2015

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Lisa Kort-Butler

University of Nebraska-Lincoln, lkortbutler2@unl.edu

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Health-Related Strains and Subsequent Delinquency and Marijuana Use

Lisa A. Kort-Butler

University of Nebraska–Lincoln, USA

Correspondence — Department of Sociology, University of Nebraska–Lincoln, 711 Oldfather Hall, P.O. Box 0324, Lincoln, NE 68588-0324, USA; email lkortbutler2@unl.edu

Abstract

General strain theory provides one framework for explaining the relationship between physical health and delinquency, pointing to mechanisms such as negative emotions, social bonds, and stress proliferation. Data from the National Longitudinal Study of Adolescent Health were used to examine these hypothetical mediators. Controlling for demographic factors, prior illicit behavior, and other strains, results from a series of regressions indicated that health-related strain (HRS) was positively associated with subsequent delinquency and marijuana use. Stressors at school were the primary mediators of these effects. Absences from school and social life due to health problems exerted an independent effect. The results lend support to the idea that experiencing HRS contributes to the proliferation of stress in other life domains, increasing the likelihood of delinquency and marijuana use.

Keywords: health, illness, delinquency, marijuana use, general strain theory

Introduction

In recent years, there has been increasing interest in the relationship between physical health and delinquency. In part, this interest has been spurred

by the development of epidemiological criminology (Akers & Lanier, 2009; Vaughn, DeLisi, Perron, Beaver, & Abdon, 2012), which recognizes the inter-related public health and public safety implications of criminality. For example, although health care represents an important safety net, more than one third of youth in custody who reported a health care need said they did not receive all the care they needed (Sedlak & McPherson, 2010).

One line of research in this area focuses on poor health as comorbid with or a consequence of delinquent involvement (Junger, Stroebe, & van der Laan, 2001; Moffitt et al., 2011; Wade & Pevalin, 2005). A second line of research considers how delinquency can be a consequence of health problems, focusing on the acute effects of health problems and lack of access to health care. General strain theory (GST; Agnew, 2006) has been utilized to understand this aspect of the relationship between health and outcomes like delinquency (Stogner & Gibson, 2010) and substance use (Ford, 2014). According to this argument, poor physical health, as well as not being able to access care, may be experienced as stressful and be associated with repercussions that promote illegitimate behaviors. The mechanisms that link health problems to delinquent outcomes, including compromised emotional wellbeing, loss of normative social bonds, and stress proliferation, have not been explored fully. Utilizing a GST framework, the current study aimed to expand the literature on the health–delinquency relationship by examining the role of these potential mediators using data from the National Longitudinal Study of Adolescent Health (Add Health; Udry, 2003).

In this study, health-related strain (HRS) was defined by the range and frequency of symptoms experienced in the previous year, and by the inability to gain access to health care when needed (Stogner & Gibson, 2010). A variety of health-related concerns may induce strain, ranging from acute symptoms to chronic conditions to serious diseases. The analysis was limited to symptoms that may result from relatively minor conditions, such as headaches and nausea. Similar acute problems may also be experienced by people with chronic conditions, based on the generic aspects of their conditions (Suris, Michaud, Akre, & Sawyer, 2008). Such symptoms may adversely affect well-being and participation in social life, particularly if care is unavailable, but the symptoms are not so severe that they physically prevent an individual from engaging in delinquency.

The Health–Crime Relationship

Research examining health and crime tends to focus on the negative health consequences of risky or criminal behavior (Piquero, Daigle, Gibson, Piquero, & Tibbetts, 2007; Piquero, Farrington, Shepherd, & Auty, 2014; Shepherd,

Farrington, & Potts, 2004; Vaughn, Salas-Wright, DeLisi, & Piquero, 2014). Among adolescents, Junger and colleagues (2001) reported a positive association between delinquency and general health status, somatic complaints, and chronic conditions. Risky behaviors in adolescence have also been linked to poorer physical health in adulthood, even among adolescent-limited offenders (Hair, Park, Ling, & Moore, 2009; Reingle, Jennings, Piquero, & Maldonado-Molina, 2014).

In contrast, research has also indicated that health problems during childhood and adolescence can precede problematic behaviors. In a meta-analysis, Pinquart and Shen (2011) determined that chronic health conditions, ranging from headaches to major illness, were associated with both internalizing and externalizing behaviors. Adolescents with certain health conditions, relative to their peers, may engage in less risky behavior, because their conditions may be associated with less physical capacity, isolation from peers, and more adult supervision, or make them more cognizant of health risks (Suris & Parera, 2005). However, research has demonstrated that adolescents with chronic conditions or disabilities are equally or even more likely to engage in substance use and delinquency (Blum, Kelly, & Ireland, 2001; Jones & Lollar, 2008; Miauton, Narring, & Michaud, 2003; Suris et al., 2008). Although a criminal lifestyle may portend injury and poor health later in life, among young people, health problems may be a risk factor for deviance.

Health and GST

GST argues that the experience of strain leads to negative emotional states, including anger, frustration, and depression (Agnew, 1992). People may select legitimate or illegitimate means to address these strains and alleviate the feelings they engender, based on their access to resources and social psychological protective factors. Furthermore, strains may lead to delinquent outcomes by fostering negative emotional traits and eroding social bonds (Agnew, 2006), as well as contributing to the proliferation of stress (Slocum, 2010a). The connection between strain and illegitimate outcomes has generally been supported (e.g., S. W. Baron, 2004; Moon, Morash, McClusky, & Hwang, 2009; Sigfusdottir, Kristjansson, & Agnew, 2012).

Among the myriad of strains examined in the GST literature, health problems have often been included on negative life events scales (Broidy, 2001; Jang & Johnson, 2003). Health problems, as independent sources of strain, fit within each of Agnew's strain categories (Ford, 2014; Schroeder, Hill, Haynes, & Bradley, 2011; Stogner & Gibson, 2010, 2011; Stogner, Gibson, & Miller, 2014). In brief, health problems are noxious stimuli that may inhibit the achievement of positively valued goals while removing positively valued

stimuli from the ill person. Furthermore, far from being seen as just and low in magnitude, individuals may feel their illness is unfair and, depending on the nature of the illness, highly aversive. The inability to access health care under these circumstances may add to such feelings. Research using a GST perspective confirms that health problems, whether measured as the presence of diagnosed chronic conditions, general health symptoms, or an overall assessment of health, are linked to delinquency and substance use (Ford, 2014; Schroeder et al., 2011; Stogner & Gibson, 2010, 2011; Stogner et al., 2014).

Stogner and Gibson (2010) argued that HRS may have additional consequences that undermine protective factors, contribute to further strain, and promote illegitimate coping. Health problems may initiate a sequence of events that increases adolescents' likelihood of delinquent or risky behaviors (Stogner et al., 2014). Consistent with Agnew's (2006) conceptualization of mediating mechanisms, HRS may foster poor emotional well-being, erode social bonds, and engender additional stressors, which lead to risky behaviors.

Fostering Poor Emotional Well-Being

GST distinguishes between emotional traits, the dispositional characteristics of individuals, and emotional states, the situational responses to stressful events (Mazerolle, Piquero, & Capowich, 2003; Moon et al., 2009). Stressful experiences may foster poor emotional well-being through both mechanisms. First, strains may act to alter personality traits (Agnew, 2006). People who are subject to strain on a continuing basis may develop less tolerance for future strains and a negative disposition, what is referred to as negative emotionality/ low constraint (Agnew, Brezina, Wright, & Cullen, 2002). Research has demonstrated the role of emotionality/constraint in the association between strain indicators and deviant behaviors (Agnew et al., 2002; S. W. Baron, 2009). People who report physical health complaints also report higher levels of negative emotionality (Watson & Pennebaker, 1989). Adolescents with health conditions, feeling their lives are restricted or limited, may become more reckless or less constrained in their behaviors than others in an attempt to live life to the fullest (Suris et al., 2008). Thus, people experiencing frequent or continuing health problems may develop higher levels of negative emotionality and low constraint, putting them at risk of illegitimate coping.

Second, strains may contribute to negative emotional states (Agnew, 2006; Ganem, 2010). Poor physical health has been linked to psychological distress (Jang, 2007; Pinquart & Shen, 2011; Scott et al., 2007; Wade & Pevalin, 2005). GST argues that feelings of depression or anxiety may not lead to externalized

forms of deviance, but may contribute to self-directed behaviors like drug use (Agnew, 2006; Jang & Johnson, 2003). Some studies have found a tentative relationship between distress and crime (Kaufman, 2009; Manasse & Ganem, 2009; Ostrowsky & Messner, 2005), but others have not (Botchkovar & Broidy, 2013; Broidy, 2001). Depression has been linked to drug use (Jang & Rhodes, 2012). Moreover, in a study of adults, Ford (2014) found evidence for the mediating effect of psychological distress between HRS and substance use. Therefore, adolescents experiencing HRS may become distressed and try to cope with these feelings through illegitimate means.

Eroding Social Bonds

Strains may undermine social relationships, thereby eroding social bonds and the informal controls associated with them (Agnew, 2006). Negative life and negative family events have been shown to weaken moral beliefs and conventional attachments, mediating the relationship between strain and deviance (Hoffmann & Miller, 1998; Jang & Rhodes, 2012). Strain may also strengthen ties to delinquent peers (Bao, Haas, Chen, & Pi, 2014; Paternoster & Maze-rolle, 1994).

Health problems may disrupt routines of school and social life, consequently reducing or limiting long-term emotional bonds, as well as reducing investment in conventional activities. Youth with chronic health conditions or disabilities may be less integrated into their schools and social worlds or may be marginalized by others at school (Blum et al., 2001; Miauton et al., 2003; Strauss & Pollack, 2003). Adolescents with poor self-rated health have fewer friends, occupy marginal positions in their social networks, and are more likely to be socially isolated (Haas, Schaefer, & Kornienko, 2010).

To the extent that health problems lead to people being “left out” of social life, they may be at risk of deviant behaviors. Research suggests that people who feel excluded may decrease their prosocial behaviors and become more aggressive (Baumeister, Brewer, Tice, & Twenge, 2007). In an effort to fit in or maintain relationships, adolescents with health problems may engage in risky behaviors to demonstrate that they are still like everyone else (Suris et al., 2008). Associating with peers is one way youth build health-promoting identities that challenge the labels applied to them (Ungar, 2000). Adolescents with health conditions may also withdraw from friendships, leading to reduced access to prosocial peer groups (Schaefer, Kornienko, & Fox, 2011). Excluded youth may become more open to peer groups previously considered undesirable and affiliate with risk-taking groups who more readily accept them (Baumeister et al., 2007; Suris et al., 2008). “Missing out” on normative school and

social experiences may lead to both the erosion of prosocial bonds and association with non-normative peers.

Stress Proliferation

Stress proliferation is the idea that stressors result in other stressors (Pearlin, 1989). A stressful condition can disrupt or alter people's established roles and routines. This disruption is stressful in itself but may also lead to stressors beyond the life domain in which it occurred (Pearlin, Schieman, Fazio, & Meersman, 2005). Proliferation may thus arise in two ways (Pearlin, Aneshensel, & LeBlanc, 1997). First, new stressors within a life domain may arise from an expansion of primary stressors. Second, primary stressors in one domain may create secondary stressors in another domain, and secondary stressors also affect well-being (Thoits, 2010). As a result of stress proliferation, people may experience negative outcomes not only in the original context in which the stressor occurred but also in secondary contexts (De Coster & Kort-Butler, 2006).

HRS among youth contributes to stressors related directly to the illness (e.g., treatment), as well as to the proliferation of secondary stressors related to daily role functioning (Compas, Jaser, Dunn, & Rodriguez, 2012). As a stressful condition, health problems are intensely personal, yet health problems may affect one's ability to fully engage other life domains, including personal relationships and school (Stogner & Gibson, 2010). Among adolescents, for example, health issues may affect school performance (Pinquart & Teubert, 2012), creating additional stress with which one needs to cope. For youth with health problems, these secondary stressors may be particularly difficult to manage (Compas et al., 2012).

The concept of stress proliferation has been applied in the context of GST (De Coster & Kort-Butler, 2006; Slocum, 2010a). Research indicates that the accumulation of stressors over time contributes to increases in drug use and to the escalation of delinquency (Hoffmann, Cerbone, & Su, 2000; Slocum, 2010b). Botchkovar and Broidy (2013, p. 15) concluded that recurring exposure to strain contributes to the "clustering" of negative events and conditions, which "may boost the crime-generating potency" of other strains. To the extent that HRS begets stressors in other life domains, such as school, secondary stressors may become more proximate causes for deviant behaviors.

Research Questions

Building on the work of Stogner and Gibson (2010, 2011) and others (Ford, 2014), this study aimed to extend our understanding of the health–delinquency

relationship by testing the mediating effects of several factors that may link HRS with delinquency and marijuana use. Among adolescents, marijuana is the most widely used illicit drug (Johnston, O'Malley, Bachman, & Schulenberg, 2013). The affective response to strain and the presence of mediating factors influence the likelihood and form of illegitimate behavior (Jang & Johnson, 2003). Thus, separating these behaviors provided an opportunity to explore whether HRS contributes to different illicit behaviors.

GST suggests that, among adolescents, HRS may lead to poor emotional well-being, being left out of school and social life, feeling less connected to school, involvement with non-normative peers, and to troubles with school itself, pressuring toward illegitimate coping behaviors such as delinquency and substance use. This led to four sets of hypotheses. First, based on prior research, HRS was predicted to have positive associations with delinquency and marijuana use. Second, both negative emotional traits and negative emotional states were predicted to mediate the relationship between HRS and each outcome. Third, social bonds, including absences from school and social life and bonds to school itself, and association with non-normative peers were predicted to mediate the relationship between HRS and each outcome. Fourth, difficulties at school, representing proliferated stress, were predicted to mediate between HRSs and each outcome.

Method

Data

Add Health is a nationally representative, probability-based survey of adolescents in Grades 7 through 12 (Bearman, Jones, & Udry, 1997). The survey used a stratified, random sample design of all high schools in the United States. High schools were stratified by region, urbanicity, school size and type, grade span, and percent White and Black. In all, 80 high schools and 52 middle or "feeder" schools were selected with unequal probability of selection. The high schools became the cluster identifier, thus the primary sampling units for participants. A nationally representative sample of students from the school rosters and from those who completed the in-school questionnaire was selected to participate in the in-home data collection phase.

The data for this study were drawn from Wave 1 in-home interviews gathered in 1994 and 1995, and Wave 2 in-home interviews gathered in 1996. Respondents who were in 12th grade at Wave 1 were not reinterviewed at Wave 2. After excluding the remaining respondents without sample weights, the final sample size was 12,247. Descriptive statistics are displayed in Table 1. Half of the respondents were male. The sample was 68% White, 15% Black, 11%

Table 1. Descriptive Statistics (*N* = 12,247).

Variable	<i>M</i> /proportion	Minimum/ maximum	95% confidence interval
Sex (male = 1)	0.50	0/1	[0.49, 0.51]
Age	15.78	11/21	[15.56, 16.00]
Hispanic	0.11	0/1	[0.08, 0.14]
Black	0.15	0/1	[0.11, 0.19]
Other race	0.06	0/1	[0.04, 0.07]
Single parent household	0.30	0/1	[0.28, 0.33]
Other household	0.01	0/1	[0.01, 0.02]
Household education	3.94	0/6	[3.82, 4.05]
Supervision	4.90	0/7	[4.79, 5.00]
Delinquency Wave 1	3.60	0/45	[3.42, 3.77]
Marijuana use Wave 1	0.36	0/8	[0.31, 0.41]
Other strains	-0.07	-4.19/16.58	[-0.17, 0.04]
Symptoms	0.79	0/4	[0.77, 0.80]
Lack of care	0.17	0/1	[0.16, 0.18]
Distress	0.54	0/3	[0.53, 0.56]
Emotionality	5.57	2/10	[5.54, 5.60]
Absences	0.65	0/8	[0.62, 0.68]
School bonds	3.80	1/5	[3.77, 3.82]
Substance-using peers	0.75	0/3	[0.69, 0.80]
Academic trouble	4.36	2/10	[4.28, 4.44]
Teacher trouble	1.89	1/5	[1.86, 1.93]
Student trouble	1.90	1/5	[1.87, 1.94]
Delinquency Wave	2 2.95	0/43	[2.82, 3.09]
Marijuana use Wave	2 1.05	0/11	[0.94, 1.14]

Hispanic, and 6% of other racial/ethnic background. About 69% of the sample lived in a two-parent household (e.g., with both biological parents; with a biological and step-parent), and the average highest education of an adult in the household was some college. By Wave 2, the average age was about 16 years.

Measures

Measures of demographic characteristics, HRS, mediating variables, other controls (excepting age and household structure), and baseline levels of delinquency and marijuana use were drawn from Wave 1. The dependent variables, delinquency and marijuana use, and controls for age and household structure were drawn from Wave 2.

Dependent variables. *Delinquency* was measured with a summed scale of 15 items covering a variety of activities as reported in the past 12 months. The response categories ranged from 0 (*never*) to 3 (*5 or more times*). The activities included fighting, theft, vandalism, unruly behavior, running away, truancy, and selling drugs ($\alpha = 0.79$). The same items were used for a baseline measure of delinquency, which was a statistical control. *Marijuana use* was measured with one item asking the number of times since the Wave 1 interview that the respondent used marijuana. This item, rather than an item asking about use in the previous 30 days, was selected because the time frame is approximately the same as the delinquency measure. The item was open-ended and generated a large range of responses, so higher values were collapsed. The resulting variable was coded so that 0 = *no use*, 1 = *used once*, 2 = *used 2 or 3 times*, and so on through 10 = *used 101 to 300 times* and 11 = *used 301 or more times*. The baseline measure of marijuana use asked about the number of times used in the past 30 days, and was collapsed so that 0 = *no use*, 1 = *used once*, and so on through 8 = *used more than 30 times*. This variable was a statistical control.

Health-Related Strain

Two variables assessing HRS were utilized (Stogner & Gibson, 2010). First, *health symptoms* were measured with a mean scale of a 14-item symptom checklist ($\alpha = .77$). Respondents were asked how often in the past 12 months they had health problems including headache, stomachache, feeling physically weak, feeling sick, dizziness, and chest pains. Response categories ranged from 0 (*never*) to 4 (*everyday*). Second, *lack of care* was modeled as a distinct form of HRS. Lack of care captures the strain surrounding the inability to access the resources needed to address health issues and the strain associated with illness. The variable was based on a single dichotomized item that asked respondents if there was a time in the past year when they did not get medical care when they needed it. The item was coded so that 0 = *no* and 1 = *yes*. The correlation between symptoms and lack of care was $r = .28$.

Emotional well-being. *Distress*, a state-based indicator, was a summed scale of 16 items that asked how frequently in the past week the respondent experienced feelings such as depression, loneliness, fearfulness, and feeling like a failure ($\alpha = .86$). Responses categories ranged from 0 (*never or rarely*) to 3 (*most of the time or all the time*). Although the measure used here was not directly tied to stress experiences, it has been used in prior research to denote negative affective states (Stogner & Gibson, 2010).

Emotionality, a trait-based indicator, was an additive scale that combined a measure of negative emotionality and a measure of low constraint. Negative emotionality was a mean scale of two items: "You usually go out of your way to avoid having to deal with problems in your life" and "Difficult problems make you upset." Low constraint was a mean scale of four items (Beaver & Wright, 2005). Items included statements such as "When you have a problem to solve, one of the first things you do is get as many facts about the problem as possible" and "After carrying out a solution to a problem, you usually try to think about what went right and what went wrong." For all items, the response categories ranged from *strongly agree* to *strongly disagree* and were coded so that higher values reflected higher levels of negative emotionality and low constraint. As each aspect of this trait was given equal weight, the two variables were added to create a composite measure.

Bonds and peer association. Two variables assessed social bonds. First, *absences* was a summed scale of two items. One item asked how often in the past month the respondent missed school events due to health or emotional problems, and the other asked about missing social/recreational events. Response categories ranged from 0 (*never*) to 4 (*everyday*). Second, *school bond* was a mean scale of three items asking whether respondents felt close to people at school, felt like a part of school, and felt happy being at their school ($\alpha = .77$; McNeely & Falci, 2004). The response categories ranged from *strongly agree* to *strongly disagree* and were coded so that higher values reflected higher levels of school bonds.

A third variable assessed a respondent's association with non-normative peers. *Substance-using peers* was measured with a mean scale of three items. Respondents were asked how many of their best friends smoked, drank, or used marijuana, ranging from 0 to 3 in each category. A mean scale, rather than a summed scale, was utilized to avoid "double counting" of peers who used more than one substance.

Proliferated stress. Three variables tapped school-based stress. First, *academic trouble* was a summed scale of two items asking how often during the school year the respondent had trouble paying attention in school and trouble getting homework done. Response categories ranged from 0 (*never*) to 4 (*everyday*). Second, *teacher trouble* was one item that asked how often the respondent had trouble getting along with teachers. Third, *student trouble* was one item that asked how often the respondent had trouble getting along with other students.

Control variables. The analyses controlled for the respondent's *sex* and *age*. Race/ethnicity was a set of dummy variables, for which White was the reference group, and *Hispanic*, *Black*, and *Other* race/ethnicity were the categories. If respondents reported more than one race, then the category with which they most identified was utilized. Household structure, described by the adolescent at Wave 2, was a dummy variable for which two-parent household was the reference and *single-parent household* and *other household* (e.g., living with an older sibling) were the categories. Socioeconomic status was operationalized as *household education*, the highest level of education completed by an adult in the household as reported in the Wave 1 parent interview, ranging from less than high school to a professional or graduate degree.

As noted above, youth with health problems may be subjected to more adult supervision relative to peers (Suris & Parera, 2005), and youth with freedom to make health-related decisions may make health-compromising choices (Videon & Manning, 2003). To reflect both issues, a control was included for parental *supervision*. This seven-item summed scale was based on a series of yes/no questions asked at Wave 1 about whether respondents could make their own decisions about weekend curfew and with whom they "hang around," as well as decisions about what to eat and how much TV to watch (Daigle, Cullen, & Wright, 2007).

HRS is one category among many, so a control for *other strains* was included, incorporating five items tapping perceived life chances, perceived neighborhood safety, poor family relations, suicide by a friend, and suicide by a family member (Stogner & Gibson, 2010). To create a composite measure, the scores of each individual stress variable were standardized; these *z* scores were then summed. The correlation between symptoms and other strains was $r = .17$; the correlation between lack of care and other strains was $r = .24$.

Analysis Plan

Mediation was assessed according to the method offered by R. M. Baron and Kenny (1986). To determine the relationship between HRS and the proposed mediators, each was regressed on the HRS variables using ordinary leastsquares regression. Then, for each analysis, the dependent variable was first regressed on the control and HRS variables. Both delinquency and marijuana use were skewed (greater than 2.50 in the observed data), with a large number of zeroes, and overdispersed, with the standard deviation 2 times greater than the mean. These analyses therefore relied on negative binomial regression. Next, the proposed mediating variables were alternately entered into the models to determine their independent effects on the relationship between HRS and the

dependent variables. Analyses culminated in final models in which all independent, mediating, and control variables were included. Supplementary analyses to test for mediation in these models utilized Sobel–Goodman tests. These tests were performed across several imputed samples, as well as with the observed data, using listwise deletion. Probabilities for listwise deletion are reported as they were the most conservative estimates.

About 1% of the sample was missing data for substance-using peers and marijuana use, and less than 1% was missing data for emotionality and household education. Multiple imputation was used to address missing data. Adjustments for the sample design were made with the sample weighting schemes advised by Chantala and Tabor (1999) for STATA.

Results

Table 1 displays the variable means and confidence intervals for the imputed sample. On average, the adolescents in the sample had low levels of health symptoms, but 17% of the sample reported not being able to access health care when they needed it. The sample, on average, had low levels of distress but moderate levels of negative emotionality/low constraint. They had low levels of past-month absences for health or emotional reasons, few substance-using peers, and felt bonded to school. On average, students had low academic trouble and troubles with teachers and other students. Although the average respondent reported few delinquent acts and little marijuana use, these variables ranged widely.

To begin the analysis, each proposed mediator was regressed on the control variables and the HRS variables (see Table 2). Net of the control variables and other strains, health symptoms were significantly associated with higher levels of emotionality, greater distress, more absences from school or social life, lower school bonds, associating with substance-using peers, and more academic, teacher, and student troubles. Lack of care was not associated with emotionality, school bonds, associating with substance-using peers, and academic troubles. However, lack of care was significantly associated with greater distress, more absences, and more teacher and student troubles. Taken together, these analyses support the idea that HRS can negatively affect emotional well-being, erode social bonds, and contribute to proliferation of stress in a key adolescent life domain.

Delinquency

Models for delinquency are displayed in Table 3. In Model 1, the control and HRS variables were regressed on delinquency. Male adolescents and

Table 2. OLS Regressions of Proposed Mediators on Health-Related Strains (*N* = 12,247).

Variable	Distress	Emotionality	Absences	School bonds	Substance-using peers	Academic trouble	Teacher trouble	Student trouble
Symptoms	0.37*** (0.01)	0.31*** (0.03)	0.61*** (0.04)	-0.22*** (0.03)	0.10*** (0.03)	1.15*** (0.07)	0.36*** (0.03)	0.42*** (0.04)
Lack of care	1.02*** (0.01)	0.02 (0.03)	0.11*** (0.03)	-0.01 (0.03)	0.04 (0.03)	0.12 (0.06)	0.07* (0.03)	0.08* (0.03)
<i>F</i>	275.41***	35.17***	57.32***	58.10***	137.62***	142.08***	71.74***	58.17***

OLS regressions, unstandardized coefficients with standard errors in parentheses. All models control for sex, age, race/ethnicity, household structure, household education, supervision, other strains, and prior delinquency. OLS = ordinary least squares. **p* < .05. ***p* < .01. ****p* < .001.

Table 3. Negative Binomial Regressions on Delinquency (*N* = 12,247).

Variables	1	2	3	4	5	6	7	8	9	10
Other strains	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.02*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.01* (0.01)
Symptoms	0.10* (0.04)	0.06 (0.05)	0.09* (0.04)	0.08 (0.04)	0.09* (0.04)	0.09* (0.04)	0.02 (0.04)	0.06 (0.04)	0.07 (0.04)	-0.03 (0.05)
Lack of care	0.07 (0.04)	0.06 (0.04)	0.07 (0.04)	0.06 (0.04)	0.07 (0.04)	0.06 (0.04)	0.06 (0.04)	0.06 (0.04)	0.06 (0.04)	0.05 (0.04)
Distress		0.13* (0.05)								-0.00 (0.05)
Emotionality			0.03* (0.01)							0.02 (0.02)
Absences				0.04* (0.02)						0.03 (0.02)
School bonds					-0.07*** (0.02)					-0.02 (0.02)
Substance-using peers						0.18*** (0.02)				0.16*** (0.02)
Academic trouble							0.08*** (0.01)			0.05*** (0.01)
Teacher trouble								0.12*** (0.02)		0.07*** (0.02)
Student trouble									0.07*** (0.02)	0.03 (0.02)
<i>F</i>	116.80***	108.26***	110.07***	107.77***	111.45***	110.90***	121.00***	111.18***	110.50***	88.79***

Unstandardized coefficients, standard errors in parentheses. All models control for sex, age, race/ethnicity, household structure, household education, supervision, and prior delinquency. **p* < .05. ***p* < .01. ****p* < .001.

younger adolescents were more at risk of delinquency (each $p = .000$), Black adolescents were at less risk than Whites ($p = .03$), and Hispanics were at greater risk than Whites ($p = .04$). Prior delinquency was a positive predictor ($p = .000$). Model 1 reveals that health symptoms were significantly related to delinquency. Lack of care did not achieve a standard level of significance. Nonetheless, this model supports the first hypothesis, demonstrating that HRS, net of the effects of other strains, increased the risk for delinquency by Wave 2. Model 2 introduced distress, and Model 3 introduced emotionality. Distress was positively associated with delinquency, and introducing it into Model 2 reduced the effect of symptoms to non-significance. This suggested a mediating effect of distress between HRS and delinquency, consistent with the second set of hypotheses. In Model 3, emotionality was significant but did not alter the relationship between HRS and delinquency.

Indicators of social bonds were entered in Models 4 and 5. In Model 4, absences due to health issues were significant and had a positive association with delinquency, and the effect of symptoms on delinquency was reduced to non-significance. This suggested a mediating effect of absences predicted in the third set of hypotheses. In Model 5, low bonds to school significantly increased involvement in delinquency, but symptoms also remained significant. Model 6 introduced substance-using peers. Association with substance-using peers increased involvement in delinquency, but did not substantially alter the relationship between symptoms and delinquency. The results in Models 5 and 6 confirmed the importance of social relationships to delinquency but did not lend support to the predicted mediating effects.

The three school stress measures were entered in Models 7, 8, and 9. Academic troubles, teacher troubles, and student troubles were each positively associated with delinquency. Including these stress variables into the models reduced the effect of symptoms to non-significance, suggesting a mediating effect that was consistent with the fourth set of hypotheses.

Finally, Model 10 included all predictors. In this model, symptoms and lack of care were not significantly related to delinquency. Of the proposed mediating variables, only association with substance-using peers, academic trouble, and teacher trouble remained significant. Absences were marginally significant ($p = .059$). Sobel–Goodman tests incorporated all the variables in Model 10, alternately examining the mediating effects between symptoms and each significant mediating variable in the model. The tests were significant for academic trouble ($p = .001$) and marginally significant for teacher trouble ($p = .08$), but not significant for either substance-using peers or absences. As predicted by the fourth hypothesis, the key mediators of the HRS–delinquency relationship appeared to be academic troubles and troubles with teachers, stressors that arose in part from adolescents' health problems.

Marijuana Use

Models for marijuana use are displayed in Table 4. In Model 1, the control and HRS variables were regressed on marijuana use. Male adolescents ($p = .03$) and those from a single-parent household were more likely to use ($p = .000$). Black adolescents ($p = .002$) and those of Other races ($p = .004$) were less likely to use than Whites. Household education ($p = .001$), supervision ($p = .000$), and prior use ($p = .000$) were all positively associated with use. Model 1 revealed that health symptoms and lack of care were significantly related to marijuana use. Supporting the first hypothesis, the model indicated that HRS, independent of the effect of other strains, led to greater levels of marijuana use by Wave 2. Model 2 introduced distress, and Model 3 introduced emotionality. Distress was not significantly related to marijuana use, but emotionality was significantly related to marijuana use. In both models, introducing these variables slightly decreased the coefficients for health symptoms on marijuana use, but both measures of HRS remained significant. These models provided little support for the second set of hypotheses.

Indicators of social bonds were entered in Models 4 and 5. Absences were positively associated with marijuana use, and school bonds were negatively associated with use. In both models, symptoms and lack of care remained significant, but their effects were attenuated. The results in these two models confirmed the importance of social relationships to marijuana use but did not lend strong support for the predicted mediating effects. Model 6 introduced substance-using peers. Association with substance-using peers led to greater levels of marijuana use. Including peers in the model reduced the effect of symptoms to non-significance and decreased the coefficient for lack of care. This finding was consistent with the predicted mediating effects of peer association between HRS and marijuana use.

In Models 7, 8, and 9, the three school stress measures were entered. In Model 7, academic trouble was positively associated with marijuana use and the effect of symptoms was reduced to non-significance, but the effect of lack of care remained significant. Teacher trouble, introduced in Model 8, was also positively associated with marijuana use. Including the variable into the model attenuated the effects of HRS but both measures remained significant. Likewise, in Model 9, student trouble was positively associated with marijuana use, but the measures of HRS remained significant. In these three models, the clearest evidence for a mediating effect consistent with the fourth set of hypothesis was found for academic trouble.

Finally, Model 10 included all predictors. In this model, neither symptoms nor lack of care was significant. The mediating variables of interest that retained a significant relationship with marijuana use were emotionality,

Table 4. Negative Binomial Regressions on Marijuana Use (*N* = 12,247).

Variables	1	2	3	4	5	6	7	8	9	10
Other strains	0.11*** (0.01)	0.10*** (0.01)	0.10*** (0.01)	0.10*** (0.01)	0.10*** (0.01)	0.05*** (0.01)	0.09*** (0.01)	0.09*** (0.01)	0.10*** (0.01)	0.04** (0.01)
Symptoms	0.27** (0.09)	0.21* (0.09)	0.24** (0.09)	0.20* (0.09)	0.25** (0.08)	0.17 (0.09)	0.07 (0.09)	0.18* (0.09)	0.24** (0.09)	-0.04 (0.09)
Lack of care	0.19* (0.07)	0.18* (0.07)	0.17* (0.07)	0.16* (0.07)	0.18* (0.07)	0.19* (0.08)	0.17* (0.07)	0.15* (0.08)	0.19* (0.07)	0.14 (0.07)
Distress		0.16 (0.09)								-0.16 (0.10)
Emotionality			0.09** (0.03)							0.08* (0.03)
Absences				0.11*** (0.03)						0.07* (0.03)
School bonds					-0.11** (0.04)					-0.06 (0.04)
Substance-using peers						0.80*** (0.04)				0.78*** (0.04)
Academic trouble							0.16*** (0.02)			0.12*** (0.02)
Teacher trouble (0.04)								0.25*** (0.03)		0.14***
Student trouble									0.08* (0.04)	-0.06 (0.04)
<i>F</i>	60.80***	56.41***	56.84***	56.59***	53.91***	83.57***	57.09***	59.81***	56.57***	60.15***

Unstandardized coefficients, standard errors in parentheses.
All models control for sex, age, race/ethnicity, household structure, household education, supervision, and prior delinquency.
* *p* < .05; ** *p* < .01; *** *p* < .001

absences, substance-using peers, academic trouble, and teacher trouble. Following the same procedure described above, Sobel–Goodman tests were performed. Like the delinquency models, the tests affirmed that academic trouble ($p = .000$) and teacher trouble ($p = .06$) significantly mediated the relationship between symptoms and marijuana use. The tests were not significant for the measures of emotionality, absences, or substance-using peers, nor for any mediation of lack of care. As in the delinquency models, these results supported the fourth set of hypotheses. The key mediators of the HRS–marijuana use relationship appeared to be academic trouble and trouble with teachers, stressors that arose in part from health problems.

Discussion

Consistent with prior research, indicators of HRS had positive associations with delinquency and marijuana use, controlling for demographic characteristics, parental supervision, prior behavior, and other strains. HRS may affect adolescents' emotional well-being (Wade & Pevalin, 2005) and social relationships (Haas et al., 2010), but in the current study, these did not appear to be the major mechanisms by which HRS contributed to delinquency or marijuana use. The results of the current study provided the greatest evidence for the stress proliferation effects of HRS. Prior research describes the process of primary stressors leading to stressors in secondary contexts (Thoits, 2010), including the role of health and secondary stressors among youth (Compas et al., 2012; Piquart & Teubert, 2012). In accordance with GST (Slocum, 2010a), adolescents who experienced HRS also experienced troubles with schoolwork and teachers, and consequently were at greater risk of delinquency and marijuana use.

Four additional issues are noteworthy. First, negative emotional states, as measured in this study, were not associated with deviant outcomes in the full models. Previous GST research suggests that depression may be more conducive to drug use (Ford, 2014), but other research provides mixed evidence for distress as mediator (Botchkovar & Broidy, 2013). However, a broader range of emotions may be elicited by specific forms of strain and have specific behavioral outcomes (Ganem, 2010). To the extent that the measure of distress used in this study actually combined several emotional states, its effects could be muddled. Given that health problems may be associated with a range of negative emotions, future research should consider similar processes that may tie specific emotional responses to health problems, and how those emotions lead to specific behaviors.

Second, school bonds, when modeled alone, were inversely related to each outcome but did not substantially attenuate the effect of HRS. In the

full models, these bonds were not significant. Rather, problems at school, which themselves are likely tied to school bonds, were the dominant predictors. Health problems may lead young people to feel less connected to their schools (Blum et al., 2001), but the added stress, more than the loss of informal social controls, may be more conducive to delinquency and drug use.

Third, health problems may contribute to feeling less connected, but they may also contribute to young people missing out on normative school and social experiences. Such absences, as measured in this study, had slightly different effects across outcomes. Absences had an effect on delinquency when modeled alone, but not in the full models. Absences attenuated the effect of HRS on marijuana use in the individual model and remained significant in the full model, but did not act as the primary mediator. Absences could portend a loss of normative bonds or a sense of being disconnected, but they could also be viewed as a source of HRS in themselves. Missing school means missing material, making up work, even falling behind. Missing social events could be viewed as a loss of positively valued stimuli. Thus, if one consequence of health problems is absences, the stress related to health problems “spills-over” into other life domains such as school. The effect of absences is also consistent with research that suggests health conditions, because they contribute to social withdrawal or exclusion, may lead adolescents to engage in risky behaviors to seem like their healthier peers (Suris et al., 2008).

Fourth, associating with substance-using peers retained an independent effect on both delinquency and marijuana use. Research has long noted the association between delinquent peers and one’s own delinquency (Weerman, 2011), although this association is about more than simple peer pressure (Ungar, 2000). Poor health symptoms were positively related to having substance-using peers, which is consistent with research indicating that health conditions, because they contribute to adolescents being left out of normative peer networks, lead to association with non-normative peers (Schaefer et al., 2011). However, affiliation with substance-using peers was not a main mediator. This could be a result of the measure, which relied on respondents’ reports of peer behavior. Adolescents’ reports of their peers’ deviance may be a proxy for their own deviance (Haynie & Osgood, 2005). Viewed in this light, peer deviance at Wave 1 may simply be another way of controlling for the respondent’s own deviance at Wave 1. To better understand how HRS influences peer networks, and consequently illicit behaviors, future research should focus on network-based strategies for identifying health-related transitions to non-normative peer groups (Schaefer et al., 2011).

There were several other limitations to the study that may temper the results. The analysis controlled for prior delinquency and marijuana use, but the potential interaction between these risk behaviors and health symptoms limits

the results. Certain symptoms could feasibly result from involvement in delinquency or substance misuse. Adolescents may also have avoided care if they were concerned about illicit behavior being discovered. Unfortunately, the data do not provide full details about the causes of symptoms, but some sort of reciprocal effects may be at work (Stogner et al., 2014). Additional research is needed to determine how the mechanisms described by this study may alter these reciprocal effects over time.

Marijuana use could also be viewed as self-medicating (Neff & Waite, 2007). Health problems are a stressor that compels a personal solution, particularly in the absence of legitimate health care; substance use may provide temporary relief (Ford, 2014). Although the medical marijuana movement may have been in its early stages when Add Health was fielded (1994-1996), *Monitoring the Future* survey results indicate that across 8th, 10th, and 12th grades, the perceived risk of marijuana use was declining, whereas marijuana use itself increased about five percentage points between 1994 and 1996 (Johnston et al., 2013). More research is necessary to determine the degree to which young people may draw on the medical marijuana narrative in response to HRS.

The health measures utilized in the study may confound acute and chronic conditions, and Add Health has limited information about chronic illnesses in the early waves. In this case, a non-categorical approach to classifying health conditions is acceptable, based on the assumption that those with chronic health conditions often experience a range of acute problems and face common life experiences based on generic rather than diseasespecific aspects of their conditions (Suris et al., 2008). The reasoning of GST thus far has been that health issues interfere with one's ability to fully engage other life domains, which may be viewed as unfair, unjust, and unpleasant (Stogner & Gibson, 2010). Assessing symptoms, whether they result from chronic conditions or just repeated problems (potentially sourced in care, diet, exercise, and/or exposure), taps into that line of reasoning. However, there may be a qualitative difference in how those symptoms are interpreted by adolescents and others in their social networks, particularly if symptoms are related to serious versus minor or acute conditions. In the future, a more refined measure of health may allow research to parse mechanisms related to general symptoms from mechanisms related to specific diagnoses.

The health measures used in this study may also confound physical and emotional symptoms, particularly when it comes to somatic complaints. Likewise, the measure of absences used in this study was limited because it access to care measure lacked depth and also included no details about whether over-the-counter treatment was available in specific case. Access to care may also be affected by family poverty, and the control variable used to denote family socioeconomic status may not fully capture economic conditions. Given these

limitations to the HRS measures, future research should examine more detailed measures of health, health conditions, and access to care.

For example, perceptions of health problems, in combination with reported symptoms or diagnoses, may yield a more well-rounded measure of health. Agnew (2001) argued that objective and subjective experiences of strain only partially overlap. The social context in which a stressful experience occurs and one's appraisal of a stressful situation affect psychological responses (Dohrenwend, 2000). In one study, appraisals moderated the impact of health-related quality of life on adaptive behaviors among adolescents with sickle-cell disease (Ziadni, Patterson, Pulgaron, Robinson, & Barakat, 2011). Negatively appraised strains have also been linked to criminal behavior among youth (Froggio & Agnew, 2007). One key dimension of strain is perceived controllability, and research has found that youth who perceive their health conditions as controllable cope more effectively with their conditions (Compas et al., 2012). Thus, the objective conditions of a health problem, the degree to which it is negatively appraised by the individual, and its perceived controllability through diet, exercise, medical treatment, as well as social support and the reactions of others to the individual's condition, may all be important characteristics of HRS to consider.

In conclusion, this study confirmed that HRS has an independent effect as type of strain promoting delinquency and marijuana use. Problems at school—difficulties with homework and paying attention and trouble getting along with teachers—were primary mediators of these relationships. Consistent with the stress proliferation argument, HRS led to stressors in another important adolescent life domain, which became more proximate causes for deviant behaviors. In addition, health-related absences from school and social events not only remove adolescents from normative experiences but are also likely to contribute to their stress load. The results of this study suggest that breaking the cycle between HRS and illicit behaviors should involve targeted support for the educational needs of students with health problems, as well as general school-based support for physical and emotional health. The results also suggest that trouble at school, which may draw punitive responses that isolate youth, could be rooted in health concerns. In this case, punishment may not be the most appropriate solution. School-based support for health may provide the opportunity to identify underlying health concerns of those students who seem to be suffering academically. Furthermore, access to quality care may help adolescents avoid health problems, help them recover more quickly, and/or help to monitor more chronic conditions to reduce school and social absences. Helping students to alleviate stress related to health problems and to participate more fully in their social worlds despite health concerns could reduce their participation in risky behaviors like delinquency and marijuana use.

Acknowledgments — Special acknowledgment is due to Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. A previous version of this article was presented at the annual meeting of the American Society of Criminology, Chicago, Illinois, 2012. Persons interested in obtaining data files from Add Health should contact Add Health, Carolina Population Center, 123 West Franklin Street, Chapel Hill, North Carolina, 27516-2524 (addhealth@unc.edu).

Conflicting Interests and Funding — Dr. Kort-Butler declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article and disclosed receipt of the following financial support for its research, authorship, and publication: this article uses data from Add Health (Udry, 2003), a program project designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris, and funded by a grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 17 other agencies.

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Author Biography

Lisa A. Kort-Butler is an Associate Professor of Sociology at the University of Nebraska-Lincoln. Her research focuses on the factors associated with the well-being of adolescents and young adults. She also studies media representations of crime and justice. Recent work has appeared in *Justice Quarterly* and *Deviant Behavior*.