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# Health Lifestyles across the Transition to Adulthood: Implications for Health

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## Abstract

Research has long established the importance of individual health behaviors such as cigarette smoking for adult morbidity and mortality. However, we know little about how health behaviors cluster into health lifestyles among adolescents and young adults in the United States, or in turn, how such health lifestyles are associated with young adult health outcomes. This study establishes health lifestyles as distinct group phenomena at three developmental time points in a single cohort: late adolescence (ages 15–17), early adulthood (ages 20–24), and young adulthood (ages 26–31). We then identify the associations between these health lifestyles and young adult health outcomes. We use the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative sample of U.S. adolescents followed into adulthood, and latent class analysis and regression models. We uncover diverse health lifestyles among adolescents, early adults, and young adults; however, few individuals engaged in a consistently salubrious lifestyle at any developmental stage. People with less healthy lifestyles also tended to exhibit poorer health in young adulthood. Our results showed that young adult health lifestyles were significantly associated with young adult cardiovascular risk. Moreover, health lifestyles in each of the three developmental stages were associated with young adult self-rated health, and accounting for lifestyles in later stages explained some of these associations. Overall, this study suggests a portrait of problematic health lifestyles among a nationally representative cohort of young Americans, with associated patterns of relatively poor physical health among those with poor health lifestyles.

### Keywords

health lifestyles; young adults; Add Health; United States; transition to adulthood

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## Introduction

Research has long established the importance of health behaviors for longevity (Rogers et al., 2000). In addition, smoking, poor nutrition and inadequate exercise, and excessive drinking all contribute to the less healthy profile of U.S. adults compared to adults living in similarly wealthy countries (Danaei et al., 2011; NRC and IOM, 2013). However, this important research establishing the health consequences of health behaviors has tended to focus on single behaviors or combinations of two or three behaviors (e.g. Danaei et al., 2011). We therefore know little about complex groupings of health behaviors, even though sociological research has long identified health behaviors as components of broader lifestyles that develop over time in social contexts (Cockerham, 2005). To fill this gap, this study contextualizes individual health behaviors within a package of broader health lifestyles and examines these health lifestyles across the transition to adulthood, a developmental stage that is particularly salient for health behaviors. This study seeks to answer two questions. First, what do health lifestyles look like during three specific developmental stages across the transition to adulthood? Second, what are the associations between health lifestyles in these three developmental stages and young adult health outcomes? Answering these questions can inform theoretical understandings of the development and implications of health lifestyles in this sensitive and important life phase.

### Health lifestyles

Health behaviors are not isolated phenomena but comprise routines and habits that make up a lifestyle (Bourdieu, 1984). Theory has highlighted the potential importance of health lifestyles in understanding how and why there are patterns to behaviors that promote or endanger health (Cockerham, 2005), and a substantial body of literature demonstrates that health behaviors cluster together within individuals (Chou, 2008; DeVries et al., 2008; Dodd et al., 2010; Leech et al. 2014). However, most of these studies examine a limited number of behaviors that affect public health most strongly: substance use, physical activity, and nutrition. Yet, there are a wide variety of other important health behaviors, such as health care use, sleep habits, and safety practices. Recently, researchers have begun to tie the theoretical literature on health lifestyles to empirical examinations of clusters of a wide range of behaviors (Cockerham et al., 2017; Mize, 2017; Mollborn et al., 2014; Saint Onge and Krueger, 2017; Skalamera and Hummer, 2016). This nascent literature suggests that U.S. children, adolescents, and adults exhibit coherent patterns of behavior, consistent with their conceptualization as health lifestyles. To our knowledge, though, only one study has examined health lifestyles as they develop from adolescence to young adulthood, but this study limited behaviors to smoking, drinking, obesity, and physical activity (Daw et al., 2017). Thus, to our knowledge, we are the first study to examine health lifestyles as they unfold across the transition to adulthood while considering a broad range of behaviors in which individuals engage. This expansive approach to health lifestyles could reveal that individuals generally fall along a spectrum of positive or negative behaviors, in which case additive or scale approaches to health behaviors would be appropriate for future research. Or, the results could reveal substantively complex combinations of behaviors that would provide evidence for more research into the contexts shaping such mixtures.

The examination of health lifestyles across the transition to adulthood is particularly important. First, these developmental stages are characterized by substantial changes in the prevalence and patterns of health behaviors. Behaviors like smoking, alcohol use, drug use, and sexual activity become increasingly common during adolescence (Kwan et al., 2012; Pampel et al., 2014). Other important developmental changes occur as well, such as an increased need for sleep (Hirshkowitz et al., 2015). Second, the transition to adulthood is a particularly important time for establishing one's identity, patterns of health-related behavior, and trajectories of adult health (Harris, 2010).

The first aim of this paper is therefore to identify prevalent health lifestyles as distinct group phenomena during the transition to adulthood among a nationally representative cohort. We examine health lifestyles within three developmental stages: late adolescence (ages 15–17), early young adulthood (ages 20–24), and late young adulthood (ages 26–31).

## Young adult health

Research has established that adult health behaviors are important for adult mortality and morbidity (Danaei et al., 2011; NRC and IOM, 2013; Rogers et al., 2000), but the relationship between health lifestyles and young adult health is less clear. First, it is unknown whether health lifestyles during these developmental stages are consequential for young adult health. It could be that the behaviors that comprise temporally limited lifestyles do not have lasting effects. Alternatively, even experimental or brief bouts of unhealthy actions could have consequences into adulthood. If health lifestyles are associated with young adult health as suggested by the latter, this relationship could operate in two ways. Health risk behaviors at critical periods in the life course can result in exposures that leave an imprint on health, years later or concurrently. Or health lifestyles may be part an overall trajectory of exposures which affect health ("pathway") (Goosby et al., 2016; Montez and Hayward, 2011). Thus, our second aim is to *identify associations between health lifestyles at three different life course stages and young adult health outcomes, while distinguishing whether any associations are best described by an imprint or pathway model*.

If results indicate that one developmental stage is most strongly associated with young adult health, and such associations are independent of other stages of health lifestyles, an "imprint effect" would be supported. If, in contrast, health lifestyles from multiple stages are associated with young adult health and associations are attenuated or accounted for when considering health lifestyles of other stages, a "pathway" model would be supported. Life course literature suggests that different life phases all matter for health, and that they sometimes operate through "imprint" processes and sometimes "pathway" processes depending on the phenomenon being studied (Berkman, 2009; Montez and Hayward, 2011). Thus, identifying the specific pattern of the health lifestyle-health relationship can shed light on the production of health as it unfolds across the life course. Importantly, we also control for confounding influences such as race/ethnicity, gender, family background socioeconomic status (SES), and adolescent health (self-rated health and weight status), all of which may influence both health lifestyle membership and young adult health.

The examination of young adult health is important not only in and of itself, but also because it helps researchers and policymakers understand what future health risks and

trajectories may look like (Harris, 2010). Most health conditions are more prevalent in middle and older adulthood compared with young adulthood, but the consequences of unhealthy practices sometimes appear in younger adulthood (Harris, 2010). We focus on two measures of health that are important and appropriate for young adults: cardiovascular risk and global self-rated health. Today's young adults have exceedingly high rates of cardiovascular risk, including high body mass index (BMI), diabetes, and glucose levels (Clark et al., 2014), and U.S. young adults ages 20–34 demonstrate higher rates of obesity and diabetes than their peers in similarly wealthy countries (NRC and IOM, 2013). Self-rated health comprehensively captures a host of physical and mental conditions and capabilities across life stages (Jylhä, 2009).

## Methods

### Data

We used the National Longitudinal Study of Adolescent to Adult Health (Add Health). This dataset was well suited for this study because it provided detail on a range of behaviors across several stages of the early life course and collected information on health outcomes in young adulthood. The first wave of Add Health surveyed 20,745 adolescents ages 11–19 in 1994–1995. We did not use Wave II because only a subsample of individuals was re-interviewed. A second follow-up (Wave III) was conducted in 2001, when respondents were aged 18–28 (99% were 18–25). Wave IV surveyed respondents in 2007–08 at 24–34 years old (96% were 26–32). See http://www.cpc.unc.edu/projects/addhealth for further details. The sample used in this study comprises 6,605 individuals who were ages 15–17 at Wave 1, participated in both Waves III and IV, and were not pregnant or "probably pregnant" at Wave IV.

### Measures

**Health outcomes—**We used two Wave IV outcomes to document young adult health: cardiovascular risk and self-rated health. Cardiovascular risk is a continuous measure that summed standardized scores for eight indicators of cardiovascular health: systolic blood pressure, diastolic blood pressure, pulse rate, HbA1c (or glycated hemoglobin), triglycerides, high density lipoprotein (HDL) cholesterol, low density lipoprotein (LDL) cholesterol, and BMI (Wickrama et al., 2015). We standardized these continuous indicators (each with a different unit) to retain the full range of information, rather than defining and using thresholds. The scale's unit was therefore a standard deviation, which allows for comparison of risk across subgroups. Further details on the collection and measurement of these indicators are available in http://www.cpc.unc.edu/projects/addhealth/documentation/guides. Self-rated health was the respondent's response to the question, "In general, how is your health?" Response categories included excellent (5), very good (4), good (3), fair (2), and poor (1). Descriptive statistics for the health outcomes are presented in Appendices C and D.

**Health lifestyle indicators—**We defined health behaviors as those actions or habits that research has shown to be influential for health or that people undertake to stay healthy. While the health effects of some of the behaviors we used are mixed in recent research,

individuals may nonetheless engage in these behaviors in the pursuit of health. The health behavior domains we included were physical (in)activity, substance use, diet, safety, health care, sleep, and sexual behaviors. Indicators were similar across the waves but differed slightly based on the questionnaire, developmental context, and fit statistics produced by analyses. Categorical measures used substantively meaningful thresholds. Lists of indicators and means for each wave are available in Tables 1 – 3.

Physical (in)activity included a count of activity sessions, screen time, seated time (Wave III only), and walking (or cycling) to work or school (Wave III); both physical activity and sedentary time are associated with health outcomes (Kesaniemi et al., 2001; Thorp et al., 2011). The activity sessions count summed how often the respondent reported participating in different physical activities in the past week; using these counts, we created three categories. Respondents were asked how long they watched television/videos and used the computer (not including for work). We summed these responses and created three categories. Seated time captured whether a respondent reported being seated at work and school 40 or more hours per week, compared to those reporting less. A dichotomous variable represented whether the respondent walked or cycled to school/work or not.

Measures of tobacco, marijuana, alcohol, and drugs comprised substance use, all of which have important health implications (Chen and Lin, 2009; Shield et al., 2014; U.S. DHHS, 2014). Alcohol consumption reflected use in the last year, and all other measures captured use in the last 30 days. Smoking cigarettes and chewing tobacco were combined. In Wave I, we compared those reporting any versus no tobacco use in the last 30 days, and in Waves III and IV, we created a trichotomous measure of tobacco use: none, some, and daily. Alcohol consumption categorized respondents into no drinking, some drinking, and problem drinking (at least one instance of heavy episodic drinking or regular heavy drinking: 4 or more drinks in one sitting for women, 5 for men). Marijuana use was a dichotomous variable representing if the individual reported using marijuana one or more times in the last 30 days, and other drug use represents whether the individual reported using cocaine, LSD, MDMA, or injection-use drugs in the last 30 days. In Wave III, an additional substance use variable measured whether the individual used legal performance-enhancing drugs, such as creatinine, in the last year.

Questions asked about diet and nutrition were different for each wave, but included measures shown to be important for healthy eating patterns (U.S. DHHS, 2015). Wave I included an indicator of whether the respondent reported eating two fruits and two vegetables during the previous day. From Waves I and III, we used a measure for eating breakfast, a habit that many believe to be important for health (Spence, 2017). For Wave I, a measure represented whether the respondent responded “nothing” when asked what s/he usually eats for breakfast. Wave III included an indicator of breakfast: once or more per week compared to none. Waves I and III also include an indicator of reporting disordered eating behaviors. The final Wave III diet measure captured weekly fast food consumption: those who ate fast food two or more times per week (versus less often). The same fast food measure was included for Wave IV. The other nutrition variable for Wave IV captured whether the respondent consumed seven or more sugar-sweetened beverages per week.

Safety measures differed across waves but comprised available indicators associated with likelihood of injury (Olivier and Creighton, 2015; Perneger and Smith, 1991; Pickett et al., 2005). Wave I included dichotomous measures of fighting in the last year, always wearing a helmet when riding a bicycle or motorcycle (or never riding a bicycle or motorcycle), always wearing a seatbelt, and ever having driven while drunk. A Wave IV dichotomous variable captured engagement in one or more serious fights in the last year.

Health care seeking was the same two variables for all waves, indicating whether respondents had a check-up or physical exam, and a dental visit, in the last year. Individuals generally perceive regular examinations to be important for health (Oboler et al., 2002).

For sleep, all waves included a measure of whether the respondent slept for nine hours (Wave I) or seven hours (Waves III and IV) based on usual weekday bedtimes and wake-up times. Additionally, Wave I included a measure of whether the respondent says he/she gets enough sleep. Sleeping less than the recommended duration is associated with increased mortality risk (Cappuccio et al., 2010).

Sexual behavior was assessed with developmentally appropriate variables that are associated with risk of contracting sexually transmitted infections (Steiner and Cates, 2006). Wave I categorized respondents into those who: never have had sex, used a condom the last time they had sex, used contraception but not a condom the last time they had sex, and used no contraception during last sex. For Waves III and IV, a dichotomous measure represented if the respondent had two or more sex partners in the last year. Wave IV also included an indicator of whether the respondent paid for sex in the last year.

**Controls—**To minimize the risk of identifying spurious relationships, we included control variables in multivariate regression models: gender, race/ethnicity, age at the Wave IV interview, family of origin SES, and adolescent health. Race/ethnicity was captured in the mutually exclusive categories of non-Hispanic White (referred to as White hereafter), non-Hispanic Black (referred to as Black), Hispanic, and other (including Asian/Pacific Islander, Native American/American Indian, and individuals reporting “other”). Parent education and household income-to-needs, both collected at Wave I, captured family of origin SES. The highest educational degree among the respondent’s parents was captured with five categories: less than high school, high school diploma, some college, college degree, and more than college degree. Household income-to-needs was the ratio of the household’s income to the U.S. Census-defined poverty threshold for the survey year and household size. We controlled for self-rated health reported in adolescence, coded identically to self-rated health in young adulthood. Weight status in adolescence was categorized as normal, overweight, or obese as defined by age, gender, height, and weight using cut points from Cole et al. (2000).

## Analytic Approach

For our first research aim, we used latent class analysis (LCA) to identify health lifestyles at each of three developmental stages (late adolescence [15–17], early adulthood [20–24], and young adulthood [26–31]), corresponding to three waves of Add Health data. LCA uses observed indicators to identify a categorical latent variable that is assumed to explain all

associations between indicators. LCA is best suited for our aims because it allows lifestyles to be categorical and emerge from the data (Abel, 1991). We used the SAS package PROC LCA (PROC LCA 2015) and accounted for clustering and weighting at each wave. Our sample included only older teens aged 15 to 17 at Wave I because health behaviors (e.g., alcohol consumption) and health lifestyles are age dependent in this developmental stage, and tests of measurement invariance demonstrated that latent class models separated by age better fit the data than pooled models. We maintained the full set of selected cases at each wave using full information maximum likelihood. We chose the number of classes based on substantive interpretation and fit statistics (including the $G^2$, Akaike Information Criterion [AIC], and Bayesian Information Criterion [BIC]; see Appendix A for fit statistics for all waves); the best-fitting results represented the lowest BIC.

For our second aim, we identified relationships between young adult health and health lifestyles at each developmental stage. Using the results from the LCA, we assigned each individual to the health lifestyle for which he or she had the highest probability of membership. We then used these class memberships in ordinary least squares regression models to predict young adult cardiovascular and self-rated health. Supplemental models using ordered logit models for self-rated health produced similar results. We chose to estimate latent classes separately from regressions rather than concurrently because the latter produces classes that are conditional on the associations. However, our approach of assigning class membership had misclassification bias that has been shown to produce underestimated associations (Bolck, Croon, and Hagenaars, 2004). Therefore, our tests were conservative, and associations were likely attenuated. We used multiple imputation to retain the full sample for descriptive statistics and regression models. We imputed using a chained equations approach, creating 10 datasets and employing all independent and dependent variables.

## Results

### Aim #1: Health Lifestyles at Each Wave

Results from the latent class analyses for the three waves provide evidence that health lifestyles are an important and meaningful construct that differs across life stages. The results demonstrate that while some individuals in each life stage engage in a lifestyle that can be described as consistently positive or negative, most individuals have a lifestyle that is characterized by a mix of salubrious and insalubrious behaviors. But perhaps most important for future health outcomes among this Add Health cohort, only a small percentage of individuals in each stage exhibited what we termed a “consistently positive” health lifestyle. During adolescence, for example, just 26% of individuals were classified as having a consistently positive health lifestyle.

The LCA for Wave I produced a seven-class solution (see Appendix A). Table 1 presents the class-conditional probabilities, which can be interpreted as the percentage of respondents endorsing that item or category. Each class was named after the behaviors that distinguish that group from the others. Class sizes are given in the row marked “Class membership probabilities.” Overall, adolescent health lifestyles comprise many patterns of health behavior, with most individuals belonging to groups with some health compromising

behaviors. The *consistently positive* group (26%) generally exhibited positive health behavior across all domains. The *mixed* group (10%) had positive activity, diet, health care, and sleep, but negative substance use and safety. *Mid, sleep problems* (15%) demonstrated the lowest rates of getting enough sleep and getting nine or more hours of sleep. The *passive* group (17%) was characterized by relatively little engagement with either health-promoting or -reducing behaviors. Both the *unsafe, no substance use* group (16%) and the *substance users and unsafe* group (8%) demonstrated poor rates of safety behaviors, but the latter also had the highest rates of each of the substances. The *mostly negative* group (9%) had mostly unhealthy behaviors, including the lowest rates of eating fruits and vegetables and health care use.

The Wave III early adult LCA resulted in five classes; Table 2 presents the class-conditional probabilities for the classes. Like adolescent health lifestyles, these classes demonstrate diverse mixes of health behavior, with substance use and activity levels appearing particularly salient for distinguishing early adulthood health lifestyles. Few individuals in this life stage demonstrated an overall healthy lifestyle. The healthiest group was the *consistently positive* group (27%), which generally exhibited healthier behaviors than average. The next group demonstrated mostly positive behaviors, but also had the highest rates of seated time and very high rates of problem drinking. At about one third of the population, the largest group was *poor diet and no health care* (35%), distinguished by high rates of fast food and disordered behaviors and low rates of breakfast and dental exams. The last two groups generally had more negative behaviors than average, but the *mostly negative but active* group (10%) had the highest activity rate. The *mostly negative, especially substance use* group (11%) generally exhibited insalubrious behavior, with particularly problematic levels of tobacco, marijuana, and alcohol use; this group, however, also had fewer hours of average seat time and tended not to use other drugs or performance-enhancing substances.

Turning to Wave IV when respondents were young adults, a four-class solution was the best fitting. Table 3 shows the class-conditional probabilities and sizes of these lifestyle classes. Like the results for the earlier life course stages, most young adults demonstrate some unhealthy behaviors. The healthiest group, *consistently positive* (20%) exhibited an overall healthy lifestyle. The *mostly positive with problem drinking* group (21%) appeared active and had favorable diet, health care, and sleep, but also exhibited high rates of problem drinking. The next group, *inactive, poor diet, poor sleep* showed quite unhealthy behavior across several domains, but also had little substance use, fighting, or sex risk. The last group, *consistently negative* (25%), had an unfavorable overall profile.

Appendix Table B presents the means for adolescent and early adult health lifestyles by young adult health lifestyles. Analyzing in detail the relationships between health lifestyles over time is unfortunately beyond the scope of this paper. We note, however, that there is much stability across time, in that the proportions of those with similar health lifestyles over time were greater than those that were dissimilar. For example, 39% of early adults in the *mostly positive, seated time and problem drinking* group were in the young adult *mostly positive with problem drinking* group. But at the same time, there was a substantial amount of change. Among early adults in that class, 25% adopted a *consistently positive* lifestyle in

young adulthood, with a similar percentage taking on an *inactive, poor diet, poor sleep* lifestyle and 12% belonging to the young adult *consistently negative* group. The differences in lifestyles across these development stages reinforce the need to examine them as independent predictors of young adult health.

### Aim #2: Health Risks in Young Adulthood

Table 4 presents results from models predicting cardiovascular risk and self-rated health, respectively, controlling for age, sex, race/ethnicity, socioeconomic background, adolescent self-rated health, and adolescent weight status. Only young adult health lifestyles were significantly associated with young adult cardiovascular risk, supporting an imprint model. Interestingly, the adolescent and early adult lifestyles do not appear salient for young adult cardiovascular health; none of those lifestyles demonstrated a strong relationship, net of controls which include adolescent weight status. However, two young adult lifestyles were strongly associated with young adult cardiovascular risk. Compared to those in the *consistently positive* referent group, those in the young adult *inactive poor diet, poor sleep* and *consistently negative* groups each exhibited increased young adult cardiovascular risk of one to two-tenths of a standard deviation. However, young adults engaging in a mostly positive health lifestyle that also included problem drinking did not evidence different cardiovascular risk. Model 4 for cardiovascular risk demonstrates that the health lifestyle coefficients were somewhat smaller compared to their counterparts in Models 1 – 3, but young adult *inactive, poor diet, and poor sleep* had significantly increased risk compared to *consistently positive*. These results provide support for an imprint model in which young adult health lifestyles shape concurrent cardiovascular risk. Membership in adolescent and early adult health lifestyles compared to *consistently positive* was not associated with cardiovascular risk, which may indicate that such lifestyles do not have lasting effects. Alternatively, the findings may be a result of low statistical power or because of limited ability to identify cardiovascular risk in young adulthood.

The right side of Table 4 considered self-rated health as the outcome variable. In contrast to the imprint model supported for cardiovascular risk, the self-rated health results presented in Table 4 support a pathway model. That is, health lifestyles in adolescence, early adulthood, and young adulthood (compared to the most positive group) were each associated with young adult self-rated health when separately considered, but these associations were attenuated in models that incorporated all life stages. When life stages were considered separately, four adolescent, three early adult, and two young adult health lifestyles were associated with worse reports of self-rated health, compared to their referent group of the healthiest lifestyle (Models 1 – 3). Effect sizes ranged from 0.11 to -0.43 of a scale point. Young adults in the *consistently negative* class exhibited the worst self-rated health, followed by young adults in the *inactive, poor diet, poor sleep*, early adults in the *mostly negative, especially substance use*, and adolescents in the *mostly negative* groups. When all three life course stages were considered in the self-rated health model (Model 4), the coefficients were slightly smaller and some groups that showed significant relationships no longer remained significant. These results provide suggestive evidence for a pathway model in that lifestyles across multiple life stages are important for self-rated health in young adulthood, in part because of associations between these lifestyles across life course stages.

## Discussion

Despite the well-established importance of health behaviors for older adult morbidity and mortality, we know little about how health behaviors cluster into health lifestyles across the transition to adulthood or the health implications of these clusters. This study had two distinct aims. First, we identified health lifestyles in a U.S.-representative longitudinal cohort at three development stages: late adolescence, early adulthood, and young adulthood. Second, we assessed the relationships between health lifestyles in these three stages and two important health outcomes in young adulthood: cardiovascular risk and self-rated health. As the first study to use a broad range of behaviors to examine health lifestyles across the transition to adulthood and to examine health consequences of these lifestyles, the results presented here contribute to our understanding of the development and import of health lifestyles. We describe here the implications of our findings, emphasizing the value of comprehensive, contextualized, and longitudinal approaches to health behaviors.

This study contributes to a growing literature emphasizing the importance of studying clusters of behaviors and provides evidence that health behaviors combine within individuals in complicated ways that are indicative of underlying lifestyles. The complex patterns that emerged from the data suggest that there is more behavioral heterogeneity than one might anticipate. For example, some individuals are generally engaging in healthful behaviors with some alcohol misuse, while others have a generally poor health lifestyle, of which heavy substance use is only a part. The results demonstrate how seemingly inconsistent behavior patterns might be the product of an underlying health lifestyle. For example, early adults in the *mostly positive, seated time and problem drinking* group may be generally health conscious but may work long hours and cope with stress with binge drinking. These complex patterns not only may have differential health consequences, but also may themselves originate from different social and cultural contexts. Future research should consider behaviors from a contextual perspective; the groupings here indicate that single indicators or scales that combine behaviors additively may obscure important patterns.

Health lifestyles at each of the three life course stages showed important associations with young adult self-rated health. Even among young adults who as a group are relatively healthy compared to older adults, we see health differences due to lifestyle. The results debunk popular conceptions that unhealthy lifestyles in adolescence or during the college years may not have lasting health implications. We find evidence that they may, even when later health lifestyles change. Some of the effect sizes were small, but small differences at these younger ages may translate into larger differences as these individuals enter middle and late adulthood.

Our results supported both the pathway and imprint models to describe outcome-specific processes through which health lifestyles shape health across the transition to adulthood. Lifestyles were both directly associated with young adult self-rated health and partially accounted for when considering health lifestyles from other stages, but only young adult health lifestyles were significantly associated with young adult cardiovascular risk. The difference across outcomes may be because self-rated health is a more sensitive outcome than cardiovascular risk in this developmental stage. One explanation is that cardiovascular

health is somewhat resilient in these earlier years, but unhealthy lifestyles have lasting effects on other aspects of physical and mental well-being. Another explanation is that cardiovascular consequences of earlier exposures may yet manifest in later life, as related health conditions decline over age. Further research is needed on the relationships between health lifestyles and health across different life stages and health outcomes. A life course approach will be key to better understanding the relationship between health behaviors and health risks.

The results show the importance of a comprehensive approach to health behaviors such as health lifestyles, rather than individual risk factors. For example, early adults in the *mostly positive, seated time and problem drinking* and young adults in the *mostly positive with problem drinking* group appear relatively healthy, but those drinking in the context of an overall negative health lifestyle (young adult *consistently negative)* had worse cardiovascular risk and overall health than the most behaviorally healthy group. It may be that the health implications of sporadic unhealthy behavior such as binge drinking are overwhelmed by an otherwise healthy lifestyle, particularly during a developmental stage when such behavior is normative. Thus, problem drinkers had different health risks depending on the other behaviors. Policies and programs targeting problem drinking without acknowledging this nuance may be ineffective. The health consequences of different behaviors depend on the developmental stage and health lifestyle in which they are embedded, further justifying the need for nuanced policy and programmatic efforts.

As the first study to identify health effects of health lifestyles across the transition to adulthood, this work has limitations that we hope future research will address. Importantly, we were unable to estimate causal relationships. We control for background characteristics including adolescent self-rated health and weight status, but there may be other confounders. We hope that future researchers will look in more detail at social and contextual determinants of health lifestyles over the early life course. Our descriptive results indicated important patterns of health lifestyles across gender, socioeconomic background, and race/ethnicity population subgroups, but we were unable to consider these diverse groups and their behavioral patterns in this paper. We anticipate, for example, that as individuals attain their own socioeconomic status, and particularly educational degrees, there will be important feedback loops between health lifestyles and social status. We also expect neighborhood and school characteristics to shape norms and attitudes that guide health lifestyle adoption. Further research on these important relationships will help us to understand inequalities in health behaviors and health.

In closing, we note that only small percentages of individuals in the three life stages fell into the most behaviorally healthy groupings. It is clear from such descriptive results that health behavior patterns among young Americans are not very healthy, which is reflected in the overall poor health standing of American young adults compared with young adults in other high-income countries around the world (NRC and IOM, 2013). Major efforts are needed to improve the health lifestyles of young Americans and reduce their chronic disease health risks as they age into middle and older adulthood.

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**Table 1**

Class-Conditional Response Probabilities from Latent Class Analyses (LCA) for **Adolescent** Health Lifestyles (Wave I, ages 15–17)

| | Population average | *Consistently positive* | *Mixed* | *Mid, sleep problems* | *Passive* | *Unsafe, no substance use* | *Substance users and unsafe* | *Mostly negative* |
|---|---|---|---|---|---|---|---|---|
| Class membership probabilities | | 26% | 10% | 15% | 17% | 16% | 8% | 9% |
| **Physical activity** | | | | | | | | |
| Weekly activity count | | | | | | | | |
| 0 | 0.37 | **0.15** | 0.16 | 0.38 | *0.75* | 0.30 | 0.44 | 0.57 |
| 1–2 | 0.31 | 0.32 | 0.24 | 0.34 | 0.23 | 0.34 | 0.33 | 0.37 |
| 3–15 | 0.32 | 0.53 | **0.60** | 0.29 | *0.02* | 0.37 | 0.23 | 0.06 |
| Weekly screentime hours | | | | | | | | |
| 0–14 | 0.48 | 0.53 | 0.40 | **0.59** | 0.48 | *0.31* | 0.56 | 0.37 |
| 14.001–28 | 0.28 | 0.30 | 0.26 | 0.27 | 0.33 | 0.23 | 0.26 | 0.26 |
| 28.001+ | 0.25 | 0.16 | 0.34 | **0.14** | 0.19 | *0.46* | 0.18 | 0.37 |
| **Substance use** | | | | | | | | |
| Any tobacco use last 30 days | 0.32 | **0.05** | 0.58 | 0.62 | 0.06 | 0.17 | *0.84* | 0.61 |
| Marijuana use last 30 days | 0.17 | **0.00** | 0.29 | 0.29 | **0.00** | 0.02 | *0.98* | 0.27 |
| Other drug use last 30 days | 0.07 | **0.00** | 0.03 | 0.07 | 0.01 | **0.00** | 0.65 | 0.03 |
| Alcohol use in last 12 months | | | | | | | | |
| Nondrinker | 0.46 | 0.71 | 0.08 | 0.08 | 0.75 | 0.73 | 0.07 | 0.09 |
| Drinker | 0.13 | 0.16 | 0.06 | 0.11 | 0.21 | 0.11 | 0.00 | 0.11 |
| Problem drinking | 0.42 | 0.13 | 0.86 | 0.81 | **0.04** | 0.17 | *0.93* | 0.79 |
| **Diet** | | | | | | | | |
| Ate 2 fruits and 2 vegetables yesterday | 0.16 | **0.26** | 0.17 | 0.17 | 0.11 | 0.14 | 0.14 | *0.00* |
| Does not eat breakfast | 0.23 | **0.10** | 0.11 | 0.30 | 0.26 | 0.20 | 0.36 | *0.46* |
| Disordered behaviors to lose weight | 0.01 | **0.00** | **0.00** | *0.03* | 0.01 | 0.01 | **0.00** | 0.02 |
| **Safety** | | | | | | | | |
| Got in fight last year | 0.31 | 0.18 | 0.54 | 0.27 | **0.05** | 0.54 | *0.58* | 0.41 |
| Doesn't always wear helmet | 0.70 | 0.78 | 0.77 | 0.66 | **0.51** | *0.80* | *0.80* | 0.54 |
| Always wears seatbelt | 0.53 | **0.74** | 0.46 | 0.53 | 0.71 | *0.25* | 0.27 | 0.33 |
| Ever driven drunk | 0.07 | 0.00 | 0.14 | 0.16 | 0.00 | 0.00 | *0.34* | 0.10 |
| **Health care in last year** | | | | | | | | |

| | Population average | *Consistently positive* | *Mixed* | *Mid, sleep problems* | *Passive* | *Unsafe, no substance use* | *Substance users and unsafe* | *Mostly negative* |
|---|---|---|---|---|---|---|---|---|
| Dental exam | 0.69 | **0.82** | 0.78 | 0.81 | 0.69 | 0.45 | 0.75 | *0.43* |
| Physical examination | 0.67 | 0.76 | **0.86** | 0.71 | 0.56 | 0.66 | 0.65 | *0.39* |
| **Sleep** | | | | | | | | |
| Gets enough sleep | 0.70 | 0.81 | **0.93** | *0.40* | 0.73 | 0.71 | 0.54 | 0.74 |
| 9+ hours sleep | 0.21 | 0.26 | **0.36** | *0.01* | 0.22 | 0.20 | 0.19 | 0.32 |
| **Last sex** | | | | | | | | |
| Never had sex | 0.56 | 0.86 | 0.26 | 0.43 | 0.78 | 0.54 | 0.22 | 0.17 |
| Condom | 0.26 | 0.10 | 0.56 | 0.30 | 0.13 | 0.29 | 0.38 | 0.36 |
| Birth control, no condom | 0.04 | 0.02 | 0.02 | 0.06 | 0.02 | 0.02 | 0.12 | 0.06 |
| No contraception | 0.14 | **0.02** | 0.16 | 0.21 | 0.07 | 0.15 | 0.28 | *0.41* |

Source: Add Health

Notes: LCA adjust for clustering and weighting. N=6605. Underlining indicates that the probability is better for health compared to the overall mean (greater or less than the 95% confidence interval around the overall mean); shading indicates that the probability is significantly worse for health. Bold (better for health) or italics (worse for health) represent greatest difference from mean.

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**Table 2**

Class-Conditional Response Probabilities from Latent Class Analyses (LCA) for **Early Adult** Health Lifestyles (Wave III)

| | Population | *Consistently positive* | *Mostly positive, seated time and problem drinking* | *Poor diet and no health care* | *Mostly negative but active* | *Mostly negative, especially substance use* |
|---|---|---|---|---|---|---|
| Population share | | 27% | 17% | 35% | 10% | 11% |
| **Physical activity** | | | | | | |
| Weekly activity count | | | | | | |
| 0 | 0.46 | 0.52 | 0.24 | 0.55 | **0.17** | *0.61* |
| 1–2 | 0.19 | 0.19 | 0.19 | 0.18 | 0.19 | 0.19 |
| 3–15 | 0.36 | 0.30 | 0.57 | 0.27 | **0.63** | *0.20* |
| Weekly screentime hours | | | | | | |
| 0–14 | 0.40 | 0.50 | **0.52** | 0.31 | 0.35 | *0.30* |
| 14.001–28 | 0.33 | 0.33 | 0.39 | 0.30 | 24.00 | 0.39 |
| 28.001–282 | 0.27 | 0.17 | **0.10** | 0.39 | *0.41* | 0.31 |
| 40+ hours weekly seated time | 0.13 | 0.15 | *0.23* | 0.09 | 0.15 | **0.06** |
| **Substance use** | | | | | | |
| Tobacco use last 30 days | | | | | | |
| None | 0.61 | **0.90** | 0.69 | 0.52 | 0.40 | *0.23* |
| Some | 0.13 | 0.04 | 0.16 | 0.13 | 0.26 | 0.16 |
| Daily | 0.26 | **0.05** | 0.15 | 0.35 | 0.33 | *0.61* |
| Marijuana use last 30 days | 0.23 | **0.00** | 0.17 | 0.09 | 0.59 | *0.95* |
| Other drug use last 30 days | 0.08 | **0.00** | 0.00 | 0.01 | *0.43* | 0.29 |
| Legal performance substance in last year | 0.09 | **0.01** | 0.11 | 0.04 | *0.48* | 0.03 |
| Alcohol use in last 12 months | | | | | | |
| Nondrinker | 0.24 | 0.50 | 0.00 | 0.20 | 0.12 | 0.00 |
| Drinker | 0.13 | 0.31 | 0.07 | 0.09 | 0.00 | 0.03 |
| Problem drinking | 0.63 | **0.19** | 0.93 | 0.65 | 0.88 | *0.97* |
| **Nutrition** | | | | | | |
| Fast food (2+/week) | 0.60 | 0.58 | **0.38** | *0.69* | 0.59 | *0.69* |
| Breakfast (any vs. none) | 0.71 | 0.76 | **0.87** | *0.61* | 0.70 | 0.63 |
| Disordered behaviors to lose weight | 0.17 | **0.14** | 0.15 | *0.20* | 0.18 | 0.17 |
| **Health care in last year** | | | | | | |

| | Population | *Consistently positive* | *Mostly positive, seated time and problem drinking* | *Poor diet and no health care* | *Mostly negative but active* | *Mostly negative, especially substance use* |
|---|---|---|---|---|---|---|
| Dental exam | 0.54 | 0.59 | **0.85** | *0.38* | 0.58 | 0.43 |
| Physical examination | 0.64 | **0.76** | 0.75 | 0.57 | 0.56 | *0.48* |
| **Sleep** | | | | | | |
| Seven+ hours sleep | 0.73 | **0.81** | 0.71 | 0.69 | *0.65* | 0.76 |
| **Sex** | | | | | | |
| 2+ sex partners last year | 0.29 | **0.09** | 0.32 | 0.29 | *0.62* | 0.43 |

Source: Add Health.

Notes: LCA adjust for clustering and weighting. N=6605. Underlining indicates that the probability is better for health compared to the overall mean (greater or less than the 95% confidence interval around the overall mean); shading indicates that the probability is significantly worse for health. Bold (better for health) or italics (worse for health) represent greatest difference from mean.

**Table 3**

Class-Conditional Response Probabilities from Latent Class Analyses (LCA) for **Young Adult** Health Lifestyles (Wave IV)

| | **Population** | ***Consistently positive*** | ***Mostly positive with problem drinking*** | ***Inactive, poor diet, poor sleep*** | ***Consistently negative*** |
|---|---|---|---|---|---|
| Population share | | 20% | 21% | 34% | 25% |
| **Physical activity** | | | | | |
| Weekly activity count | | | | | |
| 0 | 0.15 | 0.09 | **0.04** | *0.25* | 0.16 |
| 1–2 | 0.16 | 0.14 | 0.07 | 0.22 | 0.19 |
| 3+ | 0.68 | 0.76 | **0.89** | *0.54* | 0.65 |
| Weekly screentime hours | | | | | |
| 0–7 | 0.44 | **0.56** | 0.45 | 0.42 | *0.37* |
| 7.01–28 | 0.30 | 0.29 | 0.37 | 0.30 | 0.25 |
| 28.01+ | 0.26 | **0.15** | 0.18 | 0.28 | *0.38* |
| Walk to work/school | 0.05 | 0.04 | **0.10** | *0.03* | 0.04 |
| **Substance use** | | | | | |
| Tobacco use in last 30 days | | | | | |
| None | 0.59 | **0.89** | 0.60 | 0.68 | *0.23* |
| Some | 0.15 | 0.03 | 0.28 | 0.10 | 0.19 |
| Daily | 0.26 | **0.07** | 0.12 | 0.22 | *0.58* |
| Marijuana use last 30 days | 0.17 | **0.00** | 0.21 | 0.01 | *0.48* |
| Other drug use last 30 days | 0.06 | 0.01 | 0.04 | **0.00** | *0.20* |
| Alcohol use in last 12 months | | | | | |
| Nondrinker | 0.26 | 0.30 | 0.05 | 0.44 | 0.16 |
| Drinker | 0.23 | 0.46 | 0.09 | 0.28 | 0.11 |
| Problem drinking | 0.40 | **0.24** | *0.85* | 0.28 | 0.73 |
| **Nutrition** | | | | | |
| Fast food 2+/week | 0.52 | 0.32 | **0.27** | *0.70* | 0.63 |
| Sugary beverages 7+/week | 0.58 | **0.31** | 0.37 | 0.71 | *0.78* |
| **Safety** | | | | | |
| Serious fight in last year | 0.05 | **0.00** | 0.05 | 0.02 | *0.13* |
| **Health care in last year** | | | | | |

| | Population | *Consistently positive* | *Mostly positive with problem drinking* | *Inactive, poor diet, poor sleep* | *Consistently negative* |
|---|---|---|---|---|---|
| Dental exam | 0.57 | **0.77** | 0.69 | 0.50 | *0.42* |
| Physical examination | 0.73 | **0.91** | 0.74 | 0.73 | *0.58* |
| **Sleep** | | | | | |
| 7+ hours sleep | 0.73 | 0.80 | **0.83** | 0.68 | *0.67* |
| **Sex** | | | | | |
| Pay for sex | 0.02 | **0.00** | 0.01 | 0.01 | *0.05* |
| 2+ /multi sex partners last year | 0.26 | **0.08** | 0.28 | 0.20 | *0.48* |

Source: Add Health.

Notes: LCA adjust for clustering and weighting. N=6605. Underlining indicates that the probability is better for health compared to the overall mean (greater or less than the 95% confidence interval around the overall mean); shading indicates that the probability is significantly worse for health. Bold (better for health) or italics (worse for health) represent greatest difference from mean.

**Table 4**

Coefficients and significance from OLS models predicting young adult health outcomes

| | Cardiovascular Risk Scale | | | | Self-rated health | | | |
|---|---|---|---|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 1** | **Model 2** | **Model 3** | **Model 4** |
| **Adolescent health lifestyles (Consistently positive)** | | | | | | | | |
| Mixed | −0.03 | | | −0.04 | −0.09 * | | | −0.03 |
| Mid, sleep problems | −0.03 | | | −0.04 | −0.04 | | | 0.01 |
| Passive | 0.06 | | | 0.04 | −0.04 | | | −0.02 |
| Unsafe, no substance use | 0.07 | | | 0.04 | −0.15 ** | | | −0.09 + |
| Substance users and unsafe | 0.04 | | | 0.02 | −0.22 ** | | | −0.10 |
| Mostly negative | 0.11 | | | 0.07 | −0.25 *** | | | −0.15 ** |
| **Early adult health lifestyles (Consistently positive)** | | | | | | | | |
| Mostly positive, seated time and problem drinking | | −0.10 + | | −0.04 | | 0.11 * | | 0.06 |
| Poor diet and no health care | | 0.06 | | 0.07 | | −0.12 ** | | −0.08 + |
| Mostly negative but active | | −0.04 | | 0.01 | | −0.05 | | −0.02 |
| Mostly negative, especially substance use | | 0.03 | | 0.04 | | −0.26 *** | | −0.16 ** |
| **Young adult health lifestyles (consistently positive)** | | | | | | | | |
| Mostly positive with problem drinking | | | −0.06 | −0.05 | | | −0.01 | 0.01 |
| Inactive, poor diet, poor sleep | | | 0.17 ** | 0.15 ** | | | −0.28 *** | −0.24 *** |
| Consistently negative | | | 0.12 * | 0.10 | | | −0.43 *** | −0.35 *** |

Source: Add Health

Notes: Accounts for complex sampling design. N=6605. Referents are in parentheses. All models control for age, sex, race/ethnicity, parent education, adolescent household income, adolescent self-rated health, and adolescent weight status.

+ p<.10

* p<.05;

** p<.01;

*** p<.001

**Appendix Table A**

Fit statistics for latent class analysis (LCA) Waves I, III, and IV

| | Classes | G2 | AIC | BIC |
|---|---|---|---|---|
| Wave I Ages 15–17 | 2 | 34914 | 35008 | 35327 |
| | 3 | 34279 | 34421 | 34904 |
| | 4 | 33819 | 34009 | 34655 |
| | 5 | 33417 | 33655 | 34463 |
| | 6 | 33106 | 33392 | 34364 |
| | 7 | 32832 | 33166 | 34301 |
| | 8 | 32653 | 33035 | 34332 |
| Wave III | Classes | G2 | AIC | BIC |
| | 2 | 21578 | 21656 | 21921 |
| | 3 | 21013 | 21131 | 21532 |
| | 4 | 20665 | 20823 | 21359 |
| | 5 | 20620 | 20619 | 21292 |
| | 6 | 20271 | 20509 | 21318 |
| | 7 | 20117 | 20395 | 20340 |
| | 8 | 19978 | 20296 | 21376 |
| Wave IV | Classes | G2 | AIC | BIC |
| | 2 | 16419 | 16497 | 16762 |
| | 3 | 15701 | 15819 | 16220 |
| | 4 | 15475 | 15633 | 16171 |
| | 5 | 15303 | 15501 | 16174 |
| | 6 | 15136 | 15374 | 16183 |
| | 7 | 14978 | 15256 | 16201 |
| | 8 | 14853 | 15171 | 16252 |

Source: Add Health

Notes: Analyses adjust for complex sampling design. Shaded rows indicate selected class solution for each wave. N=6605.

## Appendix Table B

Means of adolescent and early adult latent class health lifestyles across young adult health lifestyles

| | Consistently positive | Mostly positive with problem drinking | Inactive, poor diet, poor sleep | Consistently negative |
|---|---|---|---|---|
| Population | 0.20 | 0.21 | 0.34 | 0.25 |
| **Adolescent health lifestyles** | | | | |
| Consistently positive | 0.23 | 0.25 | 0.38 | 0.14 |
| Mixed | 0.10 | 0.26 | 0.27 | 0.37 |
| Mid, sleep problems | 0.15 | 0.29 | 0.29 | 0.28 |
| Passive | 0.26 | 0.16 | 0.45 | 0.13 |
| Unsafe, no substance use | 0.13 | 0.11 | 0.49 | 0.27 |
| Substance users and unsafe | 0.08 | 0.20 | 0.26 | 0.47 |
| Mostly negative | 0.10 | 0.14 | 0.41 | 0.35 |
| **Early adult health lifestyles** | | | | |
| Consistently positive | 0.29 | 0.10 | 0.52 | 0.09 |
| Mostly positive, seated time and problem drinking | 0.25 | 0.39 | 0.23 | 0.12 |
| Poor diet and no health care | 0.11 | 0.18 | 0.45 | 0.26 |
| Mostly negative but active | 0.09 | 0.32 | 0.19 | 0.41 |
| Mostly negative, especially substance use | 0.04 | 0.20 | 0.21 | 0.55 |

Source: Add Health

Notes: Analyses adjust for complex sampling design. N=6605.

## Appendix Table C

Means of health outcomes, across latent class health lifestyles

| | Cardiovascular risk scale | Self-rated health |
|---|---|---|
| Mean | 0.08 | 3.66 |
| Range[a] | −2.67 – 5.84 | 1 – 5 |
| Standard deviation[a] | 1.01 | 0.92 |
| **Adolescent health lifestyles** | | |
| Consistently positive | 0.01 | 3.83 |
| Mixed | 0.12 | 3.64 |
| Mid, sleep problems | −0.04 | 3.70 |
| Passive | 0.08 | 3.66 |
| Unsafe, no substance use | 0.25 | 3.53 |
| Substance users and unsafe | 0.09 | 3.46 |
| Mostly negative | 0.21 | 3.36 |
| **Early adult health lifestyles** | | |
| Consistently positive | 0.02 | 3.70 |
| Mostly positive, seated time and problem drinking | −0.15 | 3.95 |
| Poor diet and no health care | 0.21 | 3.54 |
| Mostly negative but active | 0.16 | 3.72 |
| Mostly negative, especially substance use | 0.12 | 3.43 |
| **Young adult health lifestyles** | | |
| Consistently positive | −0.11 | 3.87 |
| Mostly positive with problem drinking | −0.12 | 3.94 |
| Inactive, poor diet, poor sleep | 0.20 | 3.57 |
| Consistently negative | 0.21 | 3.39 |

Source: Add Health

Notes: Analyses adjust for complex sampling design. N=6605.

[a]Range and SD are computed on the unimputed population and are not adjusted for complex sampling design.

## Appendix Table D

Means for health outcomes, across sociodemographic, background SES, and adolescent health measures

| | Cardiovascular risk scale | Self-rated health |
|---|---|---|
| Population mean | 0.08 | 3.66 |
| **Age at Wave IV** | | |
| Under 29 | 0.05 | 3.70 |
| 29+ | 0.10 | 3.63 |
| **Gender** | | |
| Male | 0.31 | 3.68 |
| Female | −0.15 | 3.63 |
| **Race/ethnicity** | | |
| White | 0.05 | 3.71 |
| Black | 0.20 | 3.56 |
| Hispanic | 0.11 | 3.50 |
| Other | 0.09 | 3.55 |
| **Parent highest education (Advanced degree)** | | |
| Less than high school | 0.21 | 3.50 |
| High school | 0.17 | 3.57 |
| Some college | 0.10 | 3.62 |
| College degree | −0.02 | 3.75 |
| Advanced degree | −0.16 | 3.95 |
| **Adolescent family income-to-needs ratio** | | |
| <100 | 0.19 | 2.64 |
| 100–<200 | 0.16 | 3.07 |
| 200–<300 | 0.11 | 3.39 |
| 300–<400 | 0.06 | 3.69 |
| 400%+ | −0.08 | 4.01 |
| **Adolescent self-rated health** | | |
| Poor | 0.43 | 3.49 |
| Fair | 0.36 | 3.52 |
| Good | 0.16 | 3.63 |
| Very good | 0.03 | 3.75 |
| Excellent | 0.01 | 3.83 |
| **Adolescent weight status** | | |
| Normal | −0.14 | 3.78 |
| Overweight | 0.47 | 3.41 |
| Obese | 0.93 | 3.24 |

Source: Add Health.

Notes: Analyses adjust for complex sampling design. N=6605