A Latent Class Analysis of Cancer Risk Behaviors among U.S. College Students

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Abstract

Objective—The purpose of this study is to understand how cancer risk behaviors cluster in U.S. college students and vary by race and ethnicity.

Methods—Using the fall 2010 wave of the National College Health Assessment (NCHA), we conducted a latent class analysis (LCA) to evaluate the clustering of cancer risk behaviors/ conditions: Tobacco use, physical inactivity, unhealthy diet, alcohol binge drinking, and overweight/obesity. The identified clusters were then examined separately by students' self-reported race and ethnicity.

Results—Among 30,093 college students surveyed, results show a high prevalence of unhealthy diet as defined by insufficient fruit and vegetable intake (>95%) and physical inactivity (>60%). The LCA identified behavioral clustering for the entire sample and distinct clustering among Black and American Indian students.

Conclusions—Cancer risk behaviors/conditions appear to cluster among college students differentially by race. Understanding how risk behaviors cluster in young adults can lend insight to racial disparities in cancer through adulthood. Health behavior interventions focused on modifying multiple risk behaviors and tailored to students' racial group could potentially have a much larger effect on cancer prevention than those targeting any single behavior.

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Introduction

Tobacco use, overweight/obesity, physical inactivity, unhealthy diet, and excessive alcohol
consumption are among the most common modifiable risk behaviors and conditions for
chronic disease, including cancer (Allen et al., 2009; Baan et al., 2007; Cokkinides, 2012;
Curry et al., 2003; Simard et al., 2012). Not surprisingly, these modifiable risk behaviors
frequently co-occur (Mays et al., 2012; Prochaska et al., 2008; Rebholz et al., 2012), and
only a small percentage (<5%) of United States (U.S.) adults currently practice a healthy
lifestyle characterized by no tobacco use, healthy diet and weight, regular physical activity,
and low alcohol consumption (Reeves and Rafferty, 2005). Racial and ethnic minority
groups in the U.S. exhibit appreciable disparities in cancer risk behaviors (Cokkinides,
2012) as well as disproportionately higher rates of cancer incidence, prevalence and
mortality (Ward et al., 2004; Williams and Jackson, 2005). Detailing the clustering of cancer
risk behaviors among racial and ethnic groups has not been done, but may improve
understanding regarding disparities in cancer mortality rates.

The transition from adolescence to adulthood is a critical period for developing health
behavior patterns that have implications later in life (Jekielek and Brown, 2005; Rindfuss et
al., 1987), and young adults in a college setting are particularly susceptible to unhealthy
behavior (Grace, 1997; Racette et al., 2008; Wetter et al., 2004). The clustering of unhealthy
behaviors among college students has been well documented (Dodd et al., 2010; El Ansari et
al., 2011; Emmons et al., 1998; Kwan et al., 2013; Laska et al., 2009; Lv et al., 2011;
Moreno-Gomez et al., 2012; Primack et al., 2012), yet to date, no studies have examined the
modifying influence of race/ethnicity on risk behavior clustering in this population.

Using latent class analysis (LCA), we investigated the clustering of cancer risk behaviors in
a large population of U.S. college students (Ingledew et al., 1995; Laska et al., 2009). Our
primary aim was to identify the extent to which key cancer risk behaviors and conditions,
collected during the Fall 2010 wave of the American College Health Association's (ACHA)
National College Health Assessment (NCHA), divided into homogeneous clusters according
to race/ethnicity.

Methods

Procedure and sample

The NCHA is a long-standing U.S. college student survey that collects data about student
health-related habits, behaviors, and perceptions. This self-administered survey is the largest
known comprehensive assessment of college student health (American College Health
Association, 2003) and has established reliability and validity (American College Health
Association, 2006; Arbour-Nicitopoulos et al., 2011). Institutions self-select to participate in
the NCHA and only campuses which randomly select students, or survey students in

randomly selected classrooms, are included in the NCHA. The NCHA samples have been shown to be comparable to those obtained by studies that randomly selected students to achieve nationally representative samples (American College Health Association, 2004). In the fall of 2010, 30,093 students from 39 colleges/universities participated in the survey. Sample characteristics are provided in Table 1.

Measures

Five dichotomous cancer risk behaviors/conditions were identified using data from the NCHA: tobacco use, overweight/obesity, physical inactivity, unhealthy diet, and alcohol binge drinking. With the exception of alcohol consumption, these factors were defined according to guidelines for cancer risk reduction (Kushi et al., 2012; United States Department of Health and Human Services, 2010). *Tobacco use status* was defined as true (yes) if the respondent reported using cigarettes (or hookah, cigars or smokeless tobacco) on at least 1-2 days during the last 30 days. *Overweight/obesity* was defined as having a body mass index (BMI) of 25 or larger (calculated from self-reported height and weight). *Physical inactivity* was defined as true if the respondent reported engaging in <3 days of vigorous exercise for at least 20 minutes *and* <5 days of moderate exercise for at least 30 minutes in the past seven days. *Unhealthy diet* was based on daily fruit and vegetable consumption and defined as true if the respondent reported <5 servings of fruits and vegetables per day (1 serving = 1 medium piece of fruit, 1/2 cup chopped, cooked or canned fruits/vegetables, 3/4 cup fruit/vegetable juice, small bowl of salad greens, or 1/2 cup dried fruit). *Binge drinking* was defined as true if the respondent reported consuming five or more drinks of alcohol in a single sitting during the last 14 days. We focused on binge drinking because it is especially relevant to U.S. college students and may convey greater risk for cancer incidence compared to light or moderate alcohol use (Courtney and Polich, 2009; Hill et al., 2000).

Statistical Analyses

Clustering of the five risk behaviors/conditions was investigated using exploratory latent class analysis (LCA), a powerful advancement of cluster analysis (Clogg, 1995; Collins and Lanza, 2010). To determine the smallest number of clusters, we began with a two-class model and successively increased the number of classes by one, fitting a new LCA model to the data at each step until we identified the simplest model that provided an adequate fit. The number of clusters was determined using the Bayesian Information Criterion (BIC: Elliott et al., 2006; Schwarz, 1978). The LCA model assumes the local independence assumption, i.e., risk behaviors are independent from each other within each latent class. To avoid multiple solutions in LCA parameter estimates, each model was run 200 times to search for a global solution. The analysis was conducted using the LCCA package in standard R software (Schafer, 2012). To avoid boundary solutions, which yield extreme probability estimates, parameters were estimated with a stabilizing constant of one. The LCA classes were further investigated by racial/ethnic groups.

Sensitivity Analysis—We performed a sensitivity analysis to assess the degree of violation of the local independent assumption. Interactions within a latent class would indicate that the risk factors could be explained not only by latent classes, but also by interactions among the risk factors. The latent classes were first identified based on the

posterior class membership probability (Lanza and Rhoades, 2011). Within each race-specific latent class, Poisson regression was fitted for the five risk behaviors/conditions. Next, variable selection was performed with the BIC to report the best model with the interaction terms (through five-way interactions).

Results

The prevalence of the five risk behaviors/conditions was summed for the entire sample and then stratified by racial and ethnic group (Table 2). A vast majority of students (95.2%) consumed fewer than five servings of fruits and vegetables per day. Physical inactivity was high (64.4%), while the prevalence of tobacco use, alcohol binge drinking, and overweight/obesity was less than 40%. White students reported the highest prevalence of binge drinking (37.5%), while Asian students reported the highest rate of physically inactivity (74.6%). Black students had the highest prevalence of insufficient fruit/vegetable intake (98.1%), but the lowest rates of tobacco use (13.6%) and binge drinking (17.1%). American Indian students had the highest rate of overweight/obesity (51.4%), exceeding the full sample average (32.5%) by almost 20%. Students who choose not to report their race/ethnicity (2.4% of the sample) reported the highest rate of tobacco use (27.9%).

Results of the LCA

The LCA model for the overall sample yielded four latent classes (see Table 3a). To simplify interpretation, we used a 50% threshold to indicate when a given class demonstrated a behavior. First, unhealthy diet, defined by insufficient fruit and vegetable intake, was high among students in all four clusters, even among those who presented otherwise "healthy" behaviors. For example, students belonging to Class 2 (14.9% of the full sample) presented comparatively low rates of tobacco use (9.2%), alcohol binge drinking (25.2%), physical inactivity (6.4%) and overweight/ obesity (19.1%), yet a high rate of unhealthy diet (84.9%). Class 3 (41.5% of the full sample) presented high rates of unhealthy diet (97.1%) coupled with significant incidence of physical inactivity (81.0%). Class 1 (21.0% of the full sample) presented high rates of unhealthy diet (96.8%) that co-occurred not only with physical inactivity (74.4%) but also with overweight/obesity status (68.6%). Finally, Class 4 (22.6% of the full sample) was characterized by comparatively high rates of tobacco use (63.8%), alcohol binge drinking (95.4%), unhealthy diet (97.0%) and physical inactivity (62.7%), while maintaining relatively low rates of overweight/ obesity (36.6%; below the 50% threshold).

Next, we performed LCA analyses separately by racial and ethnic group (Table 3b). Although results were generally consistent with results for the full sample, the estimates revealed differences in behavior clustering among racial/ethnic groups. As in the full sample, each group revealed a discrete coupling and high prevalence of unhealthy diet and physical inactivity (52.6% of Whites; 82.9% of Blacks; 64.9% of Hispanics; 83.1% of Asians; 74.4% of American Indians; 71.5% of Multiracial students; 81.1% of students reporting an "Other" race; and 65% of Unidentified Race-Ethnicity). In addition, portions of the groups were also characterized by high rates of tobacco use and alcohol binge drinking (35.1% of Hispanics; 16.9% of Asians; 28.5% of Multiracial students; 18.9% of Other and

35.0% of Unidentified Race-Ethnicity). Class 1 of American Indians showed the highest rate of overweight/obesity (51.4%) among racial/ethnic groups. Class 1 of Black students also showed high rates of tobacco use (75.0%), unhealthy diet (98.6%), physical inactivity (68.8%) and overweight/obesity (57.6%), but they did not report a rate of alcohol binge drinking (45.8%) that surpassed the 50% threshold.

Results of Sensitivity Analysis

Under the local independence assumption, interactions among the five risk behaviors/ conditions cannot occur within a latent class. Results showed that they appeared to interact within latent classes for White, Hispanic, and American Indian students. Additional LCA models were fitted within the subgroups defined by the risk behaviors. For example, the LCA model was fitted within subgroups defined by both alcohol and physical inactivity conditions to see if the structures of the LCA would change. Sensitivity analyses for White, Hispanic and American Indian students demonstrated consistent results, with tobacco use and alcohol binge drinking appearing simultaneously even when the local independence assumption might be sensitive.

Discussion

College students constitute one-third of young adults in the United States (Fry and Parker, 2012). Young adulthood, particularly in the college/university environment, is a critical period for developing healthy behaviors. However, college students continue to engage in a variety of unhealthy behaviors at an alarming rate despite the known health consequences (Eaton et al., 2012; Slutske, 2005). Consistent with previous studies, we found that cancer risk behaviors/conditions – tobacco use, poor diet, physical inactivity, overweight/obesity, and alcohol binge drinking – cluster among U.S. college students surveyed in the fall of 2010. However, we also found preliminary evidence of differential clustering by self-identified racial/ethnic group membership. Tobacco use and alcohol binge drinking co-occurred for all subgroups except Black students. Among Black students, we found that tobacco use co-occurred with being overweight/obese. American Indian overweight/obesity was consistently high throughout all latent classes, and contained the subgroup of students in which all five risk behaviors/conditions co-occurred (25.6% of the American Indian sample). As expected, we found high rates of certain behaviors across racial/ethnic groups: at least 90% of each racial/ethnic group reported poor diet, as defined by insufficient daily fruit and vegetable intake, and 60% reported physical inactivity, according to U.S. guidelines for cancer risk reduction (Garber et al., 2011).

The differences in the clustering of the cancer risk behaviors by racial/ethnic group can be interpreted via the dynamics of social networks. A key concept is that clustering of health behaviors in a population follows the patterns of social contacts, which can be explained by multiple social processes: 1) homophily asserts that social contacts are a product of similar attributes, whereas 2) social influence asserts that similar attributes are a product of social contacts (Salathé et al., 2013). For example, social network dynamics can explain the tobacco use in populations of adolescents via peer influences and friend selection (Mercken et al., 2009). Another key concept is that social networks tend to organize around common

psychological and sociodemographic characteristics; among these, race and ethnicity create the strongest divides in personal environments. The structure of networks can be explained via the homophily principle, which argues that contacts between similar people occurs at a higher rate than among dissimilar people (McPherson et al., 2001). These two concepts provide a theoretical foundation for a positive correlation between clustering of cancer risk behaviors and social network patterns associated with race and ethnicity. The extent to which these social processes help to explain behavior clustering in college students and differential clustering by race cannot be determined in the current study but represents a potentially important question to be addressed in future research.

Differential clustering of cancer risk behaviors in college students by race/ethnicity has potential implications for understanding racial/ethnic disparities in cancer. In 2010, the age-adjusted incidence of cancer was highest among Blacks, followed by Whites, Hispanics, Asian/Pacific Islanders, and American Indian/Alaskan Natives (U.S. Cancer Statistics Working Group, 2013). The highest incidence rate among Blacks is consistent with the clustering profile observed in the Black students in the current study, in that tobacco use and overweight/obesity are the leading causes of cancer in the U.S. Together they account for 53% of all cancers (tobacco use 33%, overweight/obesity 20%) (Colditz et al., 2012). Left unaddressed in college students, there is potential for cancer rates to escalate even higher, especially among American Indian/Alaskan Native students who were overweight/obese across latent classes and the only racial group in which all five risk behaviors/conditions co-occurred. Future research should monitor the persistence of cancer risk behavior clustering by race and ethnicity. This is critical given that the number of new cancer cases is projected to increase by 45% by 2030, and surpass heart disease as the leading causes of death in the U.S. (American Society of Clinical Oncology, In Press).

With this in mind, cancer prevention interventions, which typically focus on a single behavior (e.g., tobacco use), might be more effective if designed to target multiple behaviors and tailored to subgroups of individuals with similar risk behavior patterns (Prochaska et al., 2008). For example, while poor diet and physical inactivity should be addressed globally on college campuses, targeted policy and individual-level interventions that simultaneously address tobacco use and alcohol binge drinking could arguably be effective when addressing unhealthy behaviors in college campuses with large populations of White, Hispanic, Asian or Multiracial students. The behavior profile exhibited by nearly a quarter of American Indian students indicates a need for multiple behavior interventions that address all of the behaviors/conditions examined in this study.

Our results should be considered in the context of certain limitations. First, although our sample size was large (>30,000 students), generalizability is potentially limited because, although students were randomly selected, they were drawn from self-selecting institutions rather than from randomly selected institutions. Second, the binge drinking measure available through the NCHA survey did not allow us to define it differently for women (4 or more drinks) versus men (5 or more drinks) (National Institute of Alcohol Abuse and Alcoholism, 2004). Finally, though not assessed in the NCHA, high level consumption of animal products and fat could have been a better indicator than low level consumption of fruit and vegetables because the former is associated with greater cancer risk (Armstrong

and Doll, 1975; Cho et al., 2006; Key, 2011; Willett and Stampfer, 2013). However, low fruit and vegetable consumption may be a good proxy for high meat and fat consumption. There may be a substitute relationship between the two dietary behaviors because more animal products and fat than fruit and vegetables can be purchased with the same amount of money (Rao et al., 2013).

The novelty and significance of this study lies in our use of LCA to explore how unhealthy behaviors cluster by race and ethnicity in a large sample of U.S. college students. Previous studies have been limited by sample size or number of risk behaviors studied. Moreover, to our knowledge, no prior studies have examined whether or not the co-occurrence of unhealthy behaviors in young adults varies by race or ethnicity. This study represents an important next step, as our findings indicate that there may be racial/ethnic disparities in cancer risk behaviors/conditions that could help to explain some of the racial/ethnic disparities in cancer incidence. We observed that some risk behaviors, especially insufficient fruit/vegetable consumption and physical inactivity, were present among the overwhelming majority of college students, regardless of race or ethnicity, but also that there were clusters of risk behaviors that appear to be specific to certain racial/ethnic groups. These findings may help inform various campus-level interventions, including prevention and treatment programs which target different combinations of cancer risk behaviors among groups of college students as defined by race/ethnicity. More generally, understanding how these behaviors co-occur during young adulthood could explain how disparities in risk behaviors and later onset of disease, particularly cancer, persist between racial/ethnic groups.

Acknowledgments

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Highlights

- Cancer risk behaviors/conditions clustered among U.S. college students in 2010.

- Low fruit/vegetable intake and physical inactivity were common among all students.

- Cancer risk behaviors/conditions appeared to cluster differentially by race/ethnicity.

- Tobacco use and overweight/obesity co-occurred among Black students.

- All five cancer risk factors co-occurred in a subgroup of American Indian students.

Table 1

Sample characteristics (N=30,093)

Characteristic	
Age	21.4 (SD=5.6)
Gender	
Female	64.8%
Male	35.0%
Transgender	0.2%
Race/Ethnicity	
White	60.3%
Black	6.9%
Hispanic	7.9%
Asian	12.6%
American Indian	0.7%
Biracial or Multiracial	6.0%
Other	1.5%
Unidentified Race/Ethnicity	2.4%
Enrollment status	
Full-time	94.7%
Part-time	4.8%
Other	0.5%
Year in School	
1st Year Undergraduate	34.1%
2nd Year Undergraduate	19.7%
3rd Year Undergraduate	19.3%
4th Year Undergraduate	12.3%
5th Year Undergraduate	4.4%
Graduate/Professional	9.3%
Other	0.9%
Type of University	
2-year	5.1%
4-year	94.9%
Campus size	
< 2,500	5.1%
2,500-4,999	13.9%
5,000-9,999	26.9%
10,000-19,999	13.6%
> 20,000	40.6%
Locale	
> 500,000	14.7%
250,000-499,999	13.9%
50,000-249,999	45.8%

Characteristic	
10,000-49,999	16.8%
2,500-9,999	7.5%
< 2,500	1.3%
Region	
Northeast	23.9%
Midwest	10.4%
South	40.1%
West	22.1%
Outside U.S.	3.5%

Table 2

Descriptive statistics and rates of risk behaviors stratified by racial/ethnic group.

	% of total	Tobacco Use	Binge Drinking	Unhealthy Diet	Physical Inactivity	Overweight/Obese
All (N=30,093)	100	23.6(±0.2)	32.6(±0.3)	95.2(±0.3)	64.4(±0.3)	32.5(±0.3)
White (n=18,141)	60.3	25.9(±0.3)	**37.5(±0.4)**	94.4(±0.2)	61.6(±0.4)	30.7(±0.3)
Black (n=2,087)	6.9	13.6(±0.8)	17.1(±0.8)	**98.1(±0.3)**	70.4(±1.0)	47.7(±1.1)
Hispanic (n=2,365)	7.9	23(±0.9)	30.1(±0.9)	98(±0.3)	65.9(±1.0)	42.6(±1.0)
Asian (n=3,795)	12.6	17.6(±0.6)	21.4(±0.7)	96.2(±0.3)	**74.6(±0.7)**	24.6(±0.7)
American Indian (n=216)	0.7	23.8(±2.9)	34.9(±3.3)	93(±1.7)	66.8(±3.2)	**51.4(±3.4)**
Multiracial (n=2,310)	7.7	23.6(±0.9)	29.4(±1.0)	94.8(±0.5)	63(±1.0)	33.8(±1.0)
Non-Respondent (n=717)	2.4	**27.9(±1.8)**	37.0(±2.0)	96.1(±0.8)	62.7(±2.1)	29.7(±3.1)
Others (n=462)	1.5	20.9(±1.9)	25.6(±2.0)	94.3(±1.1)	64.6(±2.2)	34.3(±2.3)

Note: The percentage of total indicates the proportion of the overall sample that comprised each racial/ethnic group. All other values are percentages (standard error), where the percentage represents the proportion of the racial/ethnic group sample endorsing the risk behavior/condition. **Bold** (underlined) numbers indicate the **highest** (lowest) rate of the risk behavior/condition among all racial/ethnic groups.

Table 3

a: Prevalence of risk behaviors within latent classes: full sample (N=30093).

Class (% of total sample)	Tobacco Use	Binge Drinking	Unhealthy Diet	Physical Inactivity	Overweight / Obese
Class 1 (21.0%)	16.1	6.0	**98.8**	**74.7**	**68.6**
Class 2 (14.9 %)	9.2	25.2	**84.9**	6.4	19.1
Class 3 (41.5%)	10.7	14.6	**97.1**	**81.0**	16.8
Class 4 (22.6%)	**63.8**	**95.4**	**97.0**	**62.7**	36.6

b: Prevalence of risk behaviors within latent classes by racial/ethnic groups.

	Tobacco Use	Binge Drinking	Unhealthy Diet	Physical Inactivity	Overweight/Obese
White (N=18141)					
Class 1 (52.6%)	13.9	4.7	**96.4**	**75.1**	34.2
Class 2 (14.8 %)	8.8	26.4	**81.1**	10.6	15.2
Class 3 (32.6%)	**53.2**	**95.3**	**97.2**	63.2	32.1
Black (N=2087)					
Class 1 (17.1%)	**75.0**	45.8	**98.6**	**68.8**	**57.6**
Class 2 (82.9 %)	1.1	11.2	**98.0**	**70.7**	45.7
Hispanic (N=2365)					
Class 1 (35.1%)	**54.6**	**73.0**	**97.5**	61.4	46.2
Class 2 (64.9 %)	5.9	7.0	**98.2**	68.2	40.8
Asian (N=3795)					
Class 1 (16.9%)	**70.9**	**78.1**	**95.6**	67.8	36.0
Class 2 (83.1 %)	6.8	9.9	**96.3**	76.0	22.3
American Indian (N=216)					
Class 1 (25.6%)	**75.3**	**79.6**	**94.9**	66.5	**51.6**
Class 2 (74.4 %)	6..5	19.6	**91.8**	66.7	**51.3**
Multiracial (N=2310)					
Class 1 (28.5%)	**53.0**	**88.6**	**94.6**	59.6	32.1
Class 2 (71.5 %)	11.9	5.9	**94.8**	64.3	34.5
Others (N=462)					
Class 1 (18.9%)	**71.2**	**72.0**	**89.4**	52.2	49.1

Class (% of total sample)	Tobacco Use	Binge Drinking	Unhealthy Diet	Physical Inactivity	Overweight / Obese
Class 2 (81.1 %)	9.2	14.8	**95.2**	**67.4**	31.0
Non-respondent (N=717)					
Class 1 (35.0%)	**54.7**	**88.2**	**97.5**	**52.4**	35.7
Class 2 (65.0 %)	13.6	9.6	**95.2**	**67.9**	27.0

Note: All values are percentage scale. **Bold** values indicate the behavior crossed the 50% threshold for participation in the class.