



Published in final edited form as:

*Sociol Inq.* 2013 November 1; 83(4): . doi:10.1111/soin.12018.

## Adolescent Loneliness and Health in Early Adulthood

Bridget J. Goosby<sup>a,\*</sup>, Anna Bellatorre<sup>b</sup>, Katrina M. Walsemann<sup>c</sup>, and Jacob E. Cheadle<sup>d</sup>

<sup>a</sup>Department of Sociology, University of Nebraska Lincoln, 742 Oldfather Hall, Lincoln, NE 68588, United States

<sup>b</sup>Department of Sociology, University of Nebraska Lincoln, 731 Oldfather Hall, Lincoln, NE 68588, United States

<sup>c</sup>Department of Health Promotion, Education, and Behavior, University of South Carolina, 800 Sumter Street, Room 216, Columbia, SC, 29208, United States

<sup>d</sup>Department of Sociology, University of Nebraska-Lincoln, 737 Oldfather Hall, Lincoln, NE 68588, United States

### INTRODUCTION

The desire to belong and feel socially connected is a fundamental aspect of human development and well-being. Although there is an extensive sociological literature examining the health implications of social support and social integration along with a growing literature assessing the harmful impact of loneliness (i.e. perceived social isolation) among the elderly (Savikko et al. 2005; Warner and Kelley-Moore 2012), there is a dearth of information regarding the potential health consequences of loneliness relative to other indicators of social integration at earlier life course stages. The omission of early life course loneliness in the sociological literature is somewhat curious because loneliness is an eminently social-psychological construct, reflecting how people experience the communal aspects of their social worlds. Indeed, we know little about the extent to which early life course loneliness influences health during the transition to adulthood or the pathways through which loneliness impacts early adult health. Loneliness may serve as an important, overlooked pre-disease pathway for a range of health outcomes in adulthood.

Adolescence is a particularly salient time for understanding the health consequences of loneliness because youth are experiencing various developmental transitions, from biological (i.e. pubertal onset) to social (e.g. transitioning from primary to secondary school). During this developmental stage, youth are also transitioning from their parents to their friends as primary socializing agents (Crosnoe 2000). Such a myriad of transitions can lead to both friendship instability and emotional distress, which could lead to a cascade of health risks over time. Social ties are salient for life course health (Umberson and Montez 2010). For adolescents specifically, both attachment to school and parental support may be key protective factors for mental and physical health during a developmental period when distress is high (Resnick et al. 1997; Giordano 2003).

Using data from Waves 1–3 of the National Longitudinal Study of Adolescent Health (Add Health), we examine the social and psychological pathways through which loneliness influences early adult depression, self-rated health, and metabolic conditions associated with cardiovascular disease (CVD). To this end, our study expands the existing literature by

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\*Corresponding Author. Tel: +1 402 472 3820 Fax: +1 402 472 6070.

applying a life course perspective to identify the psychological and social risk and protective pathways associated with loneliness in adolescence and health in early adulthood.

## BACKGROUND

Emile Durkheim presented foundational sociological research demonstrating the importance of social relationships and health in his 19<sup>th</sup> century study of social integration and suicide (1951). Durkheim's study underscores the importance of being socially connected and having high quality social connections for individual and societal health. Durkheim's analysis of the relationship between suicide risk and social context demonstrate that disruptions in social connections (an example being economic upheaval) can lead to elevated levels of social alienation in individuals, affecting their mood and straining interactions with others, thereby leading to elevated risk of suicide at the societal level (Durkheim 1951). Durkheim's analyses are undoubtedly generalizable to other health risks and are also importantly linked to the subsequent social science research examining role of social connectedness for health outcomes (Thoits 2011; Berkman et al. 2000).

Social isolation, social integration, and loneliness have been studied with varying levels of interest across disciplines. Cornwell and Waite (2009) note that a challenge in previous research examining social isolation and health is the disciplinary disjuncture in how social isolation is studied and defined. Specifically, research in sociological literature focuses primarily on levels of social integration, defined as the "existence and quantity of social relationships" (House et al. 1988; p. 293), while psychological literature focuses primarily on perceived social isolation, or the extent to which people consider themselves as lonely (Cornwell and Waite 2009). The former is related both to social network structure (i.e. structural properties that characterize a set of relationships; House et al. 1988) and the provision of social support (Gorman and Sivaganesan 2007), while the latter is not always synonymous with having smaller social networks or less objective social support (see Heinrich and Gullone 2006 for review). In this study we focus specifically on the concept of loneliness (i.e. perceived social isolation) while accounting for objective measures of social integration as well as perceived support.

Loneliness is a painful emotional state that occurs when there is "a discrepancy between... the desired and achieved patterns of social interaction" (Peplau and Perlman 1982, p.5). Those who perceive themselves as lonely may not necessarily lack social relationships, but instead may consider their relationships as inadequate or poor in quality (Hawkley and Cacioppo 2010). Though loneliness is associated with objective social relationship characteristics such as the number of friends one has, there is not always agreement between subjective appraisals and objective measures. Several studies have demonstrated that the total number of friends people have does not adequately predict loneliness in children or adults (Parker and Seal 1996; Fischer and Phillips 1982). Moreover, it is important to note the distinction between social support and loneliness since lonely and non-lonely individuals are just as likely to interact with other people; however, for the lonely, their interactions are of lower quality and "provide them with less support and comfort" (Cacioppo et al. 2003, p73). Furthermore, the perceived availability of social support and subjective ratings of relationship quality are each associated with loneliness *and* health (Hawkley et al. 2008).

### Loneliness from a Life Course Perspective

The life course perspective is an effective framework to apply when investigating specific mechanisms through which stress related health outcomes are manifested and operate over the early life course (Turner and Schieman 2008). Our study emphasizes particular tenets of the life course perspective to examine potential pre-disease pathways through which adolescent loneliness may influence health in early adulthood, including the study of human

biological and developmental processes over time (e.g. transitioning from parent to peer socialization), the timing of and exposure to stressful life events (e.g. loneliness), and most essential, the degree to which individual lives are linked (Elder et al. 2004).

Loneliness is most prevalent during adolescence with more than 70% of adolescents experiencing recurring loneliness at age 18, a rate that declines to 60% by ages 35–40, and 39% for older adults (Heinrich and Gullone 2006; Parlee 1979; Savikko et al. 2005). Extant research using clinical and non-representative U.S. samples suggest that loneliness is directly associated with poorer mental and physical health during adolescence and early adulthood. For example, lonely adolescents report higher rates of depression and anxiety (Koenig and Abrams 1999), social withdrawal (Crick and Ladd 1993), suicide ideation and attempts (see Heinrich and Gullone 2006), psychosomatic complaints (i.e., headaches, nausea, etc.; Ponzetti 1990) and poorer overall general health (Mahon et al. 1993).

The occurrence of loneliness is especially salient for adolescents as their desire to feel socially accepted and to belong becomes particularly intense during this developmental period (Brennan 1982). Loneliness is itself an important stressor and a salient aspect of the life course tenet of linked lives because how youth *perceive* the quality of their relationships, that is, how their lives are linked to others, can have far reaching consequences for their mental and physical well-being. In addition to understanding the degree to which the perception of linked social lives directly influence health, understanding how the deleterious health consequences of loneliness are offset or moderated by social relationships is essential for identifying social mechanisms that influence individual and population level health over time (House et al. 1988).

During adolescence, both parents and peers can provide supportive environments that offset stressors such as loneliness (Giordano 2003) and may also attenuate the relationship between loneliness and health. Parental warmth, both maternal and paternal, is associated with lower levels of loneliness in their offspring (Mahon et al. 2006). Parental support is also associated with adolescent health; adolescents' perception of parental support (or lack thereof) is a significant predictor of adolescent general health complaints (Wickrama 1997) and depressive symptoms (Cornwell 2003). School attachment, or the degree to which youth feel connected or close to people at their school, is also particularly protective. Youth who are well liked and feel supported by their friends are less likely to report feeling lonely, whereas lonely adolescents feel less integrated and attached to their school (Chipuer 2001; Kingery and Erdley 2007). Adolescents who do not feel like they are part of their school report poorer self-rated health and elevated depressive symptoms in early adulthood (Goosby and Walsemann 2012; Walsemann, Bell, and Goosby 2011) thus demonstrating the importance of social connections for subsequent health. Furthermore, the links between parent support and adolescent school attachment with loneliness and health suggest that these may be understudied mechanisms through which loneliness impacts health.

Even in the presence of social support, however, lonely youth may be less able to adequately cope with stress (Larose and Bernier 2001). Specifically, individuals who feel socially isolated may have more ambivalent, less secure attachment styles (Cacioppo et al. 2000) and elevated depressive symptoms (Cacioppo, Hawkley, and Thisted 2010), which can result in difficulty maintaining and mobilizing support during stressful circumstances. In a study of adolescents transitioning into college, Larose and Bernier reported that youth with less healthy attachment styles reported higher levels of loneliness and greater difficulty seeking out support from their peers and teachers (2001). Consequently, the inability to mobilize support may not only exacerbate the cycle of loneliness, it may also intensify health risks associated with a lack of social support and isolation. Lonely adolescents may therefore be at greater risk for deleterious health outcomes compared to adolescents who are not lonely,

because lonely youth with ambivalent attachment styles can reduce the protective characteristics of social support that they may already be receiving.

**Gender Differences**—In examining the potential consequences of loneliness for subsequent adult mental and physical health outcomes, there is a dearth of literature examining whether the consequences of adolescent loneliness for adult health are moderated by gender. Salient developmental gender differences emerge during adolescence. Specifically, girls begin to experience a 2:1 higher rate of depression than boys, a difference that persists into adulthood (Nolen-Hoeksema 2001). Research assessing gender differences in adulthood loneliness indicate that women are more likely to report higher rates of loneliness and depression relative to men (Borys and Perlman 1985), yet, this pattern is not consistently found among adolescents.

Indeed, boys generally report similar or *higher* rates of loneliness as girls (cf., Koenig and Abrams, 1999 for a comprehensive literature review). According to Koenig and Abrams (1999), boys' higher rate of loneliness is associated with their increased time spent alone as compared to adolescent girls who transition from spending time with their parents, to spending more time with their peers. An important limitation of this body of work, however, is that most of the findings are based on non-representative samples that only assessed gender differences in the rates of loneliness and not in their links to subsequent health. Though there may not be differences in rates of loneliness in adolescence, there may be differences in the health risk of loneliness for boys relative to females, yet to be uncovered. Thus, we explore whether the impact of loneliness and health in adulthood varies by gender.

### Health Consequences of Loneliness

Prior studies show that *loneliness* is associated with greater risk of physical health conditions such as obesity, vascular resistance, diminished immunity, alcoholism, and mortality in adults (see Cacioppo et al. 2009; Heinrich and Gullone 2006). There are several studies reporting that childhood loneliness is also linked to high blood pressure, high cholesterol, obesity, and major depressive disorder in adulthood (Danese et al. 2009; Cacioppo, Hawkey, and Thisted 2010; Caspi et al. 2006). Depression is also tied to an array of physical illnesses associated with cardiovascular disease including metabolic conditions (Joynt et al. 2003; Kinder et al. 2004) and as such could be a risky pathway through which loneliness impacts health. The above-mentioned studies, however, do not account for the role of depressive symptoms during adolescence as a conduit connecting loneliness to later health – an important omission that we address in this study.

Our study investigates the early life course loneliness pathways to early adulthood health by assessing the social processes that could offset or exacerbate the harmful influence of adolescent loneliness for subsequent health, while accounting for important gender differences in patterns of health outcomes related to loneliness and health. Building on the existing literature, we examine the degree to which loneliness in adolescence is associated with stress-related metabolic health conditions in early adulthood, including hypertension, high cholesterol, and obesity, as well as its effects on diagnosed depression and self-rated health, addressing the following hypotheses:

*H1- Loneliness is associated with poor mental and physical health; H2 and H3- Parent support (H2) and school attachment (H3) attenuate the adolescent loneliness and adult mental and physical health relationship; H4-Lonely youth who report high levels of parent support (H4a) and/or high levels of school attachment (H4b) will report poorer health outcomes than their non-lonely counterparts; H5- Depressive symptoms mediate the adolescent loneliness and adult health relationship.* Finally, we examine whether *lonely girls at a higher risk for poor adult health outcomes relative to boys.*

## METHODS

### Data

This study utilizes data from the National Longitudinal Study of Adolescent Health (Add Health), which is a nationally representative sample of U.S. adolescents from 132 middle and high schools. The sample design for this study was a complex area probability sample of students, clustered at the school level, and stratified to take into account school type (public, private, or parochial), school size, region of the country, and the level of urbanization. High schools were eligible if they had a feeder school also eligible for the study in the catchment area of the high school capable of enrolling five or more students into the focal high school. Wave 1 survey data collection was conducted in school and at home, whereas later waves were implemented in-home only. The Wave 1 in-school questionnaire was administered to students in 1994/5 prior to the Wave 1 in-home survey in 1995 and subsequent in-home surveys were administered in 1996, 2001/2, and 2007/8 (Chantala and Tabor 1999). During the first wave of data collection, parents were also interviewed. In addition, data was collected from focal adolescents about dating and friendship patterns, health, substance use, and so on.

Our sample utilizes data from Waves 1 (1994/1995), 2 (1996), and 3 (2001/2) and includes respondents with available information in Wave 3 on self-rated health and self-reported clinically diagnosed depression, hypercholesterolemia (high cholesterol), hypertension (high blood pressure), and body mass index (BMI). Multiple imputation by chained equations in Stata 12 (the *ice* command; Royston 2004) was employed to handle missing data on the covariates included in the analysis and to maintain the pattern of relationships among them (Little and Rubin 2002). The sample only includes cases that were *not* missing on the dependent variables. We replicated analyses across 10 imputation data sets and combined the results to produce final estimates using Rubin's rules (see Schafer 1999; Royston, et al. 2009). The final sample sizes based on the dependent variables for the analyses were 10,576 for self-rated health, 10,564 for depression, 8,595 for overweight/obese, 10,560 for high cholesterol, and 10,567 for high blood pressure.

### Measures

**Dependent Variables**—The focal analysis variables are *self-rated health*, *diagnosed depression*, and *cardiovascular disease (CVD)* related metabolic conditions- *overweight or obesity*, *diagnosed high cholesterol*, and *high blood pressure* measured at Wave 3 when the youth were 18 to 27 years old. Respondents were asked “In general, how is your health? Would you say excellent, very good, good, fair, or poor?” *Self-rated health* was categorized as poor or fair health versus good to excellent health. *Diagnosed hypertension*, *high cholesterol*, and *depression* were self-reported. Self-reported diagnosed depression is included as both an outcome and a key covariate in the models assessing physical health conditions. Respondents who indicated a prior diagnosis of a condition were coded as ‘1’ for that condition and ‘0’ otherwise. Overweight-obese status was measured using adult (BMI) and was calculated using the respondents’ measured height and weight at Wave 3 as  $[(\text{weight (kg)})/(\text{height in meters})^2]$ . Respondents were categorized as overweight or obese if their value exceeded 25.

**Loneliness and Risk and Protective Mechanisms**—*Loneliness* at Wave 1 was measured using the following questions with responses on a 4-point scale (ranging from 0=never or rarely to 4=most of the time or all of the time): how often in the past seven days: (1) did you feel lonely; (2) did you feel that people disliked you; and (3) were people unfriendly to you. Respondents were also asked how much they agreed (on a scale from 1 to 5, where 1=strongly agree and 5=strongly disagree) that they felt (1) loved and wanted and

(2) socially accepted. Results from factor analysis on these five items were used to create factor scores. These scores predict the location of an individual on the latent loneliness factor; higher factor values represent higher levels of *loneliness* (Cronbach's alpha  $W1 = .70$ ). It is important to note that because the UCLA loneliness scale (Russell et al. 1980), a validated measure of loneliness, was not available in Add Health we created a scale that utilized several items from the CES-D scale and other scales that reflect dimensions of loneliness.

*Depressive symptoms* in Wave 2 were measured using the 19 items from the CES-D scale. The Center for Epidemiological Studies Depression scale (CES-D) is a validated scale for measuring recent depressive symptoms experienced in the preceding week (Radloff 1977). The measure is used here to assess whether respondents experience high levels of depressive symptoms during Wave 2. The scale was summed and dichotomized; respondents with a score of 16 or higher were coded '1' for high depressive symptoms. All else were coded '0' (Yen 2006).

*Parent support* was measured using up to eight items reporting the quality of respondents' relationship with their parents (four items for youth in single-parent families). Respondents were asked how much they agreed (on a scale from 1 to 5, where 1=strongly disagree and 5=strongly agree) that (1) most of the time, your mother is warm and loving to you; (2) you are satisfied with the way your mother and you communicate with each other; (3) overall, you are satisfied with your relationship with your mother; (4) most of the time, your father is warm and loving to you; (5) you are satisfied with the way your father and you communicate with each other; and (6) overall, you are satisfied with your relationship with your father. The parent support scale was averaged across mother and father scores and the average of standardized factor scores was calculated across Waves 1 and 2 ( $W1 \text{ alpha} = .85$ ,  $W2 = .85$ ;  $r = .57$ ), with higher scores denoting greater parental support.

*School attachment* was measured with four items using a 5-point scale where students were asked how strongly they agreed (ranging from 1=strongly disagree to 5=strongly agree) with the following statements: (1) teachers at your school treat students fairly; (2) you feel you are part of your school; (3) you feel close to people at your school; and (4) you are happy to be at your school. School attachment was operationalized as the average standardized factor score across Waves 1 and 2 (Wave 1 Cronbach's alpha = .74, Wave 2 = .75;  $r = .53$ ).

**Covariates**—Objective measures of low social integration were included to account for potential confounding. At Wave I, respondents were given the opportunity to list their five closest female and five closest male friends. Three variables were created based on respondents (1) nominating two or fewer friends, which was dichotomously coded as *2 Out-Nominations*, (2) respondents who received two or fewer friend nominations were dichotomously coded as *2 In-Nominations* and (3) respondents who nominated two or fewer friends *and* received two or fewer friend nominations were dichotomously coded as a *Social Isolate*. To account for active social networks outside of school, a measure for having *2 Out-of-School Nominations* were included in the models.

Multiple measures of adolescents' prior health were included in the analysis to account for previous health conditions that could confound the relationship between adolescent loneliness and adult health. *Adolescent health* was measured as a continuous variable in Wave 1 based on parent or guardian report of their offspring's health in adolescence. Parents or guardians were asked, "How would you rate your child's general physical health? Would you say excellent, very good, good, fair, or poor?" Adolescent health was coded so that higher values reflect better health. Because parent health is also an important predictor of offspring health, *parent self-rated health* is included as a continuous variable where higher

scores indicate better health. In addition we include a dichotomous measure of whether the adolescent had *health insurance* in Wave 1 to account for healthcare access. Two dichotomous measures of adolescent risk behavior were also incorporated and both measures were averaged across Waves 1 and 2. *Binge drinking* was measured as drinking four (females) or five (males) drinks in a row at least once over the past 12 months ( $r=.41$ ; Rodgers et al. 2005). Respondents who smoked at least one cigarette for 15 to 30 of the prior 30 days were categorized as *regular smokers* ( $r=.47$ ; Brook et al. 2006).

Additional background controls included respondent *gender*, mean centered *age* at Wave 1, racial identification, and immigrant status. Respondents' race/ethnicity is categorized in our analysis as *non-Hispanic White*, *African American*, *Hispanic*, *Asian/Pacific Islander*, and *other*. *Immigrant status* was operationalized as a dichotomous measure of whether or not the focal adolescent was born in the U.S. Family background characteristics included parent marital status (*married, separated or divorced, single/never married, or widowed*), parent education (*some high school, high school degree, some college or vocational training, college graduate, professional/advanced training*) measured using either the average of the two parents living in the household or the highest level education of the single parent in the household, and the natural log of the average *income* of parents in the household.

### Analytic Strategy

Analyses were conducted using logistic regression. All results used stratum and school clustering adjustments, however, population level weights were not used because the variables used to create the weights were included in our analyses (Winship and Radbill 1994). The model series were identical for each dependent variable with the exception of the analyses for diagnosed depression, which was included as a covariate in the physical health models. The first model assessed the relationship between loneliness at Wave 1 and the health outcome adjusting for gender, background controls, and confounders including race/ethnicity, age, family structure, immigrant status, youth self-rated health, youth smoking and binge drinking, as well as parents' income, education, and self-rated health (Model 1). Model 2 further adjusted for high depressive symptoms at Wave 2. Next, friend nomination measures, school attachment, parent support, and key interaction terms were introduced (Model 3). In this model we include a *female*  $\times$  *loneliness* interaction to assess gender differences in the impact of loneliness on early adulthood health, along with *loneliness*  $\times$  *parent support* and *loneliness*  $\times$  *school attachment* interactions to identify whether parent support and school attachment moderate the loneliness/health relationship. Model 3 is the final model reported for diagnosed depression. For the metabolic health conditions and self-rated health, the final model (Model 4) includes diagnosed depression in Wave 3 to further assess the potential link between depression and later health conditions.

## RESULTS

### Sample Characteristics

Descriptive statistics for all covariates and the dependent variables included in the models are reported in Table 1. Respondents in our sample were primarily white (48%), 54% were females, and the average Wave 1 age was 15.6 years. Most came from married households (73%) and the majority of parents had either a high school degree (30%) or some college or vocational training (29%). Twenty one percent of the sample reported two or fewer friend in-nominations while 22% reported two or fewer friend out-nominations. Approximately 8% of respondents reported two or fewer in- and out-nominations (i.e., social isolates). About 18% of youth reported high levels of depressive symptoms at Wave 2. Across Waves 1 and 2, approximately 21% of the sample reported binge drinking and 12% reported smoking regularly. In Wave 3, 10% of young adults reported being diagnosed with depression and

4% reported having poor/fair self-rated health. Thirty-five percent of young adult respondents were overweight or obese, while 5% reported separately having high cholesterol and high blood pressure.

### Bivariate Results

Table 2 reports bivariate associations between the dependent variables and a select set of covariates included in the models. Loneliness is significantly associated with the increased odds of reporting depression (OR=1.45), poor/fair self-rated health (OR=1.48), and all metabolic conditions (i.e. high cholesterol (OR=1.14), high blood pressure (OR=1.17), and overweight/obese status (OR=1.11). Females have higher odds of reporting depression and poor self-rated health than boys. High depressive symptoms at wave 2 are associated with higher odds of depression (wave 3), poor/fair self-rated health, high cholesterol, and obesity. School attachment and parent support lower the odds of reporting depression, poor/fair self-rated health, and high blood pressure. School attachment is not associated with high cholesterol and parent support is not associated with obesity.

### Multivariate Analyses

Table 3 reports the logistic regression results for diagnosed depression and self-rated health and Table 4 reports the metabolic conditions-cholesterol, blood pressure, and overweight/obesity status. All of the models in Tables 3 and 4 adjust for an extensive list of covariates, but for the sake of brevity, only loneliness, social integration measures, Wave 3 diagnosed depression, and interaction coefficients are reported in the tables. The full models are available upon request.

**Depression**—Odds ratios for models predicting diagnosed depression at Wave 3 are reported in Table 3. In Model 1 (M1), loneliness increases the odds of reporting depression (OR=1.42), a relationship that also persists across models. Reporting high depressive symptoms at Wave 2 increases the odds of reporting diagnosed depression by approximately 73% in Model 2 (M2) and attenuates the loneliness-depression relationship. In Model 3 (M3), loneliness and depressive symptoms remain significant predictors of diagnosed depression, while youth who had no in- or out-nominations (social isolates) increases odds of reporting diagnosed depression by 74%. Having more parental support is related to lower odds of diagnosed depression (OR=.87) at Wave 3. There was evidence that parent support moderates the loneliness and depression relationship; lonely youth who report supportive parents are at higher odds of having diagnosed depression in adulthood than non-lonely youth with supportive parents. Gender did not moderate the loneliness-health relationship.

**Self-Rated Health**—Loneliness is associated with higher odds of reporting poor/fair self-rated health (SRH), in Models 1 and 2 (OR=1.38 and 1.31, respectively), which is reduced to non-significance in Model 3 (see Table 3). Wave 2 depressive symptoms increase the odds of reporting poor/fair SRH (OR=1.47, M2; OR=1.47, M3), as does having no outside school nominations (OR=1.31). School attachment (OR=.81, Model 4; M4) and parent support (OR=.91, M4) are associated with lower odds of reporting fair/poor SRH. Girls who report higher levels of loneliness have higher odds of reporting fair/poor SRH compared to boys with similar levels of loneliness (OR=1.18). In addition, parent support moderates the effect of loneliness on SRH; lonely youth with high levels of parent support report a higher risk of having fair/poor SRH at Wave 3 relative to non-lonely youth (OR=1.08). Diagnosed depression at Wave 3 is also associated with higher odds of reporting poor/fair self-rated health at Wave 3 (OR=2.64).



## Metabolic Conditions

In Table 4, there is evidence that loneliness is associated with higher odds of *high cholesterol* (OR=1.11, M1), *high blood pressure* (OR=1.12, M1), and *overweight/obese status* (OR=1.06, M1) in early adulthood. In the case of high cholesterol and high blood pressure, depressive symptoms at Wave 2, objective measures of social integration, parent support, and school attachment are not associated with high blood pressure or cholesterol (see Model 4). Diagnosed depression at Wave 3 is, however, associated with higher odds of having high cholesterol (OR=1.81, M4) and high blood pressure (OR=2.46, M4). For overweight and obesity status, loneliness is no longer significant in M2 after adjusting for depressive symptoms at Wave 2; however, Wave 2 depression is not significantly associated with obesity in these models. Parent support, is unexpectedly associated with higher odds of being overweight/obese. Finally, lonely females are more likely to be overweight/obese than lonely males (OR=1.17, M4).

## DISCUSSION

In this study, we contribute to the sociological literature linking social connectedness and health by integrating an understudied aspect of social isolation in the early life course – loneliness. Our examination of the social pathways through which adolescent loneliness influences the risk of experiencing adult depression, poor/fair self-rated health, and metabolic conditions associated with cardiovascular disease, demonstrated that adolescent loneliness is a salient early life course pathway for adult health. Furthermore, important nuances in the protective contributions of parent support and school attachment along with salient gender differences in the vulnerability of health conditions brought on by loneliness were uncovered. Assessing these processes while exploring the role of depressive symptoms as a conduit through which loneliness impacts health extends existing research linking loneliness to adult health. Consequently, we disentangle conflated meanings of social support and social ties for health outcomes in the early life course by considering both perceptions of isolation along with the extent to which available support may or may not offset such deleterious relationships.

In addition to supporting previous findings indicating that adolescent loneliness is directly associated with poor health in adulthood (H1; Caspi et al. 2006), we found important evidence that parent support offsets the harmful impact of loneliness. These findings demonstrate the importance of the *linked lives* between adolescents and their parents and peers. Parent support, which is independently associated with lower risk of poor/fair-self rated health and depression, mitigated the risk of having diagnosed depression and poor/fair self-rated health, providing support for Hypothesis 2. Unexpectedly, however, parent support was associated with *higher* odds of being obese as an adult. It is possible that our measure of parent support is tapping into important aspects of parenting. Extant literature examining the relationship between parenting and offspring obesity indicates that parenting behaviors and relationship quality with their offspring are associated with risk of obesity (Zeller et al. 2008). Specifically, authoritative parenting, defined as the provision of warm nurturing environments with firm boundaries, is a protective parenting style for offspring obesity while indulgent, authoritarian (strict disciplinarian), or neglectful parenting styles are risk factors (Rhee 2008).

In general, parent support provided protective benefits for adolescent health; however, when assessing the degree to which lonely adolescents' reap the same benefits from parent support relative to their non-lonely peers, important differences were uncovered. Specifically, lonely adolescents who reported receiving higher levels of support were at elevated risk of having diagnosed depression and poor/fair self-rated health in early adulthood supporting Hypothesis 4a, compared to their non-lonely counterparts. This supports prior literature

positing that lonely individuals may have more difficulty perceiving social support as helpful and social interactions as less comforting than non-lonely individuals (Hawkley et al. 2003; Cacioppo et al. 2000), characteristics related to less healthy attachment styles (Larose and Bernier 2004). For youth experiencing severe loneliness, the presence of warm, caring parents may be acknowledged and recognized, but youth may be unable to translate that support into positive coping, therefore remaining at higher risk of experiencing depression and worse overall ratings of general health in adulthood relative to non-lonely youth.

Interestingly, adolescent school attachment was only protective for obesity, lending some support to Hypothesis 3, but showed no protective evidence for other health conditions. This was also the case for testing the moderating relationships between school attachment and adolescent loneliness. Though prior studies and our bivariate results suggest that school attachment is associated with loneliness itself (Chipuer 2001), as well as depression and substance use in adulthood (Bond et al. 2007), our study found little empirical evidence that it serves as a pathway through which loneliness influences subsequent health conditions during adulthood. Our study indicates that parental support is the most salient support mechanism for adult depression and general self-rated health. These results may suggest that during adolescence when youth are vying for independence from their parents and socializing more with their peers, parent support still provides more protection from adult depression and poor self-rated health than school attachment.

Depressive symptoms were a conduit through which loneliness influenced certain health outcomes (H5). Specifically, high depressive symptoms were associated with higher odds of reporting diagnosed depressive symptoms and poor self-rated health, also mediating the relationship between loneliness and these health conditions. The salience of depressive symptoms for the loneliness-depression relationship may be in part due to the cyclical nature of depression, as individuals who experience depressive symptoms at one point are at elevated risk experiencing related symptoms at a later time (Pearlin & Schooler, 1978). In the case of self-rated health, this measure is validated indicator of general physical *and* mental health in adulthood (Mikolejczyk et al. 2008; Manor et al. 2001), which may indicate that it may share similar constructs related to depression risk. The pathways we uncovered lend support to prior research showing that loneliness is a salient predictor of subsequent depression in adults (Cacioppo, Hawkely, and Thisted 2010).

Important gendered patterns in the loneliness-health relationship also emerged. Unlike prior literature, our national data set showed the girls were more likely to report being lonely than boys. Furthermore, lonely females were more likely to report depression, poor/fair self-rated health, and obesity in Wave 3 than lonely boys. In broader social contexts girls are more likely to report distress related to interpersonal relationships. Furthermore, during adolescence girls have tighter, more cohesive friendship networks than boys, which consequently elevate the risk of expulsion of depressed girls from their social networks (Cheadle and Goosby 2012). This gender specific process of exclusion could leave girls vulnerable to more health problems in early adulthood. Moreover, interpersonal problems are related to elevated levels of depression in girls, but not boys (Nolen-Hoeksema 2001).

Self-rated health is a strong predictor of overall well-being and mortality, and is highly correlated with depression, suggesting that lonely girls' health in adulthood could have long term risks for their overall well-being later in the life course. Finally, lonely girls are more likely to be overweight or obese in adulthood perhaps due to coping behaviors related to obesity such as eating disorders (Smith et al. 1998). Prior literature suggests that adolescent depression is associated with subsequent early adulthood obesity (Goodman and Whitaker 2002), but to our knowledge, no one has assessed whether a similar pattern is present in the case of loneliness. Because, girls are more likely to experience high levels of depression *and*

loneliness in adolescence we suggest that a more nuanced understanding of the role of gender in the consequences of loneliness for health is required during this particularly salient developmental period.

Though our specified pathways did not explain the links between loneliness and certain metabolic conditions (i.e. cholesterol and blood pressure), this study allowed us to disentangle important conflated meanings of social support, objective social ties, and loneliness to account for competing factors that may contribute to poor health in adulthood. In the case of cholesterol and high blood pressure, additional unmeasured biological factors may be at work, driving the loneliness-health relationship. Unmeasured biological processes linking these conditions such as harmful physiologic changes to the neuroendocrine, immune, and cardiovascular systems may be brought on by loneliness. Recent studies show that adolescent loneliness is associated with the stress-sensitive hormone cortisol in early adulthood (Doane and Adam 2010), high inflammation levels, and metabolic risk biomarkers including overweight, high blood pressure, and cholesterol levels (Danese et al. 2009; Caspi et al. 2006). Future studies should integrate these factors to better understand how such biological mechanisms interact with social processes to produce harmful life course health outcomes while accounting for object and subjective measures of social connectedness in the early life course.

### Limitations

Several limitations should be noted. First, this study uses self-reports of early adult health, which may underestimate existing health conditions (Miinupalo et al. 1997). In addition, measuring affective states during adolescence, a time when social desirability can play a crucial role in well-being, may make self-reported affective states less reliable (Ciarochi et al. 2001). Also, a validated measure for loneliness, such as the UCLA Loneliness scale (Russell et al. 1980), was not available in this data set. Consequently, we developed a loneliness scale that includes an item asking if respondents 'felt lonely in the past seven days.' Thus, our measure does not tap into the multiple dimensions of loneliness found in prior studies (Austin 1983). Furthermore, our loneliness scale included three items used to develop the CES-D scale in Waves 1 and 2, which did not allow us to more systematically disentangle the relationship between depressive affect and loneliness. Finally, although we controlled for a range of factors that might confound or mediate the association between loneliness and early adult health, other unmeasured social factors correlated with loneliness and our health outcomes may bias our results (e.g. school and neighborhood race/ethnic and socioeconomic composition).

### Conclusion

The impact of loneliness on health and mortality is far reaching. The fact that the consequences of adolescent loneliness can be felt into adulthood is alarming. The links between loneliness and depression along with conditions that are associated with cardiovascular disease risk, the leading cause of death in the United States (American Heart Association 2007), makes loneliness an important public health concern. Given that evidence is building for the harmful nature of loneliness across the life course, the differential patterns of social support associated with it, deeper investigation is required to understand how such health consequences for loneliness vary during different stages of the life course. Furthermore, the important gender differences in vulnerability to certain health conditions related to loneliness, give rise to the need to assess *how* loneliness may differentially impact males and females. Our study uncovered evidence that during this important life course stage where youth experience rapid developmental changes, how they perceive their social links to others, has far reaching consequence for their health. Given such salient early life course findings, we hope that this evidence encourages sociologists to

consider loneliness as a social-psychological experience deserving more attention across earlier developmental stages.

## Acknowledgments

This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>). No direct support was received from grant P01-HD31921 for this analysis. This paper is part of a larger study funded by the National Institute of Child Health and Human Development (K01 HD 064537; Bridget Goosby, PI). All opinions and errors are the sole responsibility of the authors and do not necessarily reflect those of either the helpful commentators or funding agencies sponsoring Add Health.

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**Table 1**

Sample Descriptive Statistics for the Complete Covariate List<sup>a, b</sup> (N=10,549)

	N	%N <sup>d</sup>	Mean/Prop	SE	Min	Max
<i>Adolescent Stressors, Risk, and Protective Mechanisms</i>						
Loneliness W1 <sup>e</sup>	10512	99.65	-0.01	0.83	-1.03	5.06
High Depressive Symptoms W2	10549	100.00	0.18		0	1
School Attachment (average W1-W2) <sup>e</sup>	10462	99.18	-0.01	0.80	-2.93	1.37
Parent Support (average W1-W2) <sup>e</sup>	10440	98.97	-0.03	0.90	-3.99	1.17
Binge Drinking (average W1-W2)	10521	99.73	0.21	0.01	0	1
Regular Smoking (average W1-W2)	10549	100.00	0.12	0.01	0	1
<i>Covariates</i>						
<2 In-Nominations	10549	100.00	0.21		0	1
<2 Out-Nominations	10549	100.00	0.22		0	1
<2 Out-of-SchoolNominations	10549	100.00	0.69		0	1
Social Isolate <sup>c</sup>	10549	100.00	0.09		0	1
Parent Self-Rated Health	9122	86.47	3.60	0.03	1	5
Parent Reported Respondent Health (Wave D)	9174	86.97	4.13	0.03	1	5
<i>Background Controls</i>						
<i>Race/Ethnicity</i>						
Non-Hispanic White	10544	99.95	0.48		0	1
African American	10544	99.95	0.23		0	1
Hispanic	10544	99.95	0.15		0	1
Asian-Pacific Islander	10544	99.95	0.08		0	1
Other	10544	99.95	0.03		0	1
<i>Immigrant Status</i>						
Health Insurance (Wave D)	6877	65.19	0.09		0	1
Female	9174	86.97	0.88		0	1
Age (94/95)	10549	100.00	0.54			
Family Structure	10544	99.95	15.55	1.71	11	20



	N	% <sup>N/d</sup>	Mean/Prop	SE	Min	Max
Married	9115	86.41	0.73		0	1
Never Married	9115	86.41	0.05		0	1
Divorced or Separated	9115	86.41	0.18		0	1
Widowed	9115	86.41	0.03		0	1
<i>Family Socioeconomic Status</i>						
Some High School	9089	86.16	0.15		0	1
High School Graduate	9089	86.16	0.30		0	1
Some College	9089	86.16	0.29		0	1
College Graduate	9089	86.16	0.15		0	1
Advanced Degree	9089	86.16	0.10		0	1
Family 1995 Income (ln)	8011	75.94	3.47		-4.61	6.91
<i>Region of the Country</i>						
West	10549	100.00	0.21		0	1
Midwest	10549	100.00	0.24		0	1
South	10549	100.00	0.40		0	1
Northeast	10549	100.00	0.14		0	1
<i>Outcomes</i>						
Diagnosed Depression	10535	99.87	0.10		0	1
Fair or Poor Self-Rated Health	10547	99.98	0.04		0	1
Overweight or Obese Status	8577	81.31	0.35		0	1
Diagnosed High Cholesterol	10531	99.83	0.05		0	1
Diagnosed High Blood Pressure	10539	99.91	0.05		0	1

<sup>a</sup> Adjusted means and standard deviations reported. Descriptives were calculated separately and adjusted for clusters and strata.

<sup>b</sup> Values reported are from non-imputed data.

<sup>c</sup> Social isolate is defined as having less than 2 friend in or out-nominations

<sup>d</sup> This column denotes the percentage of the sample not missing for each covariate prior to imputation.

<sup>e</sup> Indicates that values presented are in the original metric, however please note that z-scores are used in multivariate analyses. The ranges for the z-score values were (-1.25, 5.99) loneliness, (-3.62, 1.74) school attachment, and (-4.52, 1.29) parent support.

**Table 2**

Bivariate Coefficients for Key Covariates with Wave 3 Outcomes (Odds Ratios Reported)

	<i>Diagnosed Depression</i>	<i>Self-Rated Health</i>		
Loneliness (Wave 1)	1.45 ***	1.48 ***		
Female	2.39 ***	1.45 ***		
High Depressive Symptoms (Wave 2)	2.23 ***	2.40 ***		
Average school attachment (W1-W2 avg)	0.73 ***	0.69 ***		
Average parent support (W1-W2 avg)	0.74 ***	0.77 ***		
<2 out nominations	0.88	1.18		
<2 in nominations	0.94	1.38 **		
Social isolate <sup>b</sup>	1.14	1.28		
<2 out-of-school nominations	0.84 *	1.16		
Diagnosed Depression		2.94 ***		
N	10564	10576		
			<i>High Cholesterol<sup>a</sup></i>	<i>High Blood Pressure<sup>a</sup></i>
Loneliness (Wave 1)	1.14 ***	1.17 ***	1.11 ***	
Female	1.09	1.03	0.97	
High Depressive Symptoms (Wave 2)	1.29 *	1.15	1.18 **	
Average school attachment (W1-W2 avg)	0.93	0.92 *	0.95 *	
Average parent support (W1-W2 avg)	0.87 **	0.88 **	1.00	
<2 out nominations	1.21	1.12	1.08	
<2 in nominations	1.41 ***	1.21	1.47 ***	
Social isolate <sup>b</sup>	1.44 *	1.28	1.26 **	
<2 out-of-school nominations	0.87	0.93	1.01	
Diagnosed Depression	1.92 ***	2.45 ***	1.10	
N	10560	10567	8595	

\*  
p <.05\*\*  
p <0.01

P&lt;0.001

<sup>a</sup>Superscript denotes diagnosed condition<sup>b</sup>Social isolate is defined as having less than 2 friend in or out-nominations

Table 3

Exponentiated Logistic Regression Coefficients (Odds-Ratios) for Select Coefficients for Diagnosed Depression (N=10,564) and Fair or Poor Self-Rated Health (N=10,576).<sup>a</sup>

Model/Variable	Model 1		Model 2		Model 3		Model 4	
	OR	CI	OR	CI	OR	CI	OR	CI
<i>Diagnosed Depression<sup>b</sup></i>								
Female	2.30	(1.98, 2.65) <sup>e</sup>	2.22	(1.92, 2.56) <sup>e</sup>	2.20	(1.86, 2.56) <sup>e</sup>		
Loneliness (Wave 1)	1.42	(1.35, 1.50) <sup>e</sup>	1.34	(1.26, 1.42) <sup>e</sup>	1.25	(1.14, 1.42) <sup>e</sup>		
High Depressive Symptoms (Wave 2)			1.73	(1.45, 2.06) <sup>e</sup>	1.67	(1.39, 2.02) <sup>e</sup>		
No Out Nominations					0.88	(0.70, 1.11)		
No In Nominations					0.87	(0.68, 1.14)		
Social isolate					1.74	(1.15, 2.57) <sup>d</sup>		
No Outside of School Nominations					1.01	(0.86, 1.18)		
School Attachment					0.93	(0.87, 1.02)		
Parent Support					0.87	(0.80, 0.94) <sup>e</sup>		
Female × Loneliness					1.01	(0.87, 1.13)		
Loneliness × Parent Support					1.07	(1.02, 1.13) <sup>c</sup>		
Loneliness × School Attachment					0.96	(0.91, 1.00)		
Diagnosed Depression (Wave 3)								
<i>Self-Rated Fair or Poor Health</i>								
Female	1.24	(1.04, 1.48) <sup>c</sup>	1.21	(1.01, 1.44) <sup>c</sup>	1.19	(0.99, 1.42)	1.11	(0.92, 1.33)
Loneliness (Wave 1)	1.38	(1.27, 1.49) <sup>e</sup>	1.31	(1.19, 1.44) <sup>e</sup>	1.12	(0.93, 1.34)	1.10	(0.92, 1.32)
High Depressive Symptoms (Wave 2)			1.57	(1.24, 1.99) <sup>e</sup>	1.47	(1.13, 1.83) <sup>d</sup>	1.41	(1.08, 1.75) <sup>d</sup>
No Out Nominations					1.01	(0.72, 1.27)	1.03	(0.74, 1.29)
No In Nominations					1.24	(0.97, 1.71)	1.27	(0.98, 1.76)
Social isolate					0.87	(0.51, 1.36)	0.82	(0.48, 1.26)
No Outside of School Nominations					1.31	(0.99, 1.55) <sup>c</sup>	1.31	(1.00, 1.55) <sup>c</sup>
School Attachment					0.81	(0.72, 0.93) <sup>e</sup>	0.82	(0.73, 0.94) <sup>e</sup>
Parent Support					0.89	(0.82, 1.00) <sup>c</sup>	0.91	(0.83, 1.01) <sup>c</sup>

Model/Variable	Model 1	Model 2	Model 3	Model 4
Female × Loneliness		1.21	(1.04, 1.43) <i>c</i>	1.18 (1.01, 1.40) <i>c</i>
Loneliness × Parent Support		1.08	(1.00, 1.16) <i>c</i>	1.08 (1.00, 1.15) <i>c</i>
Loneliness × School Attachment		1.03	(0.94, 1.10)	1.03 (0.95, 1.11)
Diagnosed Depression (Wave 3)				2.41 (1.88, 3.05) <i>e</i>

<sup>a</sup>Note all models control for race/ethnicity, age, parent education, parent income (logged), parent marital status, respondent nativity status, health insurance access, parent self-rated health, parent reported respondent health at W1, region of residence, binge drinking frequency, and regular smoking

<sup>b</sup>Note that there is no model 4 for diagnosed depression because diagnosed depression is a predictor in Model 4 for all other models

<sup>c</sup>denotes  $p < 0.05$

<sup>d</sup>denotes  $p < 0.01$

<sup>e</sup>denotes  $p < 0.001$

**Table 4**

Exponentiated Logistic Regression Coefficients (Odds-Ratios) for Select Coefficients for Diagnosed High Cholesterol (N=10,560), Diagnosed High Blood Pressure (N=10,567), and Overweight or Obesity (N=8,595).<sup>a</sup>

Model/Variable	Model 1		Model 2		Model 3		Model 4	
	OR	CI	OR	CI	OR	CI	OR	CI
<i>Diagnosed High Cholesterol</i>								
Female	1.08	(0.91, 1.27)	1.07	(0.90, 1.26)	1.08	(0.91, 1.29)	1.03	(0.87, 1.24)
Loneliness (Wave 1)	1.11	(1.03, 1.20) <sup>c</sup>	1.09	(1.01, 1.19) <sup>b</sup>	1.02	(0.90, 1.20)	1.01	(0.89, 1.19)
High Depressive Symptoms (Wave 2)			1.18	(0.93, 1.49)	1.18	(0.94, 1.54)	1.14	(0.90, 1.48)
No Out Nominations					1.09	(0.86, 1.47)	1.10	(0.87, 1.48)
No In Nominations					1.40	(0.96, 2.05)	1.42	(0.96, 2.07)
Social isolate					0.97	(0.54, 1.75)	0.94	(0.52, 1.70)
No Outside of School Nominations					0.93	(0.73, 1.17)	0.94	(0.74, 1.18)
School A ttachment					1.05	(0.95, 1.19)	1.06	(0.96, 1.20)
Parent Support					0.94	(0.85, 1.05)	0.94	(0.86, 1.06)
Female × Loneliness					1.05	(0.86, 1.26)	1.04	(0.85, 1.24)
Loneliness × Parent Support					1.00	(0.95, 1.06)	1.00	(0.94, 1.06)
Loneliness × School Attachment					0.96	(0.90, 1.03)	0.97	(0.90, 1.04)
Diagnosed Depression (Wave 3)							1.81	(1.41, 2.36) <sup>d</sup>
<i>Diagnosed High Blood Pressure</i>								
Female	0.95	(0.81, 1.13)	0.95	(0.81, 1.13)	0.94	(0.79, 1.11)	0.87	(0.72, 1.03)
Loneliness (Wave 1)	1.12	(1.02, 1.23) <sup>b</sup>	1.13	(1.03, 1.24) <sup>b</sup>	1.05	(0.91, 1.20)	1.04	(0.89, 1.18)
High Depressive Symptoms (Wave 2)			0.95	(0.76, 1.18)	0.94	(0.77, 1.23)	0.89	(0.72, 1.17)
No Out Nominations					0.94	(0.71, 1.15)	0.95	(0.71, 1.17)
No In Nominations					1.04	(0.75, 1.48)	1.05	(0.75, 1.51)
Social is olate					1.20	(0.69, 2.11)	1.14	(0.65, 1.99)
No Outside of School Nominations					0.96	(0.82, 1.19)	0.96	(0.82, 1.19)
School A ttachment					1.03	(0.93, 1.12)	1.04	(0.94, 1.13)
Parent Support					0.93	(0.83, 1.03)	0.94	(0.84, 1.04)
Female × Loneliness					1.10	(0.91, 1.27)	1.07	(0.90, 1.25)
Loneliness × Parent Support					1.02	(0.96, 1.09)	1.01	(0.95, 1.08)

Model/Variable	Model 1	Model 2	Model 3	Model 4
Loneliness × School Attachment			0.99 (0.92, 1.06)	1.00 (0.93, 1.07)
Diagnosed Depression (Wave 3)				2.46 (2.00, 3.16) <sup>d</sup>
<i>Overweight or Obese</i>				
Female	0.92 (0.81, 1.03)	0.92 (0.81, 1.03)	0.96 (0.84, 1.08)	0.95 (0.84, 1.07)
Loneliness (Wave 1)	1.06 (1.01, 1.11) <sup>b</sup>	1.05 (1.00, 1.11)	0.99 (0.90, 1.08)	0.98 (0.90, 1.08)
High Depressive Symptoms (Wave 2)		1.03 (0.90, 1.19)	1.05 (0.89, 1.20)	1.05 (0.89, 1.20)
No Out Nominations			0.96 (0.79, 1.13)	0.96 (0.79, 1.14)
No In Nominations			1.48 (1.24, 1.72) <sup>d</sup>	1.48 (1.24, 1.72) <sup>d</sup>
Social isolate			0.87 (0.70, 1.19)	0.87 (0.70, 1.18)
No Outside of School Nominations			1.04 (0.92, 1.13)	1.04 (0.92, 1.13)
School Attachment			1.02 (0.97, 1.07)	1.02 (0.97, 1.07)
Parent Support			1.08 (1.01, 1.14) <sup>b</sup>	1.08 (1.02, 1.14) <sup>b</sup>
Female × Loneliness			1.18 (1.04, 1.31) <sup>c</sup>	1.17 (1.04, 1.31) <sup>c</sup>
Loneliness × Parent Support			1.01 (0.97, 1.05)	1.01 (0.97, 1.05)
Loneliness × School Attachment			1.02 (0.98, 1.05)	1.02 (0.98, 1.05)
Diagnosed Depression (Wave 3)				1.12 (0.95, 1.29)

<sup>a</sup>Note all models control for race/ethnicity, age, parent education, parent income (logged), parent marital status, respondent nativity status, health insurance access, parent self-rated health, average respondent self-rated health, region of residence, binge drinking frequency, and regular smoking.

<sup>b</sup>denotes p<0.05;

<sup>c</sup>denotes p<0.01;

<sup>d</sup>denotes p<0.01;