likert scale (1 = *Always*, 5 = *Never*). At each of the following waves, participants were asked to report on the same questions: whether they had engaged in anal or vaginal intercourse in the past 30 days (0 = *No*, 1 = *Yes*), and if yes, rates of condom/barrier use (1 = *Always*, 5 = *Never*).

Physical activity.—At each wave, participants indicated how many days they went to the gym to exercise during an average seven-day week over the past 30 days from *0 days* to *7 days*.

Analytic Plan

Analyses were conducted using M*plus* 8.1.[36] First, cross-sectional latent profile analyses (LPA) were examined at each wave to determine profiles of health-risk behaviors. After conducting LPA at each wave, an LTA across waves was conducted to examine participants' movement between latent profiles across waves. LPA is a person-centered analytic strategy that determines groups of individuals based on their pattern of scores on a set of continuous and categorical variables.[37] Each participant is assigned a probability of belonging to each identified profile. The number of profiles is empirically determined using fit indexes, including the Akaike Information Criterion (AIC)[38] and the Bayesian Information Criterion (BIC)[39] for which lower scores represent better fit. Additionally, the Vuong Lo-Mendal Rubin LRT test, which evaluates whether a model with k profiles provides an improvement in fit over a model with $k-1$ profiles, was used to determine the profile solution that best fit the data.[40,41] Models with high entropy were also given preference. Starting with a one-profile solution, models are estimated with increasingly more profiles until there is no further model improvement (i.e., fit indexes show no substantive change or additional profiles are small, conceptually unclear, or there are slight variations on already identified profiles).[37] LTA is a longitudinal extension of LPA that calculates individuals' patterns of transitions between latent profiles over time.[37] In addition to calculating item and profile probability parameters at each wave, LTA also produces transition probability parameters for each individual, representing the likelihood of being in a specific latent profile at time t given membership in a specific latent profile at the prior time point (t-1). For the current study, probabilities were calculated to assess participants' patterns across the five waves of data. To examine gender differences in initial status and transitions in risk behaviors over time, gender was examined as a covariate of wave 1 risk-behavior profiles and latent transition patterns. Specifically, the fit of a model that included gender as a covariate was compared to the fit of the model with gender removed. It has been suggested that LTA should be conducted on samples consisting of at least 300 cases.[42] Because missingness was estimated using full information maximum likelihood (FIML), all analyses utilized all 579 cases.

Results

At each wave, an LPA utilizing four continuous (i.e., current binge drinking, unprotected vaginal intercourse, unprotected anal intercourse, and physical activity) and two dichotomous (i.e., current marijuana use and tobacco use) health-risk indicators indicated five profiles. Specifically, a five-profile solution demonstrated the lowest AIC and BIC scores and had high entropy at each wave, as well as a significant LRT value at the majority of waves while maintaining profiles with substantive meaning and similar interpretations (see Table 1). Thus, a five-profile model was specified for the LTA with probability parameters constrained to be equal across waves. Consistent with recommendations for LTA, these constraints ensured that profile meanings were identical across waves, increasing the interpretability of profile transitions.[37]

Latent Profile Descriptions

Figure 1 displays variable probabilities for each latent profile. Profile 1 (*Low Risk Takers*) reported lower rates of substance use (i.e., binge drinking, marijuana use, tobacco use), as well as unprotected vaginal and anal intercourse along with relatively low levels of physical activity. This group was the most prevalent (43% of participants at Wave 1) and became increasingly prevalent over time (58% at Wave 2; 56% at Wave 3; 61% at Wave 4; 68% at Wave 5). Profile 2 (*Sexual Risk Takers*) reported engaging in high levels of unprotected vaginal and anal intercourse, but low rates of substance use and physical activity. This group was relatively uncommon (10% of participants at Wave 1) and decreased in prevalence over time (12% at Wave 2; 8% at Wave 3; 1% at Wave 4; 2% at Wave 5). Profile 3 (*Sexual Risk Takers with Substance Use*) reported engaging in high levels of unprotected vaginal and anal intercourse along with moderate levels of substance use and low levels of physical activity. This group was relatively prevalent (16% of participants at Wave 1), but decreased in prevalence over time (9% at Wave 2; 8% at Wave 3; 11% at Wave 4; 9% at Wave 5). Profile 4 (*Substance Abusers with Sexual Risk Taking*) reported engaging in high levels of substance use, moderate levels of unprotected vaginal and anal intercourse, and low levels of physical activity. This group was relatively prevalent (15% of participants at Wave 1), but fluctuated in its prevalence across the school year (4% at Wave 2; 8% at Wave 3; 13% at Wave 4; 2% at Wave 5). Finally, profile 5, (*Substance Users with Physical Activity*) reported engaging in high levels of substance use and greater physical activity, but relatively low levels of unprotected vaginal and anal intercourse. They made up a relatively large portion of the sample (16% of participants at Wave 1) and demonstrated high levels of stability across time (17% at Wave 2; 19% at Wave 3; 13% at Wave 4; 20% at Wave 5). The means and standard deviations for health-risk behavior indicators by profile are presented in Table 2. With regards to gender differences, the fit of the model that included gender as a covariate did not significantly differ from the fit of the model that did not include gender as a covariate ($\Delta\chi 2$ (31) = 38.25, *ns*).

Profile Transition Patterns

LTA indicated that 60% of the total sample displayed profile transition patterns that were demonstrated by at least 1% of participants (Table 3), whereas the remaining 40% of the sample demonstrated idiosyncratic transition patterns (i.e., patterns demonstrated by fewer than 1% of participants), which were not easily combined with the more prevalent patterns. A large proportion (29%) of individuals remained *Stable Risk Takers* throughout the first year of college. However, stability across all five waves was only present among individuals in the *Low Risk Takers* profile. Individuals in the other four risk-behavior profiles transitioned into a different profile at least once over the first year of college.

Several participants were classified into the same profile of risk at both the end of the year and the beginning of the year, but cycled into different patterns in the middle of the year (i.e., *Fluctuating Risk Takers*; same profile at Wave 1 and Wave 5; 5.5%). Some of these individuals were in low risk groups at the beginning and end of the year, but cycled into riskier patterns of behavior at other points of the school year, such as a group that transitioned from *Low Risk Takers* to *Substance Users with Physical Activity* back to *Low Risk Takers* (1%). Similarly, two groups of individuals who started the year with

moderate levels of risk-taking behavior, transitioned into greater risk categories during the school year before returning to a moderate risk profile at the end of the year. One of these groups transitioned from *Substance Users with Physical Activity* to *Sexual Risk Takers with Substance Use* back to *Substance Users with Physical Activity* (1.6%), and a second group transitioned from *Sexual Risk Takers* to *Sexual Risk Takers with Substance Use* back to *Sexual Risk Takers* (1.4%). On the other hand, some individuals started the year in riskier profiles, transitioned into moderate risk-taking profiles, and then transitioned back into a riskier profile at the end of the year (i.e., *Sexual Risk Takers with Substance Use* to *Sexual Risk Takers* back to *Sexual Risk Takers with Substance Use*; 1.6%).

Transitions toward relatively lower levels of engagement in health-risk behaviors (i.e., *Decreasing Risk Takers*) were more common (19.8%) than any other transition pattern. A high percentage of adolescents engaging in the highest levels of risk behavior at baseline *(i.e., Substance Abusers with Sexual Risk Taking*, *Sexual Risk Takers with Substance Use*) as well as adolescents engaging in moderate levels of risk behavior at baseline (i.e., *Substance Users with Physical Activity, Sexual Risk Takers*) engaged in fewer risk-taking behaviors over time. The most common pattern of *Decreasing Risk Takers* included individuals who began as *Substance Abusers with Sexual Risk Taking* and transitioned to *Substance Users with Physical Activity* (6.6%). Additional transition patterns included transitioning from *Sexual Risk Takers with Substance Use* to *Sexual Risk Takers* to *Low Risk Takers* (3.1%) and directly from *Sexual Risk Takers with Substance Use* to *Low Risk Takers* (1.4%). In addition, there were also a significant number of individuals who transitioned from moderate levels of risk behavior to lower levels of risk behavior (i.e., *Substance Users with Physical Activity* to *Low Risk Takers* [7.4%], *Sexual Risk Takers* to *Sexual Risk Takers with Substance Use* to *Low Risk Takers* [1.4%]).

A smaller percentage of youth demonstrated transition patterns indicative of increased health-risk behavior over time (i.e., *Increasing Risk Takers*). This included a group of individuals who transitioned from engaging in low levels of risk behavior to moderate levels of risk behavior: *Low Risk Takers* transitioned to *Sexual Risk Takers with Substance Use* to *Substance Users with Physical Activity* (3.8%), Another group of individuals transitioned from engaging in moderate levels of risk behavior to the highest levels of risk behavior: *Substance Users with Physical Activity* transitioned to *Substance Abusers with Sexual Risk Taking* (1.0%). Finally, we explored whether latent transition probabilities varied by gender. The fit of the model that included gender as a covariate did not significantly differ from the fit of the model that did not include gender as a covariate ($\Delta\chi 2$ (53) = 66.86, *ns*) indicating that men and women did not significantly vary in their likelihood of exhibiting each transition pattern.

Attrition Analyses

To determine whether participants who dropped out after wave 1 and those who remained in the study varied on key study variables, attrition analyses were conducted. Specifically, t-tests examined mean differences in continuous variables (i.e., binge drinking, physical activity, unprotected vaginal intercourse, unprotected anal intercourse) and chi-square tests examined differences in categorical variables (i.e., marijuana use, tobacco use). Participants

who dropped out of the study reported higher rates of binge drinking than those who remained in the study (t=3.36, p=.001). Additionally, participants who dropped out of the study were more likely to use marijuana (χ^2=6.00, p=.014) and tobacco (χ^2=11.82, p=.001) than participants who remained in the study.

Discussion

The current study utilized a longitudinal, person-centered approach to examine stability and change in health-risk behaviors among first-year college students through the use of LTA. Our findings suggest that among first-year college students who engage in any health-risk behavior, the majority engage in multiple types of health-risk behaviors, simultaneously. For instance, students in the *Substance Abusers with Sexual Risk Taking* group, as well as students in the *Sexual Risk Takers with Substance Use* group reported engaging in moderate to high levels of unprotected vaginal intercourse, unprotected anal intercourse, binge drinking, marijuana use, nicotine use, and low levels of physical activity simultaneously. Among students who engaged in more specific aspects of health-risk behaviors (i.e., substance use only, risky sexual behaviors only), these youth still engaged in more than one type of risk behavior. Specifically, individuals in the *Substance Users with Physical Activity* group engaged in high levels of binge drinking, marijuana use, and cigarette use, whereas individuals in the *Sexual Risk Takers* group reported engaging in high levels of both unprotected vaginal and anal intercourse. Taken together, findings suggest that while many first-year college students are likely to engage in more than one type of health risk behavior, there is considerable heterogeneity in the specific combination of their risky activities, resulting in multiple patterns of health-risk behavior. Thus, it is imperative for interventions to focus on reducing college students' engagement in multiple risk behaviors simultaneously. For instance, rather than having interventions focused solely on substance use, some interventions should focus on substance use as it occurs along with risky sexual behaviors.

Although previous research has found that college students vary in their trajectories of single health-risk behaviors, it has not examined trajectories of multiple co-occurring health-risk behaviors. Research examining individual health-risk behaviors in isolation from one another suggests that many individuals increase their engagement in risk behaviors throughout the first year of college.[24,28,29] Surprisingly, a large amount of ipsative continuity emerged in the current study. Of the 60% of participants who were classified into a common transition category, 29% remained in the same health-risk behavior profile across time (*Stable Low Risk Takers*). Importantly, the only profile to display stability across each of the five waves was the *Low Risk Takers* profile. Although college is often viewed as a time of increased experimentation with risk behavior, over a quarter of the current sample reported relatively lower amounts of health-risk behaviors throughout their entire first year of college. This finding is consistent with previous research suggesting that a large portion of college students remained stable in their substance use profile membership across smaller spans of time (i.e., two weeks) and research suggesting that adolescents largely remained in the same substance use profile over three years.[33]

Among the remaining 31% of our sample who displayed a common transition pattern but did not experience stability in their health-risk engagement, the most common transitions involved moves from riskier profiles toward profiles of less risk (i.e., *Decreasing Risk Takers*). There were several examples of this overall pattern, including students who moved from the highest risk-taking behavior profiles (i.e., *Substance Abusers with Sexual Risk Taking, Sexual Risk Takers with Substance Use*), as well as students who moved from moderate risk-taking behavior profiles (i.e., *Substance Users with Physical Activity, Sexual Risk Takers*) into profiles characterized by lower risk. It is particularly noteworthy that half of our sample either engaged in low levels of health-risk behaviors throughout their first year of college or fewer health-risk behaviors over time. These results contradict the idea that most college students initiate and continue to experience increases in health-risk behaviors before and during their first year of college,[9,13,40] which sheds light on the importance of utilizing a person-centered approach to examine transitions into and out of risk behavior profiles over time. Previous research examined mean level change in college students' engagement in health risk behaviors, but examining average levels of change may mask the substantial portions of students who engage in low levels of risk behaviors. In addition, because variable-centered analytic approaches do not consider multiple health-risk behaviors, they may not accurately capture changes in risk behavior. For instance, an individual may increase in a single risk behavior over time (e.g., binge drinking). However, this increase in binge drinking may be coupled with lower levels of engagement in all other risk indices (i.e., marijuana use, tobacco use, risky sexual behaviors). Variable-centered approaches are unable to account for this nuance and accurately capture changes in individuals overall profiles of risk.

A smaller portion of students either transitioned into a riskier profile (i.e., *Increasing Risk Takers*) or were classified into the same risky profile at the end of the year and prior to the start of college (i.e., *Fluctuating Risk Takers*). Some individuals who did not engage in any health-risk behaviors prior to the start of college (i.e., *Low Risk Takers*) or engaged in substance use only (i.e., *Substance Users with Physical Activity*) transitioned into riskier profiles at the end of their first year of college (i.e., *Substance Users with Physical Activity, Substance Abusers with Sexual Risk Taking*, respectively). In addition, some individuals transitioned into profiles characterized by higher levels of risk throughout the middle of the year (e.g., *Low Risk Takers* to *Substance Use with Physical Activity* back to *Low Risk Takers*), whereas other individuals transitioned into profiles characterized by lower levels of risk throughout the middle of the year (e.g., *Sexual Risk Takers with Substance Use* to *Sexual Risk Takers* back to *Sexual Risk Takers with Substance Use*). Thus, both individuals who were not engaging in any risk behaviors, as well as those who belonged to a moderately risky profile (e.g., *Substance Users with Physical Activity*) prior to the start of college experienced increases in health-risk behaviors at some point throughout their first year. Colleges and universities may benefit from implementing targeted intervention programs on campus that focus on specific combinations of risk behavior profiles that have emerged in research, rather than offering universal prevention programs to all incoming students during freshman orientation. This is especially important as engagement in multiple health-risk behaviors simultaneously is associated with longer-term problematic behavior

(e.g., increased risk of injury and death,[17] greater criminal activity,[18] and increased physical health problems[19]).

Notably, 40% of participants were not classified into a common transition category. This further highlights the importance of utilizing a person-centered approach to examine trajectories in health-risk behaviors due to the considerable heterogeneity in individuals' trajectories in these behaviors. Interestingly, transitions in risk behavior profiles were not found to vary by gender. Although this is inconsistent with variable-centered work, which suggests that men display steeper increases in binge drinking and substance use, whereas women display steeper increases in risky sexual behaviors, our findings are consistent with previous longitudinal person-centered work.[32] It is likely that there are more powerful predictors of transitions in risk behavior profiles that are more proximal to the ongoing college experience, such as involved parenting,[39] peer group affiliation, and activity involvement.[32] Although many students decreased in health-risk behavior over time, these individuals still engaged in some form of health-risk behavior at some point during the transition to college. The transition to college is a time characterized by fewer responsibilities and increased freedom and independence from parents.[2] Additionally, college students are confronted with greater access to substances.[45] However, after initially experimenting with risk behaviors, many students appear to decrease these behaviors by the middle of their first year of college. It is possible that these youth initially engage in risk behaviors in order to fit in with peers.[13] Once these students become acclimated and their workload increases, they may begin to engage in fewer risk behaviors. Risk behavior engagement among these individuals may be a result of experimentation and may thus be more time-limited.[2] However, students who continue to engage in health-risk behaviors throughout the first year of college may have fewer protective factors potentially leading them to engage in more serious trajectories of risk behavior over longer periods of time. These individuals may have also entered college with greater experience engaging in health-risk behaviors and thus, their engagement in such behaviors during the transition to college may be less indicative of experimentation and more reflective of serious, longer-lasting behavior.[23]

Because the current findings suggest that patterns of health-risk behavior engagement among first-year college students are nuanced, future researchers should examine the various potential predictors of these patterns. Demographic characteristics, such as race and age of risk-behavior initiation, parenting and peer behaviors, and stress or depression predict trajectories in college student' engagement in individual risk-taking behaviors.[44,46] Examining whether these characteristics also predict transitions in risk-behavior profiles is extremely important in identifying individuals at greater risk for engaging in various risk behaviors, as well as informing prevention and intervention efforts. This analysis establishes a foundation for future analyses, which will leverage additional data to robustly examine a range of predictors of risk behavior transitions. Additionally, although the current study focused primarily on risk behaviors in which students engage, future research should examine additional health behaviors, such as eating and sleep behaviors, which may also change throughout the first year of college.

The findings from the current study should be interpreted in light of several limitations. The sample was limited in terms of diversity, as most of the participants identified as White, female, and residing in the Appalachian region. This sample (89.4% White; 69.6% female) also was not reflective of the overall student population of the university at the time (80% White; 49% female). Therefore, the current study should be replicated in more diverse samples with regards to race/ethnicity, gender, and geographic location. Researchers should examine differences in class membership and transitions in health-risk behaviors among a wider age range of college students to determine whether individuals vary in their profiles of health-risk behaviors and transitions into and out of risk behavior profiles across a longer period of time (e.g., freshman to senior year). Additionally, the dichotomous measurement of tobacco and marijuana limits our ability to differentiate between trajectories of regular use versus experimentation with these substances, which may introduce heterogeneity in trajectories. Finally, attrition analyses indicated that individuals who dropped out of the study engaged in higher levels of baseline substance use than those who remained in the study. Although there was adequate variability in substance use among participants who remained in the study, findings should be interpreted with caution, as they may not apply to individuals at greatest risk.

Conclusion

Narrow intervention approaches targeting any single health-risk behavior will likely not be effective in reducing health-risk behaviors among college students. Instead, colleges and universities may need to have different types of interventions in place to target the specific health-risk behaviors that college students are engaging in. There may be utility in pretesting college students and using this information to appropriately target risk-behavior interventions. Because individuals begin college engaging in a range of health-risk behaviors, it may be important to have multiple interventions in place at the start of the academic year. Some interventions should be focused on a range of health-risk behaviors to meet the needs of individuals in the riskiest profiles (i.e., *Substance Abusers with Sexual Risk Taking, Sexual Risk Takers with Substance Use*), whereas others should be more focused and target specific health-risk behaviors to meet the needs of individuals in moderately risky profiles (i.e., *Substance Users with Physical Activity, Sexual Risk Takers*). Additionally, because a portion of students who abstain from engaging in risk behaviors during the transition to college become riskier over time, colleges and universities may also benefit from having prevention programs in place for these individuals at the start of the academic behavior to prevent them from engaging in risk behaviors over time. Findings may also provide useful information to health workers who work with student populations. For instance, health workers who work with students displaying a specific type of risk behavior (e.g., risky sexual behaviors) may also wish to provide these students with information or services to prevent or intervene with other risk behaviors (e.g., substance use), as findings suggest that risk behaviors co-occur in a large percentage of the student population. In addition, it may be beneficial to inform student services and academic programs of students' engagement in multiple health-risk behaviors simultaneously to increase their awareness in order to provide referrals to further minimize engagement in such behaviors.

The current study also demonstrates the advantages of using LTA to examine transitions in patterns of health-risk behaviors among college students, as this methodological approach provided a nuanced summary of the heterogeneity that exists among first-year college students in their engagement in a range of health-risk behaviors, including substance use, risky sexual behaviors, and physical inactivity. Understanding what predicts various health-risk behavior patterns is paramount for designing prevention and intervention strategies that will be most salient to students.

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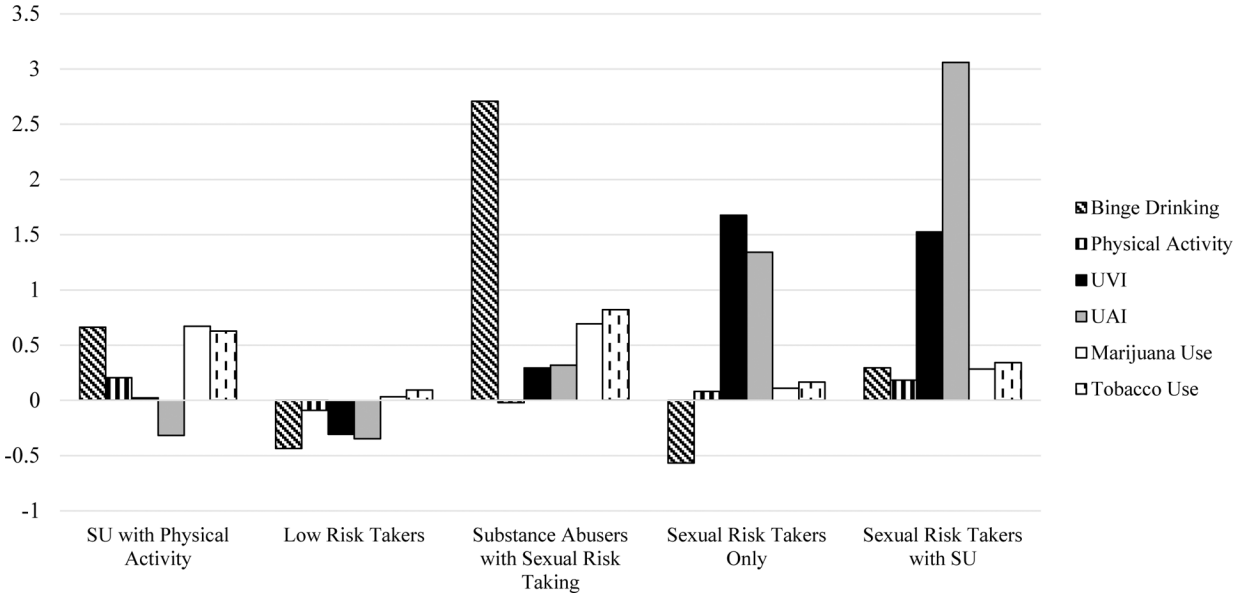

Figure 1.

Standardized health-risk behavior means (i.e., binge drinking, physical activity, UVI, UAI) and probabilities (i.e., marijuana use, tobacco use) for the health-risk behavior profiles at Wave 1.

Note. Some variable names have been shortened; UVI = Unprotected Vaginal Intercourse; UAI = Unprotected Anal Intercourse; SU = Substance Use

Table 1

Model Fit Information Used in Selecting the Five-Profile Solution

	Wave 1				Wave 2				Wave 3				Wave 4				Wave 5			
Number of Profiles	**AIC**	**BIC**	**LRT Test (*p* value)**	**Entropy**	**AIC**	**BIC**	**LRT Test (*p* value)**	**Entropy**	**AIC**	**BIC**	**LRT Test (*p* value)**	**Entropy**	**AIC**	**BIC**	**LRT Test (*p* value)**	**Entropy**	**AIC**	**BIC**	**LRT Test (*p* value)**	**Entropy**
3	7379.78	7484.30	.107	.999	5968.12	6067.99	.614	.999	5630.85	5729.69	.015	.978	5197.46	5294.14	.641	/921	4679.53	4773.91	.062	.884
4	7116.37	7261.62	.190	.962	5650.33	5779.33	.566	.999	5180.95	5308.61	<.001	.983	4829.82	4954.70	.788	.948	4498.16	4620.06	.245	.932
5	7041.65	7207.44	.002	.909	5082.45	5240.58	.773	.999	5014.66	5566.04	<.001	.921	4780.88	4933.96	.134	.999	4115.48	4264.91	.001	.933
6	6973.64	7819.98	.433	.901	5396.17	5583.43	.812	.965	5409.55	5599.97	.165	.877	4349.50	4940.77	.167	.999	4838.48	4315.43	.723	.931

Table 2

Wave 1 Descriptives of Profile Indicators by Health-Risk Behavior Profile

	SU with Physical Activity		Low Risk Takers		Substance Abusers with Sexual Risk Taking		Sexual Risk Takers Only		Sexual Risk Takers with SU	
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
Binge Drinking	1.28	.61	.21	.41	3.22	.42	.11	.33	.88	1.17
Physical Activity	3.33	2.19	2.59	2.13	2.74	2.14	.30	2.06	3.21	2.32
UVI	3.61	4.52	1.25	2.11	.43	4.70	3.15	2.96	2.56	3.19
UAI	.18	.40	.12	.39	.30	.60	.89	4.64	3.00	.75
Marijuana Use	.69	.46	.03	.16	.70	.47	.11	.33	.28	.45
Tobacco Use	.68	.47	.08	.27	.83	.39	.33	.50	.34	.48

Note. Some variable names have been shortened. SU= Substance users; UVI = Unprotected vaginal intercourse; UAI = Unprotected anal intercourse.

Table 3

Percentage of Participants Demonstrating Each Transition Pattern

Transition Pattern	Percentage of Participants
Stable low risk takers: Remained in *Low Risk Takers* profile at all waves	29%
Beginning and ending the year in the same profile	5.5%
Low Risk Takers → Substance Users with PA → Low Risk Takers	1%
Substance Users with PA → Sexual Risk Takers with SU → Substance Users with PA	1.6%
Sexual Risk Takers → Sexual Risk Takers with SU → Sexual Risk Takers	1.4%
Sexual Risk Takers with SU → Sexual Risk Takers → Sexual Risk Takers with SU	1.6%
Transitions towards less risk behavior profiles	19.8%
Substance Abusers with Sexual Risk Taking → Substance Users with PA	6.6%
Sexual Risk Takers with SU → Sexual Risk Takers → Low Risk Takers	3.1%
Sexual Risk Takers with SU → Low Risk Takers	1.4%
Substance Users with PA → Low Risk Takers	7.4%
Sexual Risk Takers → Sexual Risk Takers with SU → Low Risk Takers	1.4%
Transitions towards greater risk behavior profiles	4.8%
Low Risk Takers → Sexual Risk Takers with SU → Substance Users with PA	3.8%
Substance Users with PA → Substance Abusers with Sexual Risk Taking	1%

Note. Some variable names have been shortened; PA = Physical Activity; SU = Substance Use. The table reflects the most common profile transition patterns (i.e., patterns demonstrated by at least 1% of participants)