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Adolescent Sex and Subsequent Mental Health: How Sex Affects Adolescent Depression and Self-Esteem

Ann Meier

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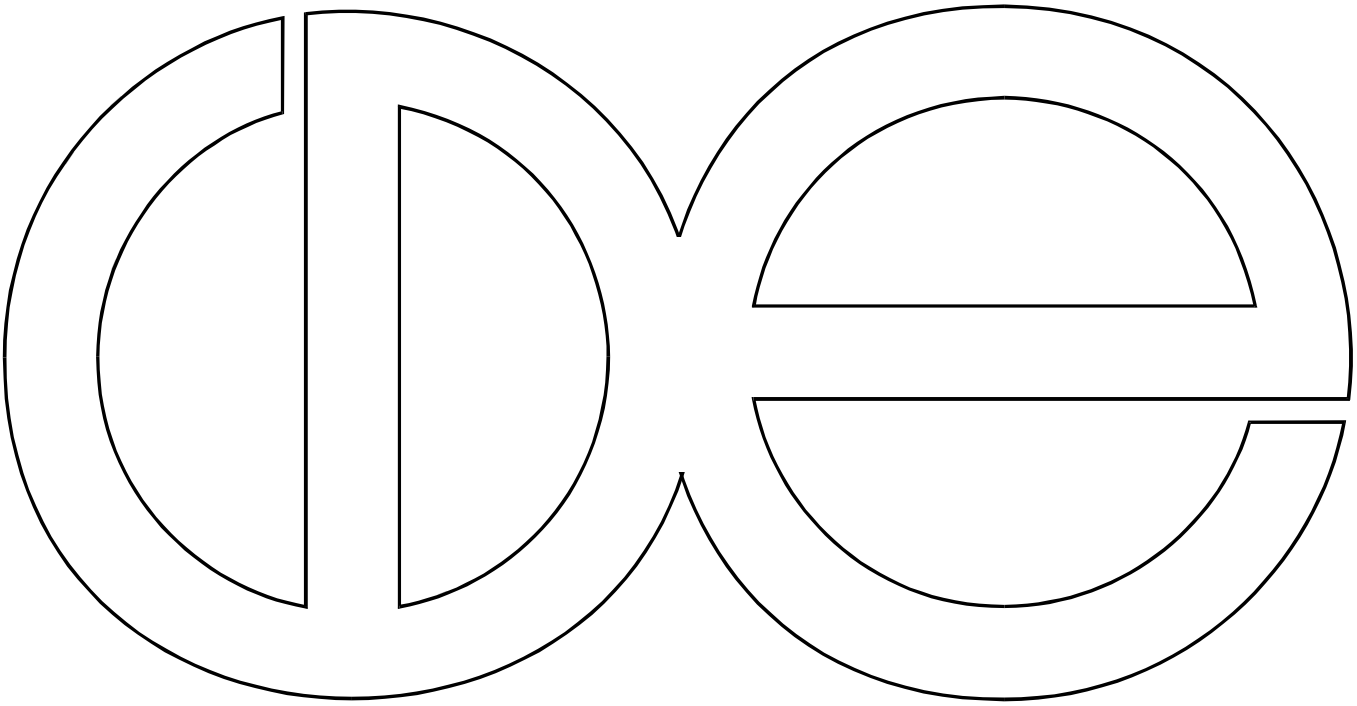

ADOLESCENTS' FIRST SEX AND SUBSEQUENT MENTAL HEALTH:

How Sex Affects Adolescent Depression and Self Esteem

By: Ann Meier

Department of Sociology
University of Wisconsin-Madison

*Communication about this article can be sent to the author listed above at: 1180 Observatory Drive, Madison, WI 53706 (ameier@ssc.wisc.edu). This research is supported by a traineeship in the Center for Demography and Ecology at the University of Wisconsin-Madison. I thank Gary Sandefur, Betty Thomson, Larry Bumpass, Jeffrey Smith, Larry Wu, Steven Durlauf, Jeremy Freese and John DeLamater for comments on this paper. I thank Chuck Halaby for helping me first understand propensity score matching and its value for estimating causal effects.

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INTRODUCTION

Until recently, the average age at which young people began having sex had steadily decreased. Now, most American adolescents report that they have had sex by they time they graduate from high school (Singh and Darroch 1999). Naturally, this trend has generated a good deal of policy, research and general public interest over the past several decades. The academic treatment of this issue has concentrated on determining what affects early sex among teens. This focus stems from the physical health consequences to which teens become exposed when they begin to have sex – teen births and sexually transmitted diseases. To be sure, these outcomes can be detrimental to adolescent well-being. Research aims to identify the antecedents so that prevention efforts can be implemented. Beyond the outcomes of teen pregnancy and STDs, there is little research on the effects of early sexual activity on other aspects of adolescent well-being.

Recent political treatment of the issue of teen sex has gone beyond addressing the physical consequences of teen sex. In 1996 Congress enacted a new abstinence education initiative as part of welfare reform legislation. The intent of this section of legislation is to teach a "just say no" message with regard to sexual activity outside marriage, and to omit discussion of contraception for fear of contaminating the clarity of the message. One proposition of this initiative is that "sexual activity outside of the context of marriage is likely to have harmful psychological and physical effects" (Social Security Act, Title V, Section 510). The extant research supports the proposition that teen sex exposes

adolescents to pregnancy and STDs, and that these physical health outcomes should be considered "harmful" among adolescents. However, there is little empirical evidence on the psychological effects of teen sex. As is often the case, political claims precede empirical evidence.

The present study investigates whether or not sexual activity, more specifically, first intercourse, leads to changes in mental health as measured by depression and self-esteem. This study makes two important contributions to the study of adolescent sex. First, while most research examines what affects whether or not young people have sex, this study focuses on what beginning sexual activity does to change the well being of adolescents. My particular contribution in this regard is a test of the assertion that sex has negative psychological or mental health consequences – an assertion that has yet to be verified or rejected. Second, investigating causal questions on this topic is inhibited by self-selection into sexual activity. The research literature shows that individuals' decisions to have sex are based on a large number of factors. This makes disentangling cause and effect from issues of selection based on these factors especially difficult. This study uses nationally representative prospective data and several uniquely appropriate techniques to address selection into sexual activity.

BACKGROUND AND SIGNIFICANCE

Adolescence, with its many changes, has long been considered a turbulent life stage. Depression and self-esteem are among the most-studied mental health outcomes for adolescents because of several of their unique characteristics during this particular life stage. First, large increases in the prevalence of depression and smaller decreases in self-esteem coincide with the onset of adolescence (Reynolds and Johnston 1994; Alsaker and

Olweus 1992). Second, a gender cross-over for depression occurs in adolescence such that boys have a higher prevalence of the condition in childhood, whereas girls surpass boys in early adolescence, and the difference remains throughout adulthood (Nolen-Hoeksema 1987; Brooks-Gunn and Warren 1989; Hankin et al. 1998). Similarly, girls report lower levels of self-esteem than boys in adolescence (Alsaker and Olweus 1992). Finally, adolescence is a time with many developmental and social changes (e.g., beginning sexual activity), and these changes are often implicated in the initiation and recurrence of depression and in the instability of self-esteem (Rosenberg 1965; Simmons, Rosenberg and Rosenberg 1973; Alsaker and Olweus 1992). Thus, disentangling the developmental and social processes of this period as they relate to depression and self-esteem becomes a key research initiative.

To date, most of the literature on teen sex conceptualizes it as a negative or deviant behavior. As noted by Risman and Schwartz (2002), "…it is the presumption of nearly all the scientific literature that teen sex is necessarily bad." Teen sex is often coupled with alcohol use, drug use, vandalism or violence in research about teen deviant behavior and its correlates (Barber 1992; Resnick et al. 1997; Furstenberg 2000). The conceptualization of teen sex as negative is motivated by a concern about the physical health outcomes of pregnancy and STDs to which teens become exposed when they begin having sex. As noted above, we know little of the existence of non-physical consequences of teen sex. While having sex may be more dangerous for young people than it is for adults, society expects that at some point in their lives, people will, and even should be having sex (Alan Guttmacher Institute 1994).

Sex is a normal part of the developmental life course. In their review of human

sexual development, DeLamater and Friedrich (2002) detail the biological development that adolescents experience as they develop sexually. They note that between the ages of 10 and 14 increases in the level of sex hormones promote sexual attraction, fantasies and the possibility of sexual interaction. However, social factors interact with biology to facilitate, or more commonly, inhibit sexual expression at these early-adolescent ages. In addition to biological development, adolescence is a time of several other developmental tasks including identity development and gaining competency in intimate relationships with others (DeLamater and Friedrich 2002). Two important parts of identity formation are developing one's sexual identity (whether heterosexual, homosexual or bisexual) and assessing one's sexual attractiveness to others. With regard to gaining competence in intimate relationships, Thompson (1995) notes that some of the girls she interviewed for her qualitative study on adolescent sex, romance and pregnancy explicitly voiced the desire to gain romantic and sexual experience as the next step to socially preparing them for life after high school. She noted that these girls treat romance and sex as developmental assignments or tasks to complete prior to college. Thus, sexual behavior can serve important biological and social developmental purposes.

While sex is more often treated as a problem behavior than a stage in the developmental process, the degree of this divergent treatment is different for boys and girls. Tolman (2002) notes that the standards of acceptability for sexual interest are much more permissive for adolescent males than for females. Sexual interest among male adolescents is considered natural, while the same interest among female adolescents is considered promiscuous and a cause for concern. In addition, social standards of acceptability and physical sexual development are age-graded. Thus, sex becomes more

socially acceptable and adolescents become more physically prepared as they age. Of course many adolescents are neither socially nor physically prepared for sex while in their teens. Still, other adolescents may be prepared in both domains.

Among adults, having sex is often associated with many positive factors: intimacy, bonding, shared pleasure, and the potential to create new life. Under the most traditional norms, marriage marks the point at which sex becomes appropriate and expected. Evolving norms may accept cohabitation or mutually monogamous relationships as appropriate contexts for sexual activity (U.S. Surgeon General, 2001). DeLamater and Friedrich (2002) note two important trends that are, in part, responsible for current levels of adolescent sexual intercourse. First, age at menarche for girls has been on the decline since the turn of the twentieth century – now it stands at about 12.5 years. At the same time, the age at first marriage has been rising – now it stands at about 25 for women and 27 for men. These divergent trends result in an increasing gap between the age at which adolescents are biologically ready to have sex and the age at which previous social convention deemed it acceptable. As social behavior is more malleable than biology, many young people resolve this inconsistency by having sex before marriage, and while still teenagers. Decades ago, adolescents may have assessed their future and observed a very short time horizon to marriage. Thus, they may have decided to wait to have sex. Today, adolescents observe a much longer time horizon to marriage, one that is perhaps equal to the number of years they have already lived. Thus, today's adolescents may decide that to wait is unreasonable. Indeed, Rogers and colleagues (2002) suggest that perhaps we, as a society, have over-emphasized the irrationality of adolescent sexual activity. Given the perspective of adolescents, starting

their sexual lives could be based in rational decision-making.

Some adolescents may share in the benefits of sex that are experienced by adults. However, the sexual experiences of adolescents are uniquely colored by their developmental stage and the context of their sexual partner relationships that are generally less stable than those of adults. In addition, sex may serve different developmental purposes for boys than it does for girls. Sex may be stressful for adolescents who are not physically or socially ready – those especially young or in unstable relationships.

Adolescent Mental Health and Sexual Activity

Several lines of research suggest causal connections between adolescent sexual activity and subsequent depression and self-esteem. First, a growing literature on stressful life events and adolescent mental health portends an important association between first sex and subsequent depression and self-esteem (Compas 1987; Compas, Orosan and Grant 1993; Compas et al. 1989; Ge et al. 1994). Second, early work by Simmons and colleagues (1973 and 1979) and recent work by Joyner and Udry (2000) indicates that adolescent romantic relationships affect self-esteem (Simmons et al.) and depression (Joyner and Udry). As sex is sometimes part of adolescent romantic relationships, it is possible that sexual activity may be independently related to depression and self-esteem. Simmons et al. (1979) find that involvement in romantic relationships leads to lower self-esteem, especially for girls. Joyner and Udry (2000) find that those who become involved in romantic relationships experience a larger increase in depression than their counterparts who do not. Again, the increase is greatest among females.

Finally, Wheaton (1990) examines the degree to which the effects of life events

on depression are conditioned on the context in which they occur. For example, divorce may be a less stressful event in the context of a horrible marriage than in a decent or good marriage. The idea of context-conditioned events allows the possibility that sex has negative mental health consequences for some adolescents, under some conditions. However, for other adolescents, sex may be better conceptualized as a stage in the normal developmental process of becoming an adult. The present article extends these three lines of research, which are discussed further below, to hypothesize that the onset of sexual activity may affect depression, especially for some individuals within specific relationship contexts.

Compas' work on stress and life events reviews the many cross-sectional studies that establish an association between stressful events and mental health. Relatively fewer, but more recent, longitudinal studies show that stressful events of both major and minor magnitude cause an increase in depression (e.g., Ge et al. 1994) or a decrease in self-esteem (e.g., Alsaker and Olweus 1992). Compas and colleagues (1993) outline three categories of stressors in adolescence: generic or normative, severe acute and severe chronic. First, generic stress is part of the ongoing developmental process of adolescence. Generic stress includes daily stresses and hassles as well as more major events such as moving to junior high school. Studies have found the relationship between these stressors and various measures of mental health to be quite modest (see Aneshensel 1992). In fact, some generic stressors, such as moving from junior to senior high school, may be positive for some adolescents, especially to the extent that graduating from junior to senior high is a desired change that may make life easier or happier. Generic stressors are likely to be events that are part of the normal developmental process of growing up.

The second category of stressors is labeled severe acute stress. This develops because of major or traumatic events in the life of an adolescent. Examples of severe acute stress include loss of a loved one, parental divorce or serious injury. The major characteristics of these types of stressors are that they have a discrete onset and affect only a small portion of adolescents. In general, they also disrupt the adolescent's ongoing world in a significant way (see Avison and McAlpine 1992 and Turner and Lloyd 1995 for examples). Most severe acute stressors are negative experiences for adolescents.

The final type of stress, severe chronic stress, is a part of an adolescents' ongoing environment. General examples of this type of stress include exposure to poverty, violence, racism, sexism and parental psychopathology. This type of stress is sometimes referred to as social structural stress because it often results in part from one's low or isolated position in the social organization of society (Aneshensel 1992, Aneshensel and Sucoff 1996). Again, chronic stress is almost exclusively a negative experience.

Within this schema of stress types, the onset of sexual activity seems to fall somewhere between generic stress and severe acute stress. Like generic stress, first sex is part of a normal developmental process, at least for older adolescents. That is, most adolescents will have sex by the time they graduate from high school just as most adolescents will progress from junior to senior high school. Furthermore, sex is accepted and even expected for all individuals at some point in their lives. In this sense, first sex may be a positive generic stressor, or no stressor at all. However, having sex generally involves more individual choice than does graduating from junior to senior high school. While completing junior high and moving on to senior high school depends in part on a child's performance, an overwhelming majority of children will make this transition at

the same age-appropriate time. First sex has no official transition point and thus is a less structured and more discretionary behavior. This may make the transition more stressful as the individual becomes fully responsible for the choice to have sex.

There are also ways in which first sex is similar to a severe acute stressor. Like other severe acute stressors, first sex has a discrete onset. In addition, among younger adolescents, sexual activity is not normative and thus happens among only a small portion of their same-age peers. Moreover, for some adolescents and depending on its context, first sex may disrupt their ongoing world in a significant way. The work of Brim and Ryff (1980) on the effects of life events provides a bridge between situating first sex as a generic stressor or a severe acute stressor. They suggest that many biological and social events are age related and an anticipated part of development. These events can become problematic only when they fail to occur at the expected point in the life span or, conversely happen prior to the expected point. Consequently, for some adolescents first sex may simply be a generic stressor (and sometimes a positive stressor) while for others it may be a severe acute stressor (and a negative stressor). Effects of sex on mental health should be larger among those for whom first sex is a severe acute stressor.

As noted above, two important articles on romantic relationships and mental health further motivate the idea that sex may affect subsequent mental health – the work of Simmons and colleagues (1973 and 1979) and Joyner and Udry (2000) on romantic relationships and mental health. Simmons and colleagues (1979) explored the impact of changing schools, pubertal development and dating (generic stressors) on self-esteem in adolescence. The authors use adjusted mean change scores of self-esteem to assess the degree to which changes in schools, physical development and dating status cause a

change in self-esteem.[1] With regard to romantic relationships and net of pubertal development, the authors find that dating is negatively related to changes in self-esteem for girls, but had no significant effect on self-esteem among boys.

Joyner and Udry (2000) present a detailed analysis of the effects of romantic relationship involvement on adolescent depression using the National Longitudinal Study of Adolescent Health (the same data used for this project).[2] They discuss a body of research on the positive and negative mental health aspects of romantic relationships. On the positive side, romantic relationships often include passion, companionship, emotional intimacy and commitment (although these accompany adult relationships more often than adolescent relationships). On the negative side, adolescent romantic relationships may alter existing relationships with family and friends especially when the romantic partner is not approved by these groups. In addition, the emotional distress accompanying the often inevitable break up of adolescent relationships can invoke feelings of low self-worth and hopelessness.

The authors compare changes in depression for adolescents with and without romantic involvement between interview waves as well as those with continuous

[1] To calculate adjusted mean change scores, Simmons and colleagues subtract time one self-esteem from time two self esteem. They use this change as their dependent variable while using time one self-esteem as a covariate to control for the initial level of self-esteem. They do this because children with initially low self-esteem will have more room for improvement, while children with initially high levels will have more room to move downward. They then include changes in school, physical development and dating status as additional key covariates. The estimation strategy employed by Simmons and colleagues becomes problematic if there is a lot of measurement error in the time one self-esteem variable. The authors do not discuss the degree of measurement error in this variable.

[2] The present study differs from that of Joyner and Udry (2000) in several ways. First, their study examined the effect of romantic relationship involvement on adolescent depression. The present study investigates the effect of becoming sexually active on depression and self-esteem. While there is some overlap, the motivation for the present article is rooted more in concerns regarding adolescent sexual activity not romantic relationships. Second, this study investigates a second mental health outcome – self-esteem – that is not addressed by Joyner and Udry. Finally, the present study uses several different methodological techniques than those used by Joyner and Udry. The methodological techniques offer a new way to deal with issues of selection in estimating causal effects.

involvement through the first and second interviews. To measures changes in depression, Joyner and Udry use time two depression as their dependent variable and include time one depression as a control for initial level of depression. Romantic involvement is included as the key covariate. They find that those who initiate involvement between interviews have higher levels of subsequent depression than those who have never been romantically involved, but not significantly higher than those who have a history of romantic involvement prior to the first interview. In addition, the authors find that effects of first and continuous romantic involvement on depression are more severe for females than males, although still significant for males. While any involvement in a romantic relationship is their focus, the authors also include covariates for whether the respondent recently ended a relationship or had more than one romantic partner. Both of these indicators were associated with an increase in depression, but neither of these factors mediated the effects of romantic relationship involvement on depression. In sum, the authors find that romantic involvement especially increases the depression of younger females. Because sex is sometimes part of romantic relationships among adolescents, it may be associated with depression.

In addition to the aforementioned studies, there is qualitative research evidence that first sex is experienced very differently for males and females (Thompson 1995; Sprecher, Barbee and Schwartz 1995; Martin 1996). This evidence suggests that first sex is often a more negative experience for females. Using a sample of college-aged individuals, Sprecher and colleagues (1995) find that women are more likely than men to be both physically and psychologically disappointed and to feel guilt after their first sexual experience. In addition, while adolescents of both genders use sexual activity as

part of the identity formation process, they do so differently (Gilligan 1982; Thompson 1995). Adolescent females generally use acts of attachment for identity development, and thus, romantic relationships are a major context for identity development. In contrast, males generally use acts of separation for identity development. In a way, sexual activity serves to develop the sexual identity of males – heterosexual masculinity in most cases. However, when sexual activity is tied to romantic attachment, it challenges the separation tenet of identity development for males. Thus, sex outside of a romantic relationship is more likely to be a negative experience for females than males. In fact, sex outside of a romantic relationship may be a positive experience for adolescent males. For females, however, sex in a romantic relationship is likely to be a positive experience only as long as the relationship lasts. Because few adolescent romantic relationships last, it is more likely that first sex will lead to initial decreases in mental health for females than males.

With regard to age and from a life course perspective, empirical evidence suggests different effects for adolescents for whom first sex is "early" as opposed to "on-time." That is, we would expect those who have sex at particularly young ages to experience larger negative effects (Settersten and Hagestad 1996; Whitbeck, et al. 1999). This is in part because sex among younger adolescents is less normative (or expected) than it is among older adolescents. In addition, the bodies of younger adolescents may be less biologically prepared. Thus, factors of biological preparedness and social stigma may make first sex an event of greater magnitude, and thus more stressful for younger adolescents.

Wheaton's (1990) work contextualizes life events to determine the conditions under which different outcomes result. His analysis is unique from others in this area

because it examines the degree to which the context of life events minimizes or enhances their stressfulness. For example, using an adult sample and longitudinal data to control for temporal ordering, Wheaton finds that working women with a high level of previous marital problems experience less distress from divorce than do their counterparts with a low level of previous marital problems. Similarly, he finds that both men and women in high conflict dating relationships experience significantly less distress from a pre-marital break-up than those in low conflict relationships. Similar results hold with regard to the effect of job loss and retirement conditioned on work problems, widowhood conditioned on marital problems, and child home leaving conditioned on parenting problems. Wheaton's idea of context-conditioned effects can be applied to the experience of first sex as well. Perhaps first sex in a dating relationship is different than beginning one's sexual life in a non-dating, casual relationship.

Simmons and colleagues (1979) and Joyner and Udry (2000) show that individual characteristics such as age and gender condition the effect of romantic relationships on mental health, and Wheaton (1990) shows that the relationship context specific to the event is also important for the ways in which events impact mental health. Together these studies suggest that gender, age and relationship context are important factors that may condition the impact of first sex on depression.[3]

By joining the life events-mental health literature with the romantic relationship-

[3] There are many other possible factors that may condition the effects of first sex on mental health. However, according to the literature, it appears that gender, age and relationship status are the most salient factors for which differential effects of first sex may result. I have examined some other possible conditioning factors including race/ethnic group membership and the simultaneous occurrence of other life changes (within the same year). There were no significant differences in the effects of sex by these other factors. A literal extension of Wheaton's work would suggest that romantic relationship quality, not just existence, should matter for how first sex affects mental health. The Add Health study contains information on physical and verbal abuse in romantic relationships, but not more general information on romantic

mental health literature and considering context-conditioned effects, this project examines the effects of the onset of sexual activity on two indicators of mental health, depression and self-esteem. Together these literatures suggest that in general, adolescents may experience modest increases in depression due to the initiation of sexual activity, but this may depend in part on gender, age and relationship context.

DATA AND MEASURES

Data

My analysis utilizes data from the National Longitudinal Study of Adolescent Health. Add Health is a school-based cluster sample of 7-12 graders that produced 20,745 respondents to an in-home interview in 1995. In 1996, the Add Health project attempted to re-interview all of the original respondents with a few exceptions.[4] This led to a sample of 14,738 adolescents, approximately 72 percent of those originally interviewed. These data are ideal for evaluating the potential causal effect of having sex on the proposed outcomes. The two waves of data collection one year apart allow me to isolate a sample of adolescents who were virgins at time one, some of whom had sex for the first time between interview waves and others who remained virgins. This allows me to establish the temporal ordering of mental health at time one, the occurrence of first sex, and mental health at time two.

This study examines only heterosexual intercourse which is defined as "when a male inserts his penis into a female's vagina." The questioning for same sex sexual intercourse is much less comprehensive. In addition, far fewer adolescents report same-

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relationship quality. There are too few cases to provide meaningful insight on adolescents who have first sex between interval waves and reported abuse in their romantic relationships.

[4] Those who were part of a disabled sample and those who where in 12th grade at time one and not part of a special genetic oversample were excluded from follow-up.

sex sexual intercourse. While this behavior may have important consequences for adolescent mental health, the scope of this study is limited to the more common sexual behavior between opposite sex partners. Further analysis should explore other types of sexual behavior.

The sample started with all adolescents who responded to both interview waves, 14,738 cases. The sample is reduced to 13,568 due to missing data on sample weights. Because the Add Health data is a clustered sample, it is necessary to use several measures to adjust for sampling design. Therefore, cases without the appropriate weights were dropped from the analysis (Chantala and Tabor 1999).[5] Next, several groups of adolescents were excluded from the sample – those who were over age 18 at time one (121) and those who were married (112) leaving a sample of 13,335. Those over the age of 18 at time one are excluded because the concern regarding early sexual activity is often focused on adolescents who are in their early- or mid-teenage years. Adolescents who experience their first sex over the age of 18 generate little attention. Many would argue that sexual behavior at this stage is age-appropriate. Similarly, there is even less interest in the sexual behavior of married adolescents. Sexual activity is universally accepted, and even expected in married relationships, regardless of age. Finally, 61 cases were dropped because of missing data on whether or not the respondent had first sex by time one or time two (leaving N=13,274). For these 61 cases, virginity status could not be determined. There are other cases for which there is partial data on virginity status and the treatment of these cases is discussed in Appendix A. Finally, only those who were

[5]There are several reasons for missing sample weights. First, if the case was not in the original sampling frame, but was added in the field, it does not have a weight. Second, if the case was selected as part of a pair (twins, half-siblings) and both were not interviewed, it does not have a weight. Finally, if the case did

virgins at time one are included in the analysis. This leaves a sample of 8,149 cases (see Appendix A for a full description of sample creation).

Measures

As described above, first sex is measured from adolescent responses to questions regarding sexual intercourse. First sex is identified by a dichotomous variable. Adolescents who have first sex in the interval between interviews are assigned a '1', while those who remain virgins are assigned a '0'.

Depression is measured using a modified depression scale from the Center for Epidemiological Studies (the scale is known as the CES-D). As noted by Avenevoli and Steinberg (2001), depression has been conceptualized in many different ways in the research literature. The measure employed for this study uses a set of symptoms indicative of a depressive syndrome. The CES-D is widely used among social scientists and performs well in tests of reliability and validity. The scale was originally developed for use with adults (Radloff 1977), but has since been validated in several different adolescent populations (Radloff 1991). The questions in the Add Health study exactly mirror those asked in the CES-D on 16 of the 20 original items. Four of the original items are not replicated in the Add Health study, and three re-worded items are added for a total of 19 items in the Add Health version of the CES-D (see Appendix A for the individual items). Each item has response options of 0 through 3 with a higher score indicating more frequent occurrence of depressive symptoms. Several positively worded items were reverse coded to maintain consistency in the direction of numeric responses. The scale has a high alpha reliability in the study sample (α= 0.86). The average level of depression

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not have a sample flag, it does not have a weight (Joyce Tabor, Add Health Data Manager, personal communication, January 17, 2003).

for my sample is about 10 with a standard deviation of approximately 7.[6] I treat depression as a continuous variable to estimate the effect of having sex on point increases in the depression scale which ranges from 0-57 in these data.[7]

Self-esteem is measured using six items from the Rosenberg self-esteem scale (Rosenberg 1965). The questions ask respondents to rate their level of agreement with various statements about their self-worth such as "I have a lot of good qualities" and "I have a lot to proud of." (see Appendix B for all statements). Each item has 5 category response options coded 0 through 4 with a higher score indicating more self-esteem. A principle components factor analysis confirms that these measures cluster into a reliable construct ($\alpha = 0.85$). The items are summed for a composite measures of self-esteem ranging from 0-24, and it is treated as a continuous measure.

Age is measured using indicators for three different age groups: 11-13; 14-16; 17-18. Age could be treated as a continuous variable, however, there are just eight categories for age in the analysis sample (and one category – age 11 – has just 10 cases). The three indicator measurement allows me to examine the experience of first sex for particularly young adolescents (11-13) as compared with those who are middle and older adolescents.

With respect to dating status, there are four indicators. "No dating" indicates that

[6] The distribution of the CES-D is right skewed. I transformed this measure to achieve a more normal distribution and ran all models with the transformed specification. Results did not differ from models with the original specification. For ease of interpretation, I show only models with the original specification.

[7] Some literature suggests using a threshold measure of depression may be appropriate (Shrier et al. 2001). Such a measure would address the question: does first sex launch a previously happy adolescent into a depressive state by some clinical standard? I have estimated the probability of crossing a point threshold on the CES-D that has been characterized as a reliable indicator of Major Depressive Disorder (MDD). However, I find the threshold measure somewhat arbitrary and highly sensitive to the point chosen. For example, choosing a point higher or a point lower can alter results. Also, there are very few adolescents who cross any specific one-point threshold between interview waves (about 4 percent of my sample).

the respondent was not in a romantic relationship at time one, time two, or at any point between the two waves. Thus, for these people, sex that happened in the interval was not in the context of a romantic relationship. "Dating up-take" indicates that the individual was not dating at time one, but started dating sometime between time one and time two and was still dating this individual at time two. For those in this category that experienced first sex in the interval between interviews, I cannot be sure that it occurred in the context of this new relationship, however it is likely that it did since initiating dating generally precedes having sex. "Dating, but broke up" indicates that the respondent was in a romantic relationship during the interval between times one and two, but he or she experienced a break-up. For these people, I cannot be sure whether those who had sex in the interval did so in the context of a romantic relationship. However, it is likely that any sex that occurred for these respondents was in the context of an unstable relationship if any relationship at all. "Dating and still together" indicates that the respondent was in a romantic relationship at time one and is still, and has consistently been, in a relationship with that same partner at time two. For these people, sex that happened in the interval was in the context of a romantic relationship and they remain in that relationship.

I include two other indicators of change in my analysis – whether or not the teen moved from junior to senior high school and whether or not they experience a change in family structure. These measures are included for several reasons. First, according to Simmons and colleagues (1973 and 1979) school progressions can be stressful, but they are generally considered generic stressors for the reasons cited above (e.g., Compas

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Therefore, I find it not very useful as an outcome variable. Future analysis will experiment with other treatments of the outcome variable.

1987). However, a change in family structure is a less universal event of more magnitude. It is generally considered a severe acute stressor with regard to mental health (Hetherington 1980; Wallerstein and Kelly 1980; Compas 1987).[8] Thus, according to the literature, these two events should be experienced as different types of stressors – generic and severe acute. Second, these are two events that a portion of my sample experiences over the one-year interval between interview waves. Including these two life event variables will allow me to better model the change in depression and compare the magnitude of their effects with that of first sex to determine the relative position of first sex in the schema of stress types.[9]

Finally, I include indicators for racial/ethnic group membership and family socio-economic status. With regard to racial and ethnic group membership, indicators for black, Hispanic, Asian and "other race" are included. There are too few adolescents who identified as American Indian to include as a separate group. "White" is used as a reference category in all multivariate analysis. Family SES is measured by mother's and father's highest education level (less than high school; high school graduate; some college; college graduate or more) and log of family income.

METHODS

One of the primary objectives of the following analytic strategy is to estimate the effect of first sex while more fully addressing issues of selection into sex that have plagued prior research. There are three possible parameters to estimate with regard to the

[8] A change in family structure means any change in the parental composition of the household, Most changes reported consisted of a parent moving out of a household, rather than one moving in. Experimentation with different definitions of this variable (to include just separation or divorce) did not change its effects.

[9] These life events were also tested in interactions with first sex to determine if multiple life changes in a short time span particularly affects mental health. No significant interactions were found, possibly due to the rare occurrence of these multiple events within one year.

effect of first sex on mental health:

$E(\Delta | St' = 1)$; (P-1)

the effect of sex on all teens who are non-virgins at the first interview;

$E(\Delta | St' = 0)$; (P-2)

the effect of sex on teens who are virgins at the first interview;

$E(\Delta | St' = 0, St = 1)$; (P-3)

the effect of sex on teens who are virgins at the first interview and non-virgins at the second interview

where Δ is the effect of sex on depression, S is whether or not the respondent had sex (1=yes; 0=no), t' is time one and t is time two. In this study, I am estimating P-3, the effect of sex on teens who are virgins at the first interview, and non-virgins at the second interview. In the experimental design literature, estimates of this parameter are often called the effect of "treatment on the treated." It is difficult to estimate the effect of sex for those who have already had it at the time of the first interview (P-1), because it is difficult to accurately account for selection-into-sex factors. Similarly, it is difficult to establish the causal ordering of sex and the mental health outcome of interest. For example, it may be that the association between sex in depression results from sex causing an increase or decrease in depression. However, it is equally possible that one's level of depression causes one to have sex in the first place. P-2 is an estimate of the effect of first sex for all time one virgins, whether or not they actually had sex. It is possible to estimate P-2 by estimating the effect of not having sex for those who did not

have it (effect of "non-treatment on the non-treated") and averaging this effect with that of the "treatment on the treated" to get the mean effect of having sex for all time one virgins. This analysis, however, is concerned with the effect of sex for those who actually had first sex in the interval between time one and time two. Thus, I estimate the parameter P-3 – the effect of the treatment on the treated.

In this study, I address a fundamental problem in studies attempting to estimate causal effects. The true effect of a cause is calculated as follows:

$$\text{Effect} = Y_{i1} - Y_{i0}$$

where Y_{i1} is the value of the outcome when unit *i* experiences condition 1 (first sex) and Y_{i0} is the value of the outcome when unit *i* experiences condition 0 (no sex). However, only one of these values can be observed for any one unit. That is, unit *i* cannot experience both first sex and sustained virginity at the same time. The unobservable or latent value is known as the counterfactual: the outcome one would observe if the unit had been exposed to the alternative condition. There are several solutions to this problem: 1) observing different units at the same time (as in an experiment) or observing the same unit at different times; and 2) balancing the "first sex" and "no sex" groups with regard to factors that influence both "first sex" and the outcome of interest. The latter solution must address the assumption of independence: that the outcome under the no sex condition, Y_{i0} is independent of "assignment" in the first sex or no sex group:

$$[Y_{i0} \perp S_i]$$

where S_i is "assignment" to a condition (sex, no sex) for unit *i* and $\perp$ represents independence. Experimental studies, with random assignment to treatment, are able to meet this assumption. Observational studies, with non-random assignment (or selection

into) the treatment, or in this case the behavior, are not able to meet this assumption without adjustment. The solutions described below help me to meet the independence assumption and estimate the effect of first sex on mental health even in the presence of the fundamental problem of causal inference.[10]

Regression with Lagged Endogenous Variable

First, to examine the effect of first sex on mental health, I use ordinary least squares models of depression and self-esteem at the second interview. These models account for adolescents' initial levels of mental health by including depression (for example) at the first interview as a covariate in the model. The inclusion of time one depression means that the remaining variables capture the change in depression. This model is preferred to a change score model where the dependent variable is time two depression minus time one depression for several reasons. Allison (1990) argues that a model with Z_2 as the dependent variable and Z_1 controlled is preferable to a change score model under two conditions – when Z_1 has a true causal effect on Z_2 and when the values of X (treatment) are determined, in part, by the period-specific components of Z_1 (p. 107). The second condition is in place in my analysis. That is, the period-specific component of depression at time one is likely to affect whether or not the individual is in the treatment group (has first sex) (see Allison 1990, p. 109 for an example). Therefore, the lagged endogenous regression approach is best suited for this study.

With time one depression controlled, I enter interaction terms between "had sex"

[10] Clearly, the event of first sex cannot be submitted to an experiment to determine its effects. Where experimental language is used in this paper, it is meant to clearly delineate the solutions employed herein to reconcile the problem of causal inference. These solutions have not been widely applied in sociology, and thus the language developed to express them comes from the language of experiments. The use of this language is not meant to suggest that this very important behavior of first sex be thought of in terms of an experiment.

and several theoretically important individual and context level variables where the literature suggests differing effects. A variable indicating whether or not the event occurred for the individual is entered into a regression equation as the primary covariate. Interaction terms can be useful to identify various groups who experience the event of interest differently. The prior literature discussed above suggests that gender, age and relationship context may condition the effect of first sex on mental health. This model is specified as:

$$Z_{i2} = \alpha Z_{i1} + \delta X_i + \beta W_{i1} + \phi(X_i * W_{i1}) + \varepsilon_i$$

where Z_{i2} is depression at time two for unit *i*, α is the effect of depression at time one, δ is the treatment effect (had sex or not), β is the effect of stable characteristics which are believed to have non-constant effects (e.g., gender); ϕ is the interaction effect of treatment with the aforementioned stable characteristics; and ε is the disturbance term. Note that the X * W interactions represent two-way and three-way interactions where appropriate (i.e., had sex * gender * age group).

As mentioned above, oftentimes stable characteristics such as gender and age have effects that operate solely through their effects on the time one measure of the outcome, so there may be no benefit of including them as covariates. By including them, I am testing the degree to which teens of particular attributes (e.g., females) or in particular contexts (e.g., a relationship that broke-up) experience different trajectories in depression or self-esteem in this one-year interval. The empirical evidence for differing changes in depression and self-esteem by gender, age and relationship context motivates the inclusion of these characteristics in the model. In addition, the inclusion of the two additional life event variables – moving from junior to senior high school (generic

stressor) and experiencing a change in family structure (severe acute stressor) – facilitates comparisons of their effects with the effect of first sex to see how sex fits in the typology of stressors discussed above.

Propensity Score Matching

Next, I estimate the causal effect of first sex using propensity score matching. Traditionally, researchers have tried to estimate causal effects by conditioning the outcomes on a few key characteristics that are suspected to have influenced whether or not the event occurred (i.e., characteristics that are likely to violate the independence assumption, $[Y_{i0} \perp S_i]$). This method, when compared with results from actual experiments, has been shown to be largely ineffective (Lalonde 1986; Dehejia and Wahba 1999, Smith and Todd 2002). However, a propensity score method of matching has yielded better results in some cases (Rosenbaum and Rubin 1984; Dehejia and Wahba 1999, Smith and Todd 2002). According to Smith (1997), matching is best suited when the treatment event is relatively rare in a sample. In my sample of virgins, approximately 15 percent experienced first sex in the interval. This could be considered a relatively rare event. Matching can be a robust method for reducing bias in estimates due to differences in observed pre-event variables (Rosenbaum and Rubin 1984). However, the primary assumption of propensity score matching is that differences between the two groups depends largely on observable characteristics included in the propensity score estimation. The value of matching as an estimator depends on the degree to which this assumption can be supported.

The Add Health dataset contains a rich set of variables that the literature suggests affect the decision to have sex and may also affect depression. Prior research suggests

variables that should be included in this model: individual characteristics (gender, age, physical development, race, weight, grade point average, intelligence), family characteristics (family structure, parental education, family income, parent-child relationship quality), mental health (time one depression and self-esteem), attitudes and values (religiosity, virginity pledge, ideal relationship behavior), risk taking behavior (impulsivity, night out without permission) and relationships status at time one (not dating, dating). These variables are all used to estimate the probability of having sex by the time two interview. All variables included in the propensity score estimation are measured at time one, prior to the event of interest. Appendix C describes more fully how the propensity score is generated and how the matching process is conducted.

To proceed with matching, I specify a caliper – a probability distance that requires the matched "no sex" respondent be within the specified distance of the "had sex" respondent to which he or she is matched. After testing several calipers, I use 0.01 for this analysis.[11] Propensity score matching pairs to each "had sex" adolescent one comparable "no sex" adolescent and associates to the outcome of the "had sex" adolescent, the outcomes of his/her neighbor in the comparison group. This yields the estimate of the overall average effect of first sex on mental health. The propensity score matched estimates can be used as a check on the more traditionally derived regression estimates.

RESULTS

Table 1 shows descriptive statistics for key analysis variables. Approximately 15 percent of time one virgins had first sex in the one-year interval between interviews. In

aggregate means, time one and time two depression and self-esteem are virtually the same. These univariate statistics may mask differences between the depression and self-esteem levels of those who had sex and those who did not.

Approximately half of the sample is female and the mean sample age is 14.5 at time one. About 30 percent of adolescents are in the youngest age group used in this analysis (11-13), while nearly 60 percent are in the middle group (14-16) and 12 percent are among the oldest adolescents studied (17-18). Forty-one percent of the sample was not dating at time one, time two or any point between; 17 percent were not dating at time one, but started dating before time two and were still with that partner; 35 percent experienced a relationship break-up between time one and time two; and 7 percent dated the same person consistently from time one through time two. With regard to the other two change variables included, 9 percent experienced a change in family structure between waves and 18 percent graduated from junior to senior high school.

The sample is fairly diverse with 10 percent of respondents who are black, 12 percent Hispanic, 5 percent Asian and 2 percent of other races. The remaining majority of adolescents, 72 percent, are white. Several family socio-economic status variables are used as controls in the models. In terms of highest education achieved by respondents' mothers, 16 percent did not graduate from high school; 31 percent achieved high school graduation; 27 percent went on to some college; and 25 percent earned an undergraduate degree or more. Among fathers, the distribution of highest education attained is as follows: 26 percent completed less than a high school degree; 30 percent earned a high school diploma; 15 percent attended some college; and 29 percent earned an

[11] Using a caliper of 0.01 causes me to lose just 4 cases for the propensity score matching analysis in the full sample of 8149. That is, there were only 4 "had sex" cases for which I was unable to find a

undergraduate degree or more. The mean log of family income is 3.61 which, when transformed, is about $37,000 in 1995 dollars.[12]

<Table 1 about here>

Table 2 gives a more detailed look at depression and self-esteem in the analysis sample. This table shows the mean levels of depression and self-esteem by gender and age. The first panel gives statistics for females. We see that mean scores on the CES-D scale increase with age and the mean self-esteem levels decrease with age until age 15, at which time they appear to level out. The second panel shows a similar pattern, but at different levels for males. Mean CES-D scores increase with each year of age, but the overall mean levels of CES-D are lower at every age than they are for females. Similarly, self-esteem scores decrease with every year of age for males. The decline in self-esteem does not level off for males as it does for females, but again, the absolute level of mean self-esteem is higher for males than females at every year of age.

Table 2 is consistent with most of the prior literature on adolescent depression and self-esteem. However, I do not replicate the gender cross-over in depression as reported in many other studies. If there were a cross-over, I would see lower levels of depressive symptoms for females than males in the very youngest ages (those <=12) and higher levels of depressive symptoms for females than males at the older ages. Instead, Table 2 shows higher levels of depressive symptoms for females at all ages. Most of the literature suggests the crossover happens in early adolescence – about age 13, and a review of the cross-over findings indicates that the age at cross-over may be declining over time

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comparison case within 0.01 propensity score points.

[12] There are a substantial number of missing cases for father's education (5%) and family income (22%). These statistics and the multivariate analysis use mean substitution based on cases where data is not

(Petersen et al. 1991; Nolen-Hoeksema 1987; Brooks-Gunn and Warren 1989; Hankin et al. 1998). If the cross-over is happening at progressively younger ages, it may appear here if data were collected from even younger respondents. However, the patterns of higher levels of depression and lower levels of self-esteem among females as well as the trajectory of both measures of mental health are consistent with general findings in the adolescent mental health literature.

<Insert Table 2 here>

Table 3 shows the baseline effect of first sex on subsequent depression and self-esteem as estimated by regression and propensity score matched models. This table gives the first look at the effects of first sex on the outcomes and how they differ by modeling strategy. Recall that in regression models with the time one measure of the outcome variable included as a covariate, all observed and unobserved stable pre-sex differences between those who had sex and those who did not are absorbed in the coefficient of the time one measure of the outcome (depression, for example). In Model 1, we see the result of this estimation. By the regression model, having first sex has a significant effect on depression; those who had first sex between waves experience a one point (0.968) increase on the CES-D scale compared to those who did not, net of time one depression. Model 2 shows no significant effect of first sex on subsequent depression using the propensity score matching method. Similarly, the table shows significant effects of first sex on a decrease in self-esteem (0.265 points) via ordinary least squares regression methods, but no significant effects by the propensity score matching method.

Recall that the propensity score matching method has created a comparison group

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missing. For father's education, the modal category of high school graduate is used. For multivariate analysis, flag variables are included to indicate cases where mean substitution was used.

of those who did not have sex that is very similar to those who did have sex on 25 pre-sex factors. By this initial comparison of methods, it appears that the propensity score method, by creating a nearly identical comparison group, is eliminating the effect of selection factors. Still, the significant effects of first sex that are produced by the regression models deserve further attention. Perhaps when more precisely specified, the models will produce results that will be replicated with the propensity score matching method.

<Table 3 about here>

Next, I investigate the context-specific effects of first sex on depression. Table 4 shows a hierarchical series of models that explores the possible differences in the effect of first sex on subsequent depression based on the context of the event. The models all include variables for first sex, time one depression and characteristics that are expected to have non-constant effects: gender, age group, relationship status, race and other life change variables (family structure change and graduating from junior to senior high school) and family SES variables.

Model 1 shows that having first sex is associated with an increase in depression even when other variables are included in the model. Here we see that having first sex leads to a small (2/3 of a point), but significant increase on the CES-D scale. Consistent with the literature on gender and age differentials in depression during adolescence, being female is associated with an increase in depression and being younger is associated with a decrease in depression. Of the relationship status variables, only being in a relationship that broke-up is significantly related to depression. Compared to whites, Hispanic and Asian adolescents are more likely to experience a greater increase in depression between

the two interview waves.

Model 1 also shows that experiencing a change in family structure is significantly related to an increase in depression, but graduating to senior high school is not. The effect of first sex on subsequent depression is similar in magnitude to the effect of experiencing a change in family structure (0.681 v. 0.808). This indicates that perhaps first sex may be considered a severe acute stressor. However, one should be cautious not to over-interpret this comparison because the effects measured in this analysis are initial effects, not sustained effects. It is likely that the effects of a change in family structure will persist over a longer period of time, while the effects of first sex will dissipate with time and further sexual experience. Of the family SES controls, only having a highly educated father (undergraduate degree or more) significantly impacted (decreased) depression.

To further test the differences in the effect of first sex for specific groups, I tested all first order interactions between first sex and the following variables: gender, age group and relationship status. Model 2 shows the result of the significant interaction between first sex and broke-up. This means that having first sex for those who broke-up leads to a 1.281 increase (1.024 + 0.257) on the depression scale which is about two-times the size of the effect of first sex for all adolescents in Model 1. This indicates that adolescents who had sex and experienced a relationship break-up are driving the overall effect of first sex shown in Model 1. It is also of interest that the main effect of first sex in Model 2, which is the effect of first sex for those who did not experience a relationship break-up is no longer significant. The effects of the other variables in the model do not change with the inclusion of the interaction term.

<Table 4 about here>

To further explore the significant effect of first sex for those who experience the dissolution of their romantic relationship, I tested the three way interactions between first sex, broke-up and gender and age group. Model 3 shows the result of the significant interaction between first sex, broke-up and female. Here we see that females who had sex and broke-up with their romantic partner experience a 2.389 increase (2.361 + -0.200 + -0.074 + 0.302) on the depression scale which is more than three times the size of the effect of first sex for all adolescents in Model 1. This indicates that adolescent females who had sex and experienced a relationship break-up are driving the overall effect of first sex in the earlier models. Also noteworthy is that the lower-order interaction for female*broke-up is not significant. This indicates that it is not simply a relationship dissolution that causes an increase in depression for girls. Rather, having sex increases depression, and especially so for girls whose relationship also dissolves. Finally, four-way interactions were tested to determine whether even more specific groups of adolescents for whom the effect of first sex was significant could be identified. However, higher order interactions were not significant. Thus, Table 4 shows that first sex increases depression for girls who also experienced a relationship break-up.

Figure 1 shows the predicted effect of sex on the change in depression for males and females who did or did not experience a relationship break-up (the effects are generated from the coefficients in Table 4, Model 3). This graph shows that it is not simply female adolescents who had sex that experienced an increase in depression; this would be the case if both female bars were equal in size. It is also not simply those who had sex and broke-up with their partner that experience an increase in depression; this

would be the case if both cross-hatched bars were equal in size. Instead, the figure shows that it is the combination of having first sex, being female and experiencing a relationship break-up that leads to the significant increase in depression. That is, the effect of first sex for females who had a relationship break-up far surpasses any other age or gender effect on subsequent depression.

<Figure 1 about here>

Next, I turn to the outcome of adolescent self-esteem. Does first sex affect self-esteem in the same way that it affects depression? Is the self-esteem of the same group of girls who experienced a relationship break-up especially affected? Table 5 investigates these questions by first examining the baseline effect of first sex on subsequent self-esteem net of initial level of self-esteem, gender, age, relationship status, race, other life events and family SES controls. Model 1 shows that net of these factors, having first sex leads to a relatively small, but significant decrease in self-esteem (about 1/3 of a point on a scale of 0-24). Being female, Hispanic, or Asian is also associated with a decrease in self-esteem. However, being black is associated with a half-point increase in self-esteem. With regard to dating status, those who never dated and those who dated but broke-up reported declines in self-esteem compared to those who dated throughout.

Model 2 further explores specific groups for whom first sex may have particularly negative effects on self-esteem. All interaction terms between first sex and gender, age and relationship status were entered into individual models. Model 2 reports the result of a significant interaction between first sex and the youngest age group. Adolescents age 11 to 13 who had sex experienced a one point decrease in self-esteem (-0.965 + -0.152 = -1.117). In addition, the coefficient on the main effect of had first sex (-0.152) is no

longer significant indicating that those who had sex but were not in this youngest age group experienced no significant change in self-esteem. The effects of most of the other variables in Model 2 remain similar in size and significance as in Model 1.

<Insert Table 5 here>

To further explore the significant effect of first sex for the youngest adolescents, I tested the three-way interactions between first sex, the youngest age group and gender and relationship status. Model 3 shows the result of the significant interaction between first sex, youngest age group and female. Here we see that particularly young adolescent females who have first sex experience a two point decrease in self-esteem (-1.935 + -0.164 + 0.018 + 0.132 = -1.949). This is more than six times the size of the effect of first sex on self-esteem for all adolescents in Model 1. This finding indicates that adolescent females who begin to have sex when they are particularly young (ages 11-13) are driving the overall effect of first sex on self-esteem in the earlier models. Again, four-way interactions were tested to see if even more specific groups of adolescents for whom the effect of first sex was significant could be identified. However, higher order interactions were not significant. Thus, Table 5 shows that first sex decreases the self-esteem of the youngest female adolescents.

Figure 2 shows the predicted effect of sex on the change in self-esteem for younger (11-13) and older (14-18) adolescent males and females (the effects are generated from the coefficients in Table 5, Model 3). This graph shows that it is not simply younger adolescents who had sex that experienced a decrease in self-esteem – if that were the case, both of the "younger" bars would be equally high. It is also not simply females who had sex that experience an decrease in self-esteem – if that were the

case, both cross-hatched bars would be equal in size. Instead, the graph shows that it is the combination of being an especially young female adolescent who begins to have sex that leads to a significant decrease in self-esteem.

<Figure 2 about here>

So far, this analysis has established negative mental health effects of first sex for adolescent females who are particularly young when they have first sex (self-esteem) or who are in a relationship that recently broke-up (depression). When these groups are identified, we see that the main effects of first sex drop out of significance indicating that in their respective models, the effects of sex on these specific groups drives the overall significant effect of sex seen in the baseline models of Tables 3 and 4. However, recall that the propensity score matching models found no significant overall effects of first sex on depression or self-esteem. Now that we have discovered the driving factors in the significant baseline effects of the regression models, perhaps we can revisit the propensity score matching models using the particular groups for whom we have identified significant interaction effects.

Table 6 reports the effect estimates for these specific groups via the regression and propensity score matching models. The effect estimates for the regression models are calculated from the coefficients in Model 3 of Tables 4 and 5. The effect estimates for the propensity score matching models are calculated using reduced samples of only females who experienced a relationship break-up for the depression outcome and only females in the youngest age group for the self-esteem outcome. When checked against one another, the effect of first sex estimates for both more specific groups are significant and similar in magnitude by both methods. This lends support to the finding that first sex

causes an increase in depression among girls who experience the dissolution of their romantic relationship and a decrease in self-esteem among especially young girls.

<Insert Table 6 here>

The effects reported in Table 6 indicate that for two groups of girls, first sex leads to decreases in mental health. For one group of girls, first sex leads to a two to two-and-a-half point increase in depression on the CES-D scale with a range from 0-57. For the other group of girls, first sex leads to a one-and-a-half to two-point decrease in self-esteem on a scale with a range of 0-24. While these increases are statistically significant, the substantive significance of effects of this size is not immediately clear. These results could mean that generally happy adolescent females who had sex and broke-up with their partner became slightly less happy (and only in the short term). Perhaps this is nothing to worry about. Similarly, young adolescent girls who have sex experience a decrease in self-esteem of nearly two points. These effects may not be large enough to cause concern. Is this a significant substantive issue, or is it simply a significant statistical issue?

One way to examine the substantive importance of these findings is to measure the magnitude of the change in depression and self-esteem against the standard deviations in depression and self-esteem in the sample. From Table 1, we know that the mean of depression is about 10 and the standard deviation is about 7. The mean of self-esteem is about 19 and the standard deviation is about 3.45. Figure 3 graphs the proportion of a standard deviation change that is implied by each of the effects on depression and self-esteem.

The figure shows that while statistically significant in the baseline regression models, the effect of first sex on depression and self-esteem is very small, about one-

tenth of a standard deviation in the respective outcomes (0.138 for depression, 0.032 for self-esteem). Furthermore, the effects were not statistically significant in the propensity score matched models where the effect on self-esteem was even in the unexpected direction. In general, a minimum of one-third of a standard deviation change may be considered substantively meaningful, and one-half of a standard deviation change is considered quite substantial (Rosenthal, Rosnow and Rubin 2000).

<Insert Figure 3 here>

When considering the effects of first sex on depression and self-esteem in the more nuanced groups, however, we see that more substantively (and statistically) significant effects are evident. First, the effect of first sex on subsequent depression for girls who experience a relationship break-up is equal to about one-third of the standard deviation of depression by both methods, although slightly larger by the regression method. Again, effects by both methods are statistically significant for this group of adolescents. Next, the effect of first sex on subsequent self-esteem for the youngest adolescent girls is even larger than the aforementioned effect on depression in terms of standard deviation in the outcome variables. Here, the effect of first sex on self-esteem is over half of a standard deviation in self-esteem by the regression method and about four-tenths of a standard deviation in self-esteem by the propensity score matching method. Again, effects on self-esteem by both methods are statistically significant for younger adolescent girls. Thus, while the baseline effects of first sex on depression and self-esteem for all adolescents are statistically significant, they are probably not very substantively meaningful. In contrast, the effects of first sex on depression and self-esteem for the specific groups of adolescent girls identified in this analysis are both

statistically and substantively meaningful.

DISCUSSION

In both the regression model with a lagged endogenous variable and the propensity score matched model, it appears that first sex can lead to increases in depression and decreases in self-esteem, but not among all adolescents. Having sex in a romantic relationship that dissolves or as a very young adolescent delivers a particularly strong blow to the mental health of girls. The gender distinction in these effects is not ignorable. Perhaps one source of the greater onset of depression among adolescent girls is tied to how they experience stressful events. This has been suggested in several studies, but starting sexual activity has neither been tested as a stressful life event for any adolescent, nor examined for a gender difference in its effects on mental health (Ge et al. 1994; Isakson and Jarvis 1999; Alsaker and Olweus 1992; Petersen et al. 1991; Compas et al. 1989; Nolen-Hoeksema and Girgus 1994).

This study examines the effects of first sex in conjunction with the effects of several other life events that are more commonly considered stressors: a move from junior to senior high school and a change in family structure. The former has been shown to be a stressor in some studies, but not in others. In our study, the move from junior to senior high school did not appear to have negative mental health effects. However a change in family structure had a significant effect on adolescent depression similar in size to the effect to first sex in the first Models in Tables 4 and 5. Perhaps first sex can be considered a severe acute stressor, much like that of a change in family structure, for some adolescents. In fact, the effect of first sex for girls whose relationships ended (2.389) was much larger than the effect of a change in family structure (0.808) for all

adolescents. However, this study is concerned with the effects and first sex and thus did not examine the conditional effects of a change in family structure. It is likely that there are specific groups for whom a change in family structure may be larger than the effects of first sex – perhaps the same groups for whom first sex is especially impacting. However, given the findings of this study regarding the importance of first sex, it appears that beginning sexual activity should be considered a stressful life event for adolescent girls, especially younger girls and those in particularly vulnerable romantic relationships.

In addition, socialization of young girls often emphasizes the importance of relationships while that of boys emphasizes individual achievement and independence (Gilligan 1982, Thompson 1995). If the relationships of adolescent females dissolve shortly after first sex, the effects of first sex are particularly devastating. Such devastation is not apparent for adolescent males. Of course most adolescent romantic relationships eventually dissolve. Does this mean that all adolescent girls who have sex will eventually suffer mental health consequences when their high school relationships dissolve? The scope of this study does not extend far enough to determine the longevity of the negative mental health effects for girls who break-up. In this study, if a relationship dissolved, it did so within less than a year of first sex. Both the event of first sex and the relationship break-up are relatively recent, and thus their effects are probably at their height. This study cannot show whether or not first sex has negative effects in relationships that dissolve after more than a year, or if the negative effects of first sex found in this study are sustained over time. However, the present study does suggest that among female adolescents, first sex has no significant negative mental health consequences in committed, long-term relationships among older adolescents.

Finally with respect to the gender distinction in effects, it is possible that adolescent females experience more negative mental health consequences because they are most vulnerable to the serious negative physical health consequences that can result from having sex. Perhaps the negative mental health consequences that accrue to adolescent girls who have sex stem from their serious concerns about pregnancy and sexually transmitted diseases.

Several caveats are in order. First, even with a rich and powerful data set like the Add Health study, when examining events conditioned on a number of factors with a sub-sample of the population (time one virgins), the number of cases for some specific combinations of conditions is uncomfortably small. Fortunately for this analysis, there are a substantial number of cases in the group of females who had sex and experienced a relationship dissolution (n=266) and of younger girls who had sex (n=90). However, there are other important conditions that had to be overlooked due to this constraint. For example, more detailed information on dating relationship quality is available, but the addition of this factor makes for even smaller groups.[13]

A second caveat relates to the duration of effects. While the study design, with two waves of data collection within the space of approximately one year, is very attractive for establishing causal connections, it precludes examination of the long-term effects of sex on depression and self-esteem. Strong effects may dissipate and weak effects may manifest themselves as stronger over time. It is likely that the effects of first sex dissipate over time as these effects are replaced or dampened by the effects of sustained or serial sexual relationships and the effects of other events in the lives of

young adults such as graduation from high school, entering the workforce, marriage and childbearing. This duration-since-event phenomenon is not unique to the effects of first sex, however. All events have initial effects that are subject to change over time.[14] The third wave of data collection for the Add Health study is currently underway and may allow for examination of this issue. However, as duration since first sex increases, so to do other possible intervening events that may influence mental health. Researchers examining these effects overtime will need to use care in modeling all possible intervening events.

A third caveat is with regard to the main independent variable of interest – first sex. Because this study attempts to model causal connections between sex and mental health, it is necessary to establish temporal ordering. The prospective nature of the Add Health dataset allows this to be done by identifying adolescents who are virgins at time one, some of whom have sex in the interval between interviews and others who do not. This allows the researcher to identify mental health before and after the event of interest. However, by taking advantage of this clean temporal ordering, the outcome measured must be first sex or beginning sexual activity rather than frequency of sex, number of partners, of any other measure of sustained sexual behavior. Thus, the results presented herein apply only to the effects of initiating one's sexual life, not the characteristics of that sexual life over time.

A final caveat is with regard to the conceptualization of stress. Most of the

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[13] The information on relationship quality is with regard to physical and verbal abuse in a romantic relationship. There are few adolescents in the analysis sample of virgins at time one who had sex between intervals and reported a physically or verbally abusive relationships.

[14] I have tested for differential duration-since-sex effects for those who had first sex within the year of data that I have available to me by using a variable that indicates months-since-sex. No significant duration effects appeared. However, this is a very short time span in which to examine duration effects.

literature on stress focuses on negative stress. First sex as a stressor may be a positive stressor for some adolescents. There is some literature on positive emotions and their corresponding outcomes (see Fredrickson 1998 for a review). While there are no studies on first sex as a positive stressor, the literature on positive emotions in general indicates that they have positive mental health effects (Fredrickson 1998). In addition, some of the qualitative evidence on adolescent sex indicates that sex is a positive experience for many adolescents (Thompson 1995; Tolman 2002). An extension of these findings would imply that if first sex is a positive stressor, it should lead to improved mental health. Other positive events may induce stress that has negative mental health consequences. A job promotion, for example, is probably a positive stressor for most people. However, the extra responsibilities that a promotion entails may lead to negative mental health consequences. The results of the present study indicate that while first sex is probably a stressor, it may be its context that determines whether it is a positive or negative stressor.

CONCLUSION

It is well established that pregnancy and STDs are, on balance, negative outcomes for adolescents. However, these outcomes are not pre-determined consequences of sex. The majority of sexually active adolescents do not become pregnant, get someone pregnant, or contract a STD. Thus, to focus the study of adolescent sex solely on these outcomes makes little sense.

This study should be seen as an early attempt to address the effects of teen sex beyond its physical consequences and with particular attention to addressing selection issues. I test the idea that sex outside of marriage and among teens has negative mental health consequences as posited in policy debates. I also test the nearly universal treatment

of teen sex as an inherently negative behavior. The intent of this study is not to show how sex is good for some teenagers. Perhaps other negative effects of teen sex, such as the oft-studied physical effects, far outweigh any evidence of null mental health effects for some groups in this study. However, a more balanced representation of the multi-dimensional effects and non-effects of sex among teenagers is warranted. This study attempts to provide this balance, and it should start a dialogue about the many and varied effects of teen sex on well-being, rather than lead to sweeping generalizations with regard to its effects. In fact, the underlying message is that no such generalizations can be made. Instead, the effects of sex need to be estimated carefully and with attention to the context in which it occurs.

Appendix A: Reporting of First Sex

Reporting of First Sex

First sex is measured from adolescent responses to questions regarding sexual intercourse (including month and year of first intercourse) asked at both the first and second interview (see Appendix A for question wording). This part of the interview was self-administered using audio-CASI (Computer Assisted Self Interview) due to the sensitive nature of these questions. The respondents hear questions via headphones, and enter responses into a laptop computer without interaction with an interviewer.

Self-reports of sexual behavior are an area of concern for researchers. Several studies have sought to understand the degree and nature of misreporting of sexual behavior among adolescents by comparing reports by the same individuals at two different time points (see Upchurch et al. 2002 for a review). There are several types of misreporting that can be detected with regard to the occurrence and timing of first sex when data are collected at two points in time. First, with regard to occurrence, adolescents can report that they have experienced intercourse at time one, and rescind that report at time two. This is considered "reclaimed virginity status." Second, with regard to timing, adolescents can report a month and year of first sex at both time one and time two, but the two reports of the date at first sex may be inconsistent. Third, with regard to both occurrence and timing, adolescents can report that they had never experienced sexual activity at time one, and then report having experienced first sex at time two with a date of first sex prior to the date of the time one interview.

A recent study by Upchurch, Lillard, Aneshensel and Li (2002) is of particular interest in examining the issue of misreporting of sexual behavior in the Add Health

study. First, they examine the degree of "reclaimed virginity status" by several socio-demographic characteristics including gender and race/ethnicity. In addition, they examine the degree to which family background characteristics, respondent aptitude, and interview characteristics contribute to misreporting. They find that males of all race-ethnicity groups are more likely to reclaim virginity than their female counterparts. Those who are older, those who live in alternative family situations (not two parent, single-parent or stepparent families), and those with more educated mothers are less likely to reclaim virginity.

Second, they investigate the variability in reported dates of first sex. Again, they consider how age, gender, race/ethnicity, family background, respondent aptitude, and interview characteristics contribute to differential date of first sex reports. They find that among those reporting sexual experience at both interviews, only 22 percent reported the same date (month and year) of first sex at both times. They note that those with lower verbal ability and males, especially African American males, had the largest variability in reporting dates.

Finally, they test seven different methods of treating occurrence and timing inconsistencies to determine the degree to which results are driven by the method of coding that the researcher employs to deal with inconsistencies. In this final effort, they find surprisingly few differences in results predicting the risk of first sex using samples derived by each of the seven different treatment options.

The present study examines the occurrence of first sex between interviews at time one and time two. To construct a sample of adolescents who were virgins at the time of the first interview, and then determine whether or not first sex occurred between

interviews, it is necessary to establish both occurrence and timing. First, I exclude all adolescents who had experienced first sex prior to wave one. As noted above, due to inconsistent reporting this is not straightforward. 7900 adolescents consistently reported virginity at time one. That is, at time one they reported being a virgin, and at time two they reported either still being a virgin (6854), or having first sex sometime after the time one interview but before the time of the second interview (1046). An additional 530 adolescents reported being a virgin at time one, reported they had first sex by time two, but reported a date of first sex prior to the time of the first interview. One might reasonably expect some degree of recall error has occurred with these adolescents. Since adolescents were asked to report month and year of first sex, I have allotted a recall error of up to two months. That is, if adolescents reported at time two that they had first sex in the two months prior to the date of the time one interview, they were considered to have had first sex between waves (91). In addition, 158 adolescents reported being a virgin at time one and having first sex by time two, but they had missing data on month and year of first sex (120), just year of first sex, but not month (23), or just month of first sex, but not year (15).[15] Including these cases generates a sample of 8149 time one virgins (sample A) to be used in all subsequent analyses.

It is also possible that those who qualify under the two-month recall error window had sex prior to the time one interview, but did not give honest responses when initially asked (that is, they denied their sexual experience). I reason that those who had sex more than two months prior to the first interview are much more likely to have given dishonest responses and thus are excluded. First sex is generally considered a relatively salient

[15] This last group of 15 cases does not include those who reported a year of first sex as any year prior to the year of the first interview. These cases are thus, not included in the sample of time one virgins.

event that should be fairly easily recalled by respondents (Upchurch et al. 2002; Wu et al. 1999). Thus, a recall error of greater than two months for an event that happened a year ago is perhaps not credible. In contrast, those who dated their first sex two or fewer months prior to the time one interview may have simply recalled the date incorrectly at time two. I give them the benefit of the doubt and include them in my sample. Of course there is no way to know with certainty the honesty of these responses or the degree to which adolescents miscalculate or incorrectly recall dates.

To assess the degree to which my rules for creating the sample affect my results, I conduct analysis using two supplementary samples as shown in Appendix Table A. The first supplementary sample (sample B) uses a more restrictive accounting of virginity status by including as time one virgins only those who consistently report virginity status. This includes those who reported being a virgin at time one and time two and those who reported virginity at time one and first sex between the two interview dates. The second supplementary sample (sample C) uses a more liberal accounting of virginity status by including as time one virgins all adolescents who report being a virgin at time one, even if at time two they report a date of first sex more than two months prior to the time of the first interview, or if they are missing data on month and/or year of first sex. In addition, this sample includes adolescents who reported they had sex before time one, and rescinded that report at time two. Consistent with the findings of Upchurch and colleagues (2002), after testing all of my models with the three samples, I find little difference in results. In general, effect estimates were slightly smaller, although still with the same statistical significance, in models using sample B and virtually identical in models using sample C.

Appendix B: Dependent Variable Measurement

Variable: Had First Sex (asked by Audio-CASI)

Have you ever had sexual intercourse? When we say sexual intercourse, we mean when a male inserts his penis into a female's vagina.

This question is asked at both T1 and T2 interviews. Subsequent questions ask about month and year of first sex. Using these questions, I identify a sample of T1 virgins treating ambiguous or conflicting response in various ways to test the sensitivity of specification. Then, the response to the above question at T2 serves as the indicator of first sex between interview waves.

Variable: Center for Epidemiological Studies – Depression Scale (CES-D)
Composite measure constructed from 19 questions (4 dropped, three added) from the CES-D.

How often was each of the following things true during the past week?

1) You were bothered by things that usually don't bother you.
    - 0 never or rarely
    - 1 sometimes
    - 2 a lot of the time
    - 3 most of the time or all of the time
2) You didn't feel like eating, your appetite was poor.
3) You felt that you could not shake the blues, even with help from family and friends.
4) You felt that you were just as good as other people.
5) You had trouble keeping your mind on what you were doing.
6) You felt depressed.
7) You felt that you were too tired to do things.
8) You felt hopeful about the future.
9) You thought your life had been a failure.
10) You felt fearful.
11) You were happy.
12) You talked less than usual.
13) You felt lonely.
14) People were unfriendly to you.
15) You enjoyed life.
16) You felt sad.
17) You felt that people disliked you.
18) It was hard to get started doing things.
19) You felt life was not worth living.

Positively worded items were reverse coded before being summed with the other items. In the composite measure, the higher the value, the more depressed the individual (0-57).

Variable - Self-Esteem Scale

Composite measure constructed from 6 questions similar to the Rosenberg Self-Esteem Scale. The questions are as follows:

1) You have a lot of good qualities
    1 strongly agree
    2 agree
    3 neither agree nor disagree
    4 disagree
    5 strongly disagree
2) You have a lot to be proud of.
3) You like yourself just the way you are.
4) You feel like you are doing everything just about right.
5) You feel socially accepted.
6) You feel loved and wanted.

The response scale was recoded to range from 0-4 for all items. In the composite measure, the higher the value, the higher the self-esteem of the individual (0-24)

Appendix C: Propensity Score Matching

Appendix Table B shows the results of the logit equation used to estimate the propensity score. Several of these characteristics are strongly related to having sex. For example, an adolescent who reports that his or her ideal romantic relationship would include sex is almost 2 times (odd ratio = 1.891) more likely to have sex than a respondent who did not indicate their ideal relationship would include sex. In another example, Asian adolescents are just half as likely as white adolescents to have sex between interview waves (odds ratio = 0.535).

Appendix Table C shows the degree to which each of the variables used in the propensity score estimation was different between the two groups prior to, and after matching. This table indicates that matching essentially takes the cases of adolescents who have had sex in the interval between time one and time two, and matches to them a group of virgins who are very similar to them on these 25 characteristics. That is, for each individual who had sex, there is a matched individual who did not have sex (matched on 25 covariates). For example, before matching, 10 percent of those who had sex and just 5 percent of those who did not have sex had spent a night outside of their home without parental permission. After matching, 11 percent of those who did not have sex spent a night out without permission. Similarly, 31 percent of those who had sex compared to 20 percent of those who did not have sex are from single-parent families before matching. Once the matching process produces a new comparison group, 31 percent of this matched group of those who did not have sex are from single-parent families.

One important condition to be met in order for propensity score matching to give

a meaningful estimate of a causal effect is referred to as the support condition. The support condition assesses whether or not there are enough comparison cases at each level of the propensity score to be matched to the "had sex" cases at the same level. Because the "had sex" cases actually had sex, they should have a higher average propensity for first sex. Likewise, because comparison cases did not have sex, they should have a lower average propensity score. The distributions of the propensity score for both the "had sex" and "no sex" groups must overlap sufficiently to provide a substantial area of support – where there are enough comparisons to match to "had sex" case of a similar score.

Appendix Figure 1 shows the distribution of propensity scores in increments of 0.05 for those who did and those who did not have sex in the interval between interviews. This figure can be used to assess the degree to which the data conform to the support condition. There are several things to note about these distributions. First, both distributions are highly right skewed, indicating relatively low propensities to have first sex. This makes sense because this is a sample of virgins who has thus far resisted (or not had the opportunity for) having sex. Second, the distribution of propensity scores is more severely right skewed for the comparison group – those who did not have sex. Again, this makes sense because those who did not have sex are more likely to have a lower propensity for sex. Third, there is substantial overlap between the two groups at almost every level of the propensity score. This indicates that there are enough comparison cases to match to almost all of the "had sex" cases – the support condition is sufficiently satisfied with these data.

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Table 1: Weighted Desriptive Statistics

Key Variables:	Means	Std. Dev.	Range
had first sex	15.18	-	0/1
t1 depression	9.87	6.94	0-57
t2 depression	9.81	7.05	0-57
t1 self-esteem	18.94	3.48	0-24
t2 self-esteem	19.26	3.43	0-24
female	0.52	-	0/1
age	14.56	1.51	11-18
age 11-13	0.29	-	0/1
age 14-16	0.59	-	0/1
age 17-18	0.12	-	0/1
never dated	0.41	-	0/1
started, still dating	0.17	-	0/1
dating, broke-up	0.35	-	0/1
dated throughout	0.07	-	0/1
change in family structure	0.09	-	0/1
moved from jr to sr high	0.18	-	0/1
white	0.72	-	0/1
black	0.10	-	0/1
hispanic	0.12	-	0/1
asian	0.05	-	0/1
other race	0.02	-	0/1
Mother < HS	0.16	-	0/1
Mother HS grad	0.31	-	0/1
Mother some college	0.27	-	0/1
Mother college grad +	0.25	-	0/1
Father < HS	0.26	-	0/1
Father HS grad	0.30	-	0/1
Father some college	0.15	-	0/1
Father college grad +	0.29	-	0/1
Lg Family Income	3.61	0.78	0-6.9

Sample N = 8149 / Weighted N=11,683,249

Table 2: Mental Health Levels by Age and Gender

Female

Age	Depression Mean	Self-Esteem Mean
<=12	9.69	19.32
13	10.19	18.83
14	11.35	18.52
15	12.64	17.86
16	12.95	17.74
17	13.01	17.98
18	14.04	17.99
	R (0-57)	R (0-24)

Male

Age	Depression Mean	Self-Esteem Mean
<=12	9.00	20.14
13	8.55	20.10
14	9.32	19.58
15	9.93	19.00
16	10.54	18.92
17	11.54	18.82
18	12.28	18.63
	R (0-57)	R (0-24)

Sample N=8149

Table 3: Baseline estimates of the effect of first sex on subsequent mental health

	Model 1 Regression Model			Model 2[ab] Propensity Score Matched Model	
	Coeff.	Std Err		Coeff.	Std Err
T2 Depression					
had first sex	0.968	0.287	***	0.227	0.338
t1 depression	0.618	0.013	**	--	--
T2 Self-Esteem					
had first sex	-0.265	0.126	*	0.100	0.160
t1 self-esteem	0.559	0.012	***	--	--

***p<0.001, **p<0.01, *p<0.05

[a]time one depression is a covariate in the estimation of propensity score for the matched model

[b]Standard error takes account of possibly repeated use of control observations but not of estimation of propensity score.

Table 4: Conditional effect of first sex on T2 depression: gender, age and relationship context [ab]

	Coeff.	Std Err		Coeff	Std Err		Coeff	Std Err	
T1 Depression	0.590	0.014	***	0.591	0.014	***	0.590	0.014	***
had first sex	0.681	0.290	*	0.257	0.329		0.302	0.468	

Table 5: Conditional effect of first sex on T2 self-esteem: gender, age and relationship context[ab]

	Model 1			Model 2			Model 3		
	Coeff.	Std Err		Coeff	Std Err		Coeff	Std Err	
T2 self-esteem	0.544	0.013	***	0.543	0.012	***	0.543	0.013	***
had first sex	-0.310	0.125	*	-0.152	0.139		-0.164	0.210	
female	-0.328	0.082	***	-0.331	0.081	***	-0.286	0.103	**
age grp 2 (14-16) omitted									
age grp 1 (11-13)	0.162	0.095		0.254	0.102	*	0.259	0.129	*
age grp 3 (17-18)	-0.038	0.137		-0.045	0.136		-0.042	0.136	
dated throughout omitted									
never dated	-0.441	0.180	*	-0.427	0.178	*	-0.432	0.181	*
started, still dating	-0.156	0.165		-0.139	0.164		-0.143	0.166	
dated, broke up	-0.563	0.173	**	-0.538	0.172	**	-0.540	0.177	**
chg in family structure	-0.053	0.155		-0.050	0.155		-0.054	0.153	
transition to high sch	-0.164	0.097		-0.148	0.097		-0.146	0.096	
white omitted									
black	0.503	0.121	***	0.496	0.121	***	0.492	0.122	***
hispanic	-0.333	0.159	*	-0.326	0.158	*	-0.324	0.157	*
asian	-0.308	0.153	*	-0.303	0.153		-0.291	0.154	
other race	-0.610	0.362		-0.635	0.361		-0.631	0.360	
had first sex x age grp 1 (11-13)				-0.965	0.381	*	0.132	0.586	
had first sex x age grp 1 x female							-1.935	0.736	*
had first sex x female							0.018	0.301	
age grp 1 x female							-0.012	0.203	
HS grad omitted (mother and father)									
mother < HS	-0.215	0.141		-0.224	0.142		-0.227	0.142	
mother some college	0.053	0.111		0.053	0.112		0.044	0.113	
mother college grad +	-0.066	0.134		-0.060	0.134		-0.074	0.134	
father < HS	-0.162	0.117		-0.155	0.118		-0.160	0.115	
father some college	-0.086	0.123		-0.088	0.124		-0.098	0.121	
father college grad +	0.171	0.101		0.169	0.101		0.175	0.099	
Log of family income	-0.075	0.065		-0.081	0.064		-0.082	0.064	

***p<0.001, **p<0.01, *p<0.05

[a]These models include indicator variables for variables with missing values where mean substitution was used: self-esteem t1 < 1%; father's ed 3%; family income 22%

[b]All models adjust for complex design of the Add Health study using STATA's svy commands.

Table 6: Effect Estimates of first sex on subsequent mental health for specified groups

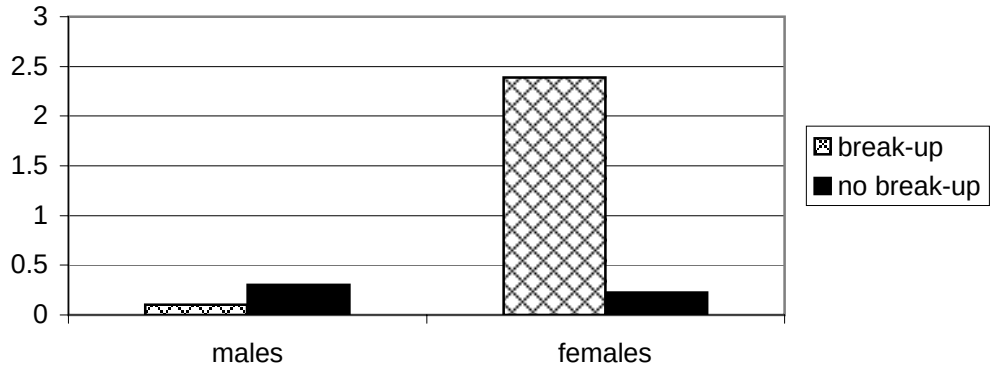
	Model 1 Regression with Interactions			Model 2[ab] Propensity Score Matched		
	Coeff.	Std Err		Coeff.	Std Err	
T2 Depression						
sex for girls who broke up	2.389	--	*	2.078	0.820	*
T2 Self-Esteem						
sex for youngest girls	-1.949	--	*	-1.404	0.520	*

***p<0.001, **p<0.01, *p<0.05

[a]t1depression is a covariate in the estimation of propensity score for the matched model

[b]Standard error takes account of possibly repeated use of control observations but not of estimation of propensity score.

Figure 1: Effect of First Sex on Increase in Depression by Gender and Break-up Status



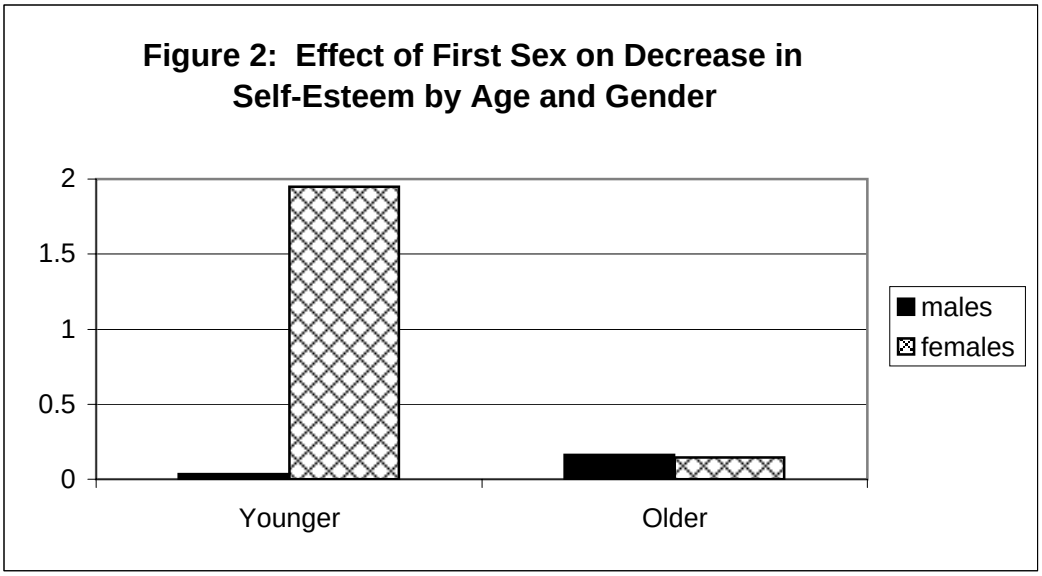


Figure 2: Effect of First Sex on Decrease in Self-Esteem by Age and Gender
2
1.5
1
0.5
0
Younger
Older
males
females

Figure 3: Proportion Standard Deviation Change in Depression and Self-Esteem

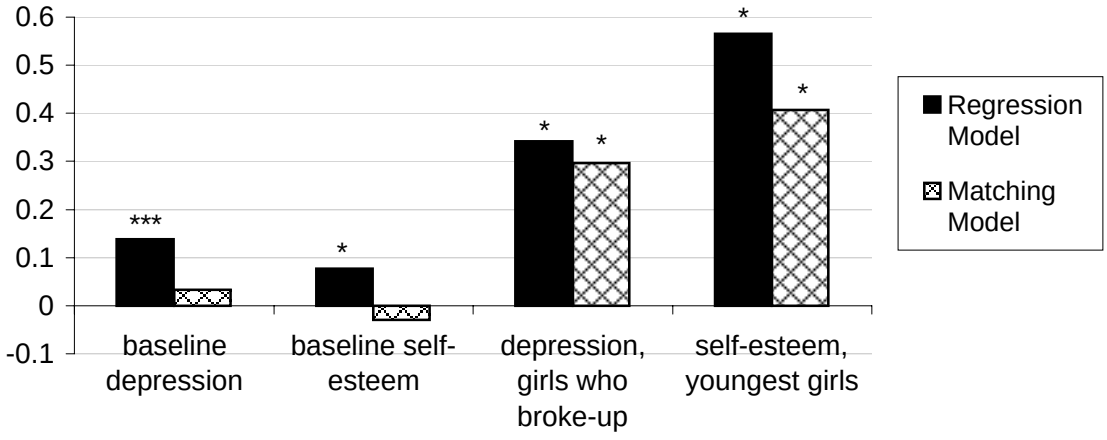


Table A: Reported Virginity Status Categories

Category Definition	Frequency	Percentage	T1 VIRGINS - SAMPLES A	B	C
1. t1 virgin, t2 virgin	6854	51.63	X	X	X
2. t1 virgin, t2 nonvirgin date between interview dates	1046	7.88	X	X	X
3. t1 virgin, t2 nonvirgin missing month, but year >= t1 interview	15	0.11	X		X
4. t1 virgin, t2 nonvirgin missing year, but not month	23	0.17	X		X
5. t1 virgin, t2 nonvirgin missing both month and year	120	0.90	X		X
6. t1 virgin, t2 nonvirgin date <= two months prior to t1 interview	91	0.69	X		X
7. t1 virgin, t2 nonvirgin date > two months prior to t1 interview	439	3.31			X
8. t1 nonvirgin, t2 nonvirgin	4068	30.65			
9. t1 nonvirgin, t2 missing occurrence report	22	0.17			
10. t1 nonvirgin, t2 virgin reclaimed virginity	596	4.49			X
Total N=	13274	100%	8149	7900	9184

Table B: Logit Regression Model Predicting First Sex
Predicted probabilies used for propensity score matching.

	Coeff Estimate	Standard Error		Odds Ratio
Propensity score covariates:				
intercept	-4.200	0.552	***	
female	0.300	0.070	***	1.350
age wave 1	0.223	0.023	***	1.250
black	0.218	0.095	*	1.244
hispanic	-0.097	0.095		0.908
asian	-0.626	0.153	***	0.535
other race	-0.198	0.248		0.820
GPA	-0.178	0.045	***	0.837
self-assessed intelligence	-0.039	0.033		0.962
Body mass index	-0.014	0.008		0.986
self-assessed physical development	0.184	0.032	***	1.202
step-family structure	0.181	0.100		1.198
single-parent family structure	0.324	0.093	***	1.384
other family structure	0.528	0.176	**	1.695
mother's education	-0.032	0.014	*	0.968
father's education	-0.018	0.013		0.982
log of family income	0.045	0.048		1.046
family relationship quality	-0.050	0.017	**	0.951
parent-child relationship quality	-0.020	0.012		0.980
t1 depression (CESD)	0.011	0.005	*	1.011
t1 self-esteem	0.019	0.012		1.019
religiosity	-0.030	0.009	***	0.970
self-assessed impulsivity	0.185	0.069	**	1.203
ideal relationship would include sex	0.637	0.072	***	1.891
taken virginity pledge	-0.317	0.093	***	0.728
spent night out w/o permission	0.227	0.118		1.255
dating at t1	0.821	0.075	***	2.272
Log Likelihood	-3568.175			

***p<0.001, **p<0.01, *p<0.05

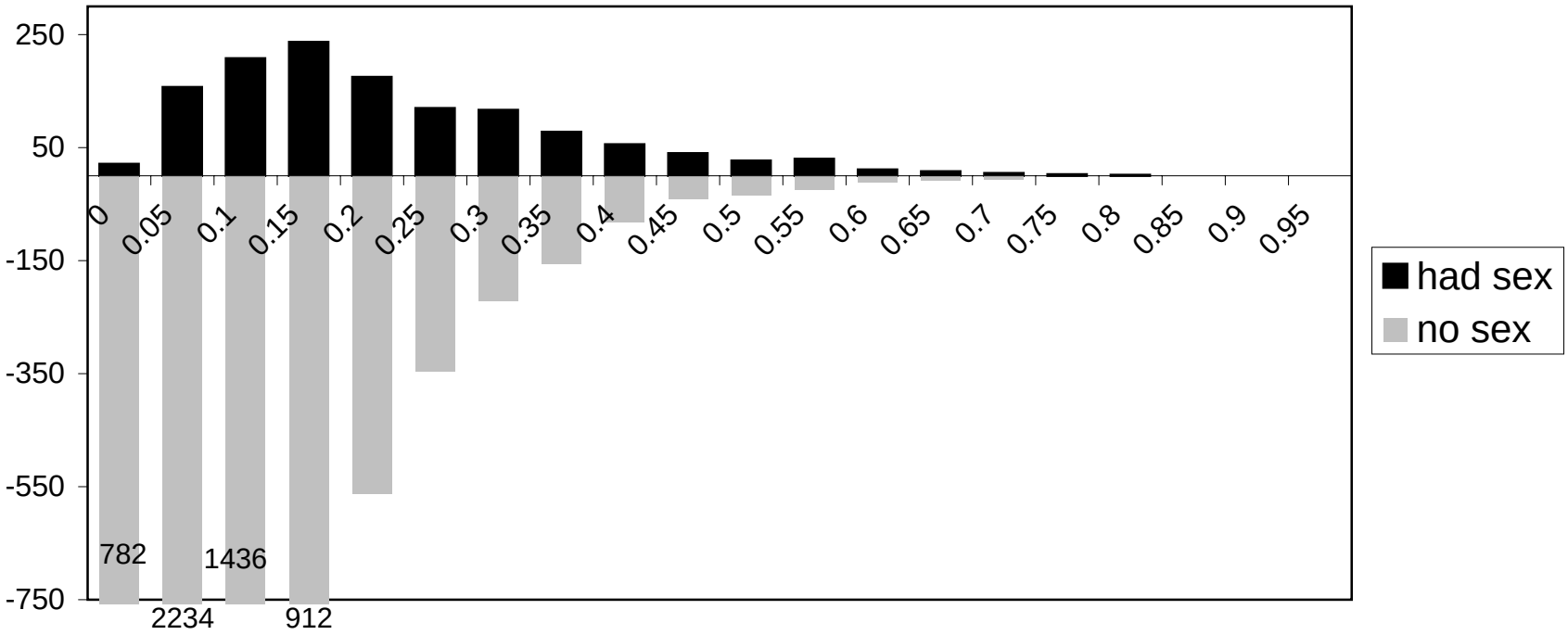
[a] variables were included to indicate cases with missing values on several variables. Mean substitution was used for these variables. None of the indicator variables were significant.

Table C: Covariate imbalance among those who had sex and those who did not before and after matching.

	Mean Had Sex	Mean No Sex	Mean Matched No Sex	Absolute bias before[a]	Absolute bias after[a]	Absolute bias reduction
Propensity score covariates:						
female (1=yes; 0=no)	0.57	0.53	0.60	7.06	5.47	22.62
age (11-18)	15.33	14.74	15.34	39.87	0.73	98.18
black (1=yes; 0=no)	0.19	0.15	0.19	10.47	0.83	92.06
hispanic(1=yes; 0=no)	0.18	0.16	0.17	5.93	1.25	78.94
asian (1=yes; 0=no)	0.05	0.09	0.04	16.80	0.63	96.25
other race (1=yes; 0=no)	0.02	0.02	0.02	0.00	0.00	0.00
mother's ed (continuous in years)	13.09	13.51	13.04	16.23	1.94	88.05
father's ed (continuous in years)	12.20	12.91	12.24	22.69	1.42	93.73
log of family income (continuous)	3.58	3.65	3.61	9.77	3.31	66.15
stepfamily (1=yes; 0=no)	0.14	0.12	0.14	6.18	0.23	96.22
single-parent family (1=yes; 0=no)	0.30	0.21	0.30	19.29	1.43	92.57
other family structure (1=yes; 0=no)	0.05	0.03	0.05	12.86	1.22	90.50
dating at time one (1=yes; 0=no)	0.31	0.14	0.31	41.52	0.38	99.09
T1 depression (0-57; higher=more dep)	11.64	9.81	11.70	25.91	0.82	96.84
T1 self-esteem (0-24; higher=higher se)	18.39	18.93	18.32	15.09	2.09	86.12
religiosity (0-16)	10.43	11.29	10.53	22.70	2.71	88.05
BMI (body mass index)	22.35	22.08	22.13	6.47	5.27	18.60
took virginity pledge (1=yes; 0=no)	0.15	0.20	0.16	13.81	2.59	81.26
physical dev't (1=less dev't to 5=more dev't)	3.31	3.11	3.27	19.03	3.51	81.57
GPA (0-4.0)	2.58	2.84	2.61	32.11	2.68	91.65
self-assessed intelligence (1-6)	3.84	3.99	3.86	13.46	1.71	87.29
fam relationship quality (0-12; higher=better)	8.04	8.70	7.96	28.10	3.66	86.99
par-child rel quality (0-20; higher=better)	16.79	17.56	16.83	26.09	1.46	94.40
self-assessed impulsive (1=yes; 0=no)	0.40	0.34	0.38	12.45	2.42	80.55
ideal rel would include sex (1=yes; 0=no)	0.38	0.20	0.37	41.04	2.96	92.80
spent nt out w/o permission (1=yes; 0=no)	0.10	0.05	0.11	19.40	4.08	78.97

[a]'bias' is the standardized percentage bias for that regressor [the difference of the sample means in the treated and comparison sub-samples as a percentage of the square root of the average of the sample variances in the treated and non-treated groups (Rosenbaum and Rubin 1985)].

Figure A: Propensity Score Distribution by Had First Sex



Center for Demography and Ecology
University of Wisconsin
1180 Observatory Drive Rm. 4412
Madison, WI 53706-1393
U.S.A.
608/262-2182
FAX 608/262-8400
comments to: ameier@ssc.wisc.edu
requests to: cdepubs@ssc.wisc.edu