Alcohol and sex: the influence of friendship networks on co-occurring risky health behaviors of U.S. adolescents

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Background: U.S. adolescents face the reality that engaging in one risky health behavior facilitates co-occurring risky behaviors. Moreover, adolescents may change their behaviors to develop new friendships or to match the behavior of existing friends. These relationships among friends can lead to increase in risk-taking. Methods: Utilizing a nationally representative saturated sample (n=901) with friendship network data from two large schools in the Wave I of the National Longitudinal Study of Adolescent Health (Add Health), this study examined the influence of friendship network structure upon adolescents' sexual intercourse and alcohol consumption in tandem. Results: Findings highlighted that, in one school, adolescents in denser and smaller friendship networks were at higher risk for engaging in sexual intercourse and drinking alcohol simultaneously. Additionally, in this school, network attributes (i.e., out-degree and betweeness) and adolescents' age were associated with an increased risk of sexual intercourse and drinking behaviors. In the other school, more diffused friendship networks seemed to pose less risk of engaging in these two risk behaviors in tandem. Moreover, engagement in risky behaviors was significantly predicted by teens' age and gender, but there were no effects of network attributes on adolescents' risky behaviors. Conclusion: The influence of friendships on adolescents' sexual intercourse and drinking alcohol may play out in different ways, depending on the size and composition of the friendship networks and adolescents' characteristics. Therefore, structural features of friendship networks, such as denser and smaller networks, and characteristics of adolescents (i.e., age and gender) should be considered in developing intervention programs to reduce adolescents' risky behaviors.

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Introduction

In the United States, the national Youth Risk Behavior Survey (YRBS) has documented that 9th – 12th grade students in high school have engaged in many risky health behaviors. According to the YRBS data from 2011, 70.8% of teenagers reported having consumed at least one alcoholic drink (Centers for Disease Control and Prevention, 2012a). Moreover, 47.4% of adolescents had engaged in sexual intercourse (Centers for Disease Control and Prevention, 2012c). These two behaviors (i.e., alcohol use and sexual intercourse) occur more frequently among adolescents than other risky behaviors, such as tobacco use (44.7%) (Centers for Disease Control and Prevention, 2012d) or marijuana use (39.9%) (Centers for Disease Control and Prevention, 2012b). In addition, in the same year, 22.1% answered positively to the item: "Did you *drink alcohol* or use drugs before you had *sexual intercourse* the last time?" — indicating that nearly half of the adolescents who engaged in sexual intercourse, did so under the influence of drugs or alcohol (Centers for Disease Control and Prevention, 2012c).

Risky behaviors among adolescents are a significant threat to their health during the adolescence years, yet engaging in risky behaviors can lead to non-trivial health problems, even as adults (DiClemente, Hansen & Ponton, 1996). Certain levels of alcohol consumption during adolescence can negatively affect physiological development (by affecting the brain and hormones, for instance), and can lead to other risky behaviors, including unprotected sexual activity and tobacco use (Guo et al., 2002; Santelli et al., 2001). Although engaging in sexual activity during adolescence is normative within many social groups in the United States (Brendgen, Wanner & Vitaro, 2007), beginning sexual intercourse at an early age leads to an increased risk for contracting or transmitting sexually transmitted infections (STIs), or for becoming pregnant (Tapert et al., 2001). These risks may increase when sexual activity is

coupled with significant amounts of alcohol consumption (Bailey et al., 1999), because high blood-alcohol levels can impair judgment and lead to unprotected intercourse.

The literature on adolescents' health addresses the notion that when adolescents engage in a risky behavior, they are more likely to engage in other risky behaviors. For instance, in a study conducted by MacArthur et al. (2012), the authors documented that alcohol use among adolescents (aged 15 and 16) was positively associated with other risky behaviors (i.e., substance use, sexual activity). Additionally, the study by Patrick and Schulenberg (2010) presented adolescents' substance use (i.e., smoking and marijuana use) as leading to greater intentions to drink alcohol.

For these phenomena, earlier literature demonstrate that, in particular, friends and/or friendship networks during adolescence play a key role in influencing adolescents' risky behaviors (Alexander et al., 2001; Pollard et al., 2010; Sieving et al., 2006; Valente, Unger & Johnson, 2005), because friends and friendships underlie person-to-person and/or group-to-group interactions. For instance, the study conducted by Schwinn and Schinke (2014) found that drinking and offering alcohol increasingly affected other teens' intentions toward drinking. In addition, in a study by Fujimoto and Valente (2012a), the authors addressed a key finding that various types of friendships among adolescents (i.e., mutual, reciprocal, and directional friendships) strongly influenced friends' substance use (e.g., drinking, smoking).

Moreover, other studies have identified friendships as probably the most significant factor in the spreading of risky behavior among groups of teens (Ali & Dwyer, 2011; Fujimoto & Valente, 2012b; Jaccard, Blanton & Dodge, 2005), because of adolescents' development and most of them needing to belong to their friends or other social groups outside their own family. Therefore, examining friendship networks may provide better information on adolescents'

behaviors and their interpersonal mechanisms, than the study of individual intra-personal factors alone.

One way to capture the influence of friendships among adolescents is Social Network Analysis (SNA). Studies have highlighted that SNA can be applied to understanding the scope of changes in risky health behaviors and friendship ties among adolescents, because friendship networks and behaviors occur inside dynamic interpersonal systems. Specifically, utilizing SNA can provide visuals (in graph form) that are useful to describe and analyze the patterns of a network's structure, as well as verify statistical measures (Crnovrsanin et al., 2014).

The theoretical perspective of network theory focuses on structural and/or relational approaches to the research of social (network) influence (Cook & Whitmeyer, 1992), compared with learning and/or observing approaches in traditional theories. In other words, network theory is based on the notion of network influence in that adolescents are affected by directly and indirectly interacting with their friends or with their friends' friends (Ennett & Bauman, 1996). The result is that they can share similar behaviors (i.e., influence by friends or exert influence on friends) or stand similar positions in friendship networks (i.e., individuals connecting to all other friends in the network measured by network centralities such as degree (the number of links to and from a person), density (the ratio of the number of actual connections divided by the total possible connections in the network), and betweenness (the number of times an adolescent lies on the shortest paths linking other adolescents in the network)) (Valente, 2010). Therefore, utilizing network analysis can examine the network composition of adolescents' risky behaviors.

Traditionally, risky behavior dissemination relies on individual-level information on how adolescents adopt a behavior through learning and/or observing others perform the behavior. Researchers have used traditional theories such as the Theory of Planned Behavior or Social

Cognitive Theory in studies of health and risky behaviors among adolescents. These classical theories have emphasized the individual-level interpersonal process of learning risky behavior by directly observing how others behave, or by adopting a group's social norms and framing attitudes according to these norms in order to be accepted into those groups (National Institues of Health, 2005).

Regarding our topic of interest, here, in addition to social network theory, Jessor's Problem Behavior Theory (PBT) can also help explore the mechanism of influence of friendship network structure upon adolescents' risky behaviors. PBT is based on a social-psychological framework that attempts to explain risk factors related to adolescent involvement in various problem behaviors such as sexual intercourse, tobacco, alcohol, and drug use (Jessor, 1987). PBT includes three major systems of socio-psychological variables: the personality system (i.e., individual values, beliefs, and attitudes), the perceived environment system (i.e., family and friend influences), and the behavior system (i.e., drinking, deviant behavior, marijuana, cigarettes, and drug use behaviors). According to Jessor (1987), adolescents' problem behaviors are associated with the perceived environment system (e.g., peer relations) and personality system (e.g., attitudes), because, within peer relations, friends' behaviors can directly influence various risky behaviors in adolescents.

Informed by these theoretical perspectives, the purpose of this study, therefore, is twofold: using data from a large, representative sample of adolescents in the U.S., to 1) describe the structure of friendship networks for adolescents who engage in, and for adolescents who do not engage in sexual intercourse and alcohol consumption simultaneously; and 2) assess the influence of friendship network structure upon adolescents' risky health behaviors (specifically the behaviors of sexual intercourse and alcohol consumption in tandem). To achieve this

purpose, we employ SNA techniques, which utilized by authors in the research of social networks (Ennett et al., 2006; Mercken et al., 2009; Valente, Gallaher & Mouttapa, 2004).

This study is important because it examines two risky behaviors simultaneously, while most previous studies examine a single risky behavior in isolation. We believe that research examining multiple simultaneous risk behaviors can significantly help with the design of more effective prevention programs that promote adolescents' healthy development.

Methods

Data source

This study utilized the longitudinal data generated by the National Longitudinal Study of Adolescent Health (Add Health) in the United States. The Add Health study gathers information (e.g., health-related behaviors of adolescents, demographics, and family socio-economic status) for students in grades 7 through 12 nationwide, thus yielding representative data stored in the Inter-University Consortium for Political and Social Research (ICPSR). To date, Waves I, II, III, and IV of the data collection conducted in 1994-1995, 1996, 2001-2002, and 2007-2008, respectively, have followed youth from adolescence to young adulthood. The Add Health dataset comprises completed in-school questionnaires and in-home interviews. The Wave I in-school questionnaire (n = 90,118) from 145 schools completed during 1994-1995 includes topics such as demographic characteristics (e.g., age, gender, and ethnicity), health-risk behaviors, extracurricular activities in the school year, and friendship nominations for the five best male and five best female friends from school rosters (Harris et al., 2009).

Sample

From the pool of adolescents completing the in-school questionnaire and the in-home interview, the Wave I in-home interview sample (n = 20,745) in grades 7−12 is drawn. The in-home interview includes sensitive questions including those about alcohol use and sexual behavior. Additionally, the in-home interview sample contains a subsample, called the "*saturated"* school sample (n = 3,702) from 16 schools where all enrolled students in the schools participated in in-home interviews. Therefore, in order to achieve our purpose, this study used the saturated sample from the two schools providing the largest samples out of the original 16, for analysis. The remaining 14 schools are excluded due to relatively small sample sizes and substantially larger amounts of missing data. Moreover, friendship nominations in these saturated schools allow us to construct complete friendship networks, indicating these networks can provide inter-relationships such as adolescent's relations and network positions among individual adolescents.

We limited our analysis to adolescents who answered "yes" or "no" to the question, "The most recent time you had sexual intercourse, had you been drinking alcohol?" in the in-home interview, from the two schools with the largest saturated samples. This resulted in a total sample of 901 (School 1: n = 324 and School 2: n = 577) (see Figure 1).

Measures

Friendship nominations were obtained by asking students to name up to five best male and five best female friends. The friendship nominations from the same school rosters to which the respondent belonged received unique identification codes (e.g., 12345678), whereas friends from different schools were duly identified by specific codes (e.g., 77777777). We excluded friendship nominations from different schools in subsequent analyses because these friends did not connect with each other within the same friendship networks. Using nominations from the

same school rosters, we can create complete networks within a given school. These complete networks allow us to measure adolescent's relations and network positions.

We computed the following measures of friendship networks via a social network analysis computer program.

a) Degree is "the number of links to and from a person". Out-degree is the number of friendship ties that the ego (person responding to the survey) nominates; in-degree is the number of friendship nominations the ego receives (Valente, 2010).

b) Density is the ratio of the number of actual connections divided by the total possible connections in the network (Valente, 2010).

c) Betweenness is the number of times an adolescent lies on the shortest paths linking other adolescents in the network (Valente, 2010).

d) Bonacich centrality is the notion that "…not only a function of how many friends an individual has but also the number of friends one's friends have" (Ali, Amialchuk & Rizzo, 2012).

In this study, we assessed the influence of friendship network structures upon the behaviors of sexual intercourse and alcohol consumption in tandem, based on a question in the in-home interview at Wave I. Specifically, students were asked if they had been drinking alcohol when they last had sexual intercourse. Originally, while the questionnaire offers the option of answers coded as three categorical variables (e.g., 0 = "no", 1 = "yes", and 3 = "refused"), we dichotomized the variable, examining only participants who answered "yes" or "no". We also utilized gender and grade as control variables, coded as dichotomous (0 = female and 1 = male) and categorical variables (e.g., 7 = 7^{th} grade and 8 = 8^{th} grade) from the in-home interview at Wave I.

Statistical analyses

For descriptive analyses we employed through Stata 13 (StataCorp LP, College Station, TX). Moreover, to analyze the saturated samples from the in-home interview at Wave I, we utilized the NetDraw feature in UCINET, a dynamic network analysis tool, to describe the structure of the friendship network for adolescents who engage, for those who do not engage in simultaneous sexual intercourse and alcohol use Using this analytic technique, we can draw a graph to visualize the network structure of adolescents engaging in risky behaviors, and we can report network centrality degree measures (i.e., in-and out-degree) of the networks.

To assess the relationship between network structure and adolescents' risk behaviors, for each school we ran a logistic linear regression using Stata 13. In a preliminary analysis, we assessed whether students in the two schools were similar enough to agglomerate into a single sample, and found there were statistically significant differences between Schools (1 and 2) on the question regarding alcohol use during sexual intercourse ($p = 0.03$). We report our analyses, therefore, separately for each school, as students in the schools differed significantly in their responses on the surveys. Moreover, we also assessed multicollinearity, reporting variance inflation factors (VIF), among variables in the logistic regression analysis. The VIF values of all variables were below 4.42 in Schools 1 and 2, indicating multicollinearity was not analysis problem (O'Brien, 2007).

Results

Descriptive statistics

As shown in Table 1, we employed descriptive statistics to highlight the characteristic of the samples from School 1 (n = 324) and School 2 (n = 577), respectively. In School 1, nearly half of the students were female (49.48%), 29.1 % reported 18 years old, and 93.83% did report their ethnicity. In School 2, more than half of the students (54.1%) were male, 35.88% were 18 years old, and 91.85% did report their ethnicity.

Table 2 shows descriptive statistics for adolescents from the two schools who engage in ("yes") and who do not engage in ("no") drinking alcohol before having intercourse. School 1 had 50 students in the "yes" group, and 274 students in the "no" group. More than half of students in the "yes" group (62%) were boys and 34 % were 17 and 18 years old, respectively. 94% did not report their ethnicity. Among the "no" group at School 1, more than half (51.5%) of students were girls and 28.1% reported 18 years old. 93.8% were did not report their race. In School 2, 40 % were boys in the "yes" group and 40.98% were 17 years old. 85.25% did not report their ethnicity. In the "no" group, 52.7% were boys also, 37% were 18 years old, and 92.6% did not report their race.

Networks

Figure 2 depicts the network structures of School 1 and 2 for the adolescents who *engage* in sexual intercourse and drinking alcohol. Each square (adolescents engage in risky behaviors) or circle (their friends) represents a student in the network. Squares and circles are sized based on degree. In School 1, there are 137 adolescents with 147 ties. The graph for School 2 displays 92 students with 41 ties.

Figure 3 shows students (circle) who *do not engage* in the two behaviors we assessed within each school. Each circle represents a student in the network. Circles are sized based on

224 degree. School 1 portrays 468 adolescents with 524 ties in the network. School 2 shows 701
225 students with 448 ties.
226
227 *Assessing the influence of network structure on individual behavior*
228 Table 3 shows the results of the probabilities (or odds ratios – OR - of engaging in sexual
229 intercourse and drinking alcohol associated with individual-level and network-level variables for
230 adolescents in Schools 1 (n = 324) and 2 (n = 577). The probabilities were estimated separately
231 for each school.
232 In School 1, in terms of demographic predictors, age was significantly associated with
233 simultaneous engagement in sexual intercourse and alcohol consumption (OR = .66, $p < .05$),
234 indicating adolescents who were at a younger age were more likely to participate in these two
235 behaviors.
236 We also tested network centrality measures such as degree, density, and Bonacich power
237 and found out-degree and betweenness to be associated with engaging in these behaviors (sex
238 and drinking alcohol). Engaging in sex and drinking alcohol simultaneously was significantly
239 predicted by out-degree (students named others as a friend: OR = 1.39, $p < .05$) in this friendship
240 network, indicating adolescents who named more friends were more likely to have an increased
241 engagement in these behaviors. Additionally, betweenness (the fraction of the shortest path
242 between students: OR = 1.01; $p < .05$) was significantly related with engagement in risky
243 behaviors (sexual intercourse and drinking alcohol in tandem), indicating students who were
244 connected through a short path with others exhibiting risky behaviors were more likely to engage
245 in these risky behaviors, themselves.

In School 2, engagement in risky behaviors (sex and alcohol consumption simultaneously) was significantly predicted by gender (OR = .46, $p < .05$), indicating male students were more likely to have increased involvement in risky behaviors. Moreover, as another demographic predictor, age (OR = 1.43, $p < .05$) was a significant predictor, indicating students who were older were more likely to engage in sexual intercourse and drinking alcohol at the same time. In contrast with the results from School 1, none of the network centrality measures for the School 2 sample had a statistically significant relationship with adolescents' sexual intercourse and drinking in tandem.

Discussion

In this study, we were interested in the influence of friendship network structures upon adolescents' risky health behaviors, specifically the simultaneous behaviors of sexual intercourse and alcohol consumption. Utilizing SNA, we identified three predictors (i.e., age, out-degree, and betweenness) in School 1and two predictors (i.e., gender and age) in School 2. These factors were significantly associated with risky behaviors (sexual intercourse and drinking alcohol in tandem) among adolescents in our sample. Our results indicated that (a) the structure of friendship relationships (i.e., out-degree and betweenness) among students was related to an increased risk for engaging in these behaviors in one school, but not in the other; and (b) demographic attributes (i.e., age and gender) also varied by school.

In School 1—as shown in Table 1 describing the characteristic of the sample—the sample size is relatively smaller (n = 324) than School 2 (n = 577), but, the friendship network in School 1 shows a larger number of connections (denser network) among adolescents sampled than School 2 (as depicted in Figure 2, School 1 had147 ties in the "yes" group). School 2

displays a friendship network with sparser connections (also in Figure 2: School 2 had 41 ties in the "yes" group). This suggests that in this study, at least, tightly-bound friendship networks in smaller schools (School 1) may carry higher risk of engagement in sexual intercourse and alcohol consumption in tandem. On the other hand, more diffused (spread out) networks in larger schools (School 2) seem to pose less risk of engaging in these two risk behaviors simultaneously. This finding suggests that, counterintuitively, larger networks may pose less risk, depending on how densely connected its members are.

With respect to network attributes (i.e., out-degree and betweenness) in School 1, out-degree refers to the number of friendship nominations teens made (Valente, 2010). In this study, the out-degree attribute was correlated with an increased risk of engaging in sexual intercourse and alcohol consumption simultaneously. As defined earlier, out-degree refers to the nominations made by a study participant (or the number of ties that stem from a node in the directed network; in the case of friendship networks: a measure of gregariousness); in-degree refers to the nominations received by a study participant (in the case of friendship networks, a measure of popularity) (Valente, 2010). In our sample, students who nominate others rather than receive nominations from others appear to influence their peers' behaviors within their friendship network. This may indicate that potentially, these students actively seek contact with other students in order to embed into friendship networks. In the study by Fujimoto and Valente (2012a), authors examined the influence of friendship types (i.e., mutual, directional, and intimate friendships) on risky behaviors (i.e., drinking alcohol and cigarette use) among adolescents. They found students who nominated others were more likely to influence their friends' smoking and drinking behaviors, than adolescents who were nominated by others.

Betweenness is another attribute of a network, referring to the number of times an adolescent lies on the shortest paths linking other adolescents in the network (Borgatti, Everett & Johnson, 2013). We included betweenness centrality because it can be an indirect measure of network flow or influence spread among adolescents. Betweenness also allows us to identify individuals who would possibly exert control over others, within the network.

In this study, the betweenness attribute was significantly related with engagement in sexual intercourse and drinking alcohol in School 1. This relationship potentially indicates that individuals in the network are likely to be influenced by the risky behaviors of friends or exert influence toward risky behaviors on others, because they are connected by a greater number of geodesic paths. Additionally, it may be possible that there are individual adolescents with higher betweenness in the network, so they control or influence behavior or information flow serving as gatekeepers among the other adolescents (Ennett et al., 2006). Supporting this finding, a study conducted by Ennett et al. (2008) assessed the relationship between peer attributes and adolescents' smoking utilizing SNA. Authors found there was a significant correlation between friend's cigarette use and betweenness centrality: higher betweenness centrality was related to an increased risk for engaging in smoking behavior.

While these two network attributes (out-degree and betweenness centrality) were associated with risky behaviors (sex and drinking alcohol simultaneously) in School 1, no effects for network structure were found in School 2.

Consistent with previous research on adolescents' risky health behaviors and peer influence, we did find that adolescents' age was associated with an increased risk for involvement in sexual intercourse and simultaneous alcohol consumption. In School 1, adolescents who were younger were more likely to have engaged in these risky behaviors;

conversely, in School 2, teens who were older were more likely to participate in those behaviors. In other words, being young, within certain structures, may entail protection. On the other hand, being young, within different structures, may lead to risk. A study by Ali and Dwyer (2011) assessed the association between peer friendship networks and adolescent's sexual behavior. The authors documented that older adolescents enrolled in higher grades were more likely to have had sexual intercourse and multiple sexual partners.

Regarding gender, surprisingly, we did not find any effect in School 1. Even when we calculated a logistic regression model including only demographic variables and no network attributes, the results did not show gender as having a positive relationship with the risky behaviors (OR = .642, p = .166). However, in School 2, male teens were more likely to have engaged in the two risky behaviors we assessed, compared with female teens. It is possible that male adolescents within this present friendship network particularly may show high susceptibility toward risky behaviors; therefore, it led result in adaptation to practiced sexual intercourse and simultaneous alcohol consumption of their peers. It may also indicate that male teens may get an earlier start to engage in risky behaviors than females in this study. Reasons explaining why gender was a significant predictor in School 2, but not in School 1, are not clear. Findings indicated that, for School 1 study participants, knowledge about the structure of their networks superseded knowledge about individual students' gender. In other words, for School 1, if attempting to predict engagement in sexual intercourse and alcohol consumption (in tandem), having information about the network would be more valuable than information on gender. For School 2, because the network structure had no association with the behaviors, knowing the students' gender becomes valuable predictive information.

We did find in one school that adolescents' friendship network characteristics can influence their and their friends' risky behaviors, within certain contexts. These findings are in line with network theory because the theory proposes that network properties (such as network centralities: degree or density) represent mechanisms that can affect outcomes of interest (Fredericks & Durland, 2005). Moreover, our findings suggest the underlying causes of tie formation (i.e., out-degree and betweenness) among adolescents can influence the risky behaviors of other adolescents in the network. Therefore, these findings can provide an additional layer of understanding and greater insight into the overall influence of friendship networks on adolescents' risky behaviors.

Applied to risky behaviors of adolescents (e.g., smoking or drinking alcohol), previous studies have found evidence that intrapersonal factors (e.g., attitudes or beliefs) and the relationships among adolescents (interpersonal factors) are significantly correlated with teens' risky behaviors. Such findings indicate that adolescents' risky behaviors can be influenced by friendships or observation of other teens' behaviors. Jessor's Problem Behavior Theory (PBT) helps explain this phenomenon as it proposes that problem behaviors can be explained from the perspective of three major systems acting upon each other: socio-psychological variables, such as families (i.e., parent or siblings) or friends' behaviors (perceived environment system) may affect the adolescents' beliefs or attitudes (personality system) that may predispose individual adolescents toward risky behaviors (behavior system) (Donovan, Jessor & Costa, 1991; Jessor, 1987). Therefore, PBT as a conceptual framework can help clarify the mechanisms through which adolescent ties can influence their behavior.

Our study makes an important contribution to the literature on adolescent health promotion because it examines engagement in two risk behaviors, simultaneously (sexual

intercourse and drinking alcohol in tandem), and approaches this examination from a friendship network perspective. Nonetheless, despite its contributions, this study contains important limitations: (1) we did not include any intrapersonal variables such as attitudes, norms, or beliefs, in our analyses; and (2) we only assessed one time period (Wave I). Further analyses might include intrapersonal factors as control variables, to better tease out the potential effects of network structure(s). Also beneficial would be to examine multiple points in time (e.g., Waves I and II) in order to provide a better understanding of the changes in behavior and in network composition/structure resulting from the influence of friends who engage in risky behaviors; (3) Wave I data in the Add Health dataset were collected over 10 years ago. It is possible that our findings may not generalize to a more contemporary sample; and (4) the Add Health data set is based on self-reported data and carries with it the potential errors in recall and reporting

Recommendations for researchers and health promoters

This study suggests that denser friendships ties, coupled with specific network characteristics (i.e., out-degree and betweenness) among students in a smaller school are associated with prevalence of engagement in sexual intercourse and alcohol consumption simultaneously, as compared to a lager school. Age and gender were also found to have an association, although gender was not a factor in one of the schools. These findings have implications for future research and for the development of health promotion programs for adolescents.

Regarding research, we believe future studies should employ SNA to examine adolescents' risky behaviors, but they should also include multi-level data (intrapersonal, interpersonal, and school characteristics). Researchers should, whenever feasible, use

longitudinal data to understand the mechanisms through which friendship networks lead adolescents to change their behaviors (Kobus, 2003).

Finally, when designing health promotion programs for adolescents, health promoters should consider designing programs directed at networks of adolescents, especially dense friendship networks (Haynie, 2001). Given that most of these networks are school-bound, this approach only requires a shift in perspective—from an individual-centered intervention, to a network-centered one. Moreover, when designing programs to target adolescent networks, health promoters should attempt to learn about the composition/characteristics of the network and identify individual adolescents with high betweenness centrality—these teens may become valuable peer leaders or gatekeepers and influence many others in the network (Ennett et al., 2006). Working with these teens might be an efficient way to promote the health of the entire network.

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Figure 1(on next page)

Flow diagram of sample

Figure 1. Flow diagram of sample

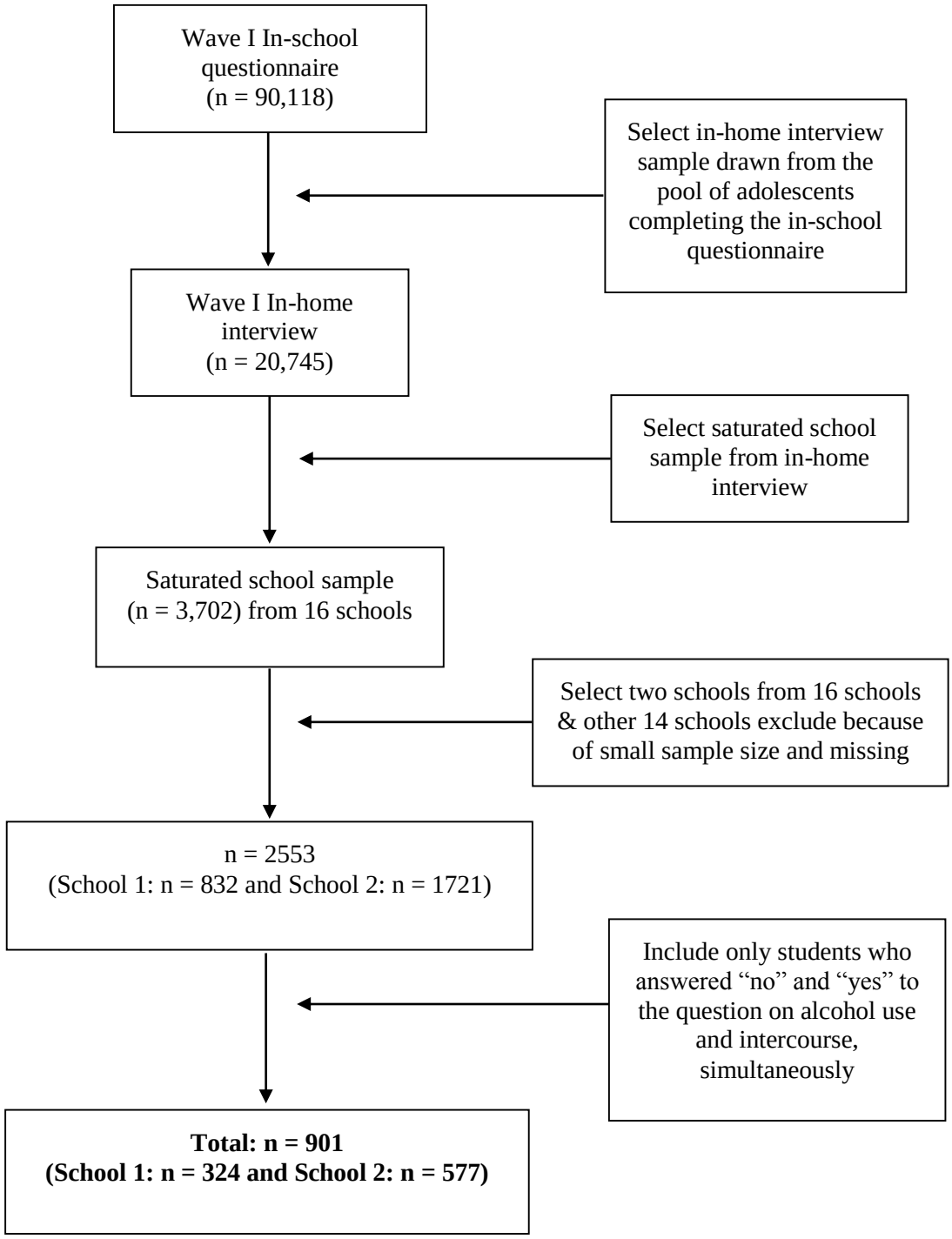
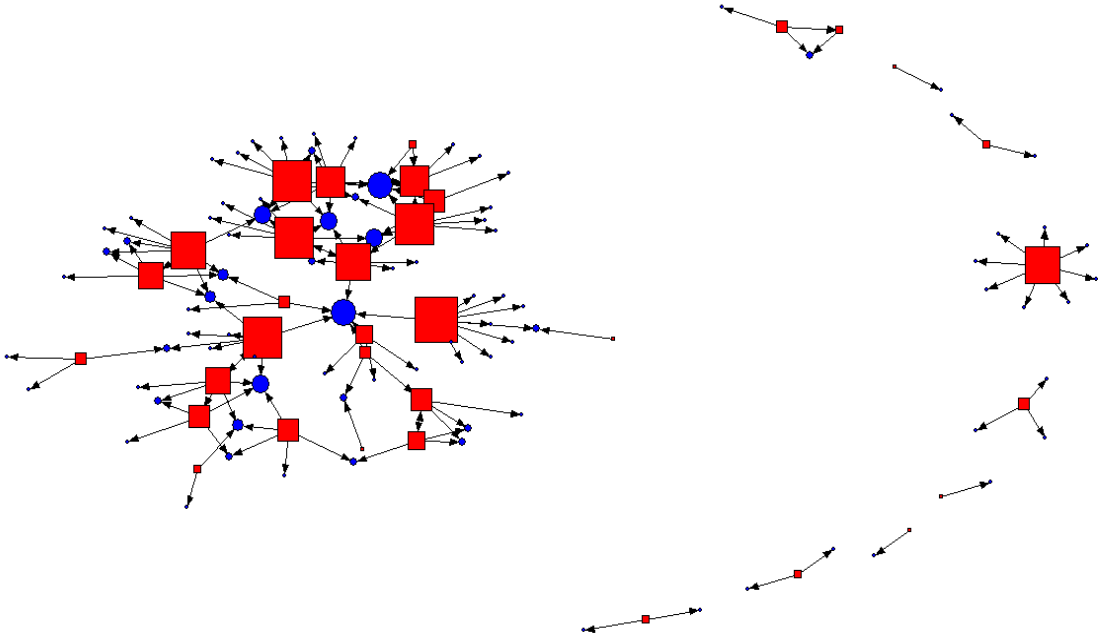


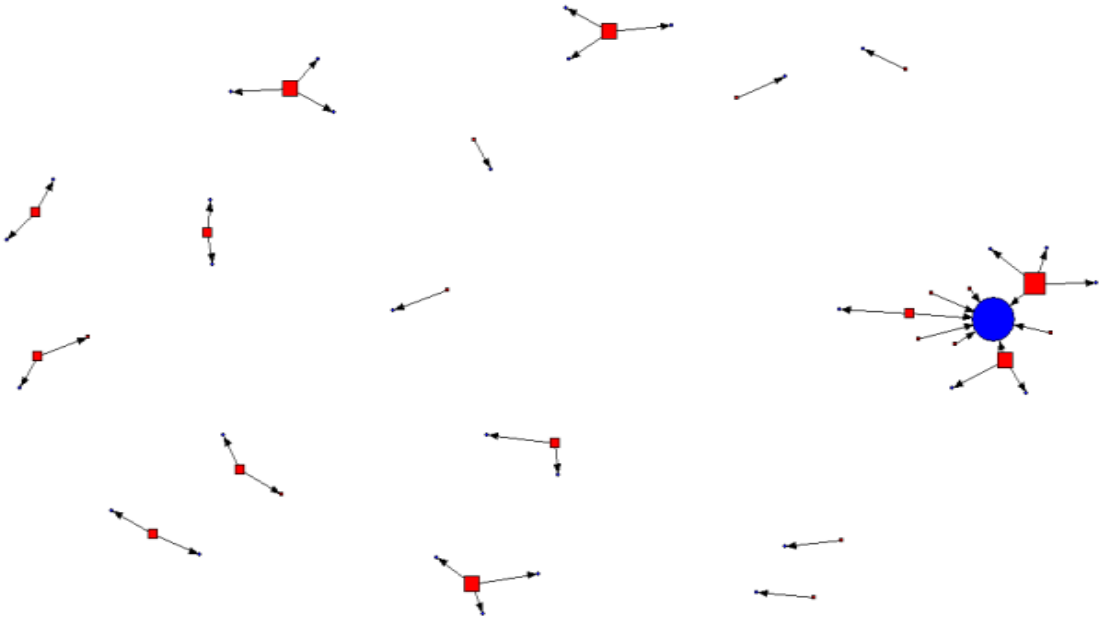
Figure 2(on next page)

Network of adolescents who engage in sexual intercourse and alcohol drinking, simultaneously

Figure 2. Network of adolescents who engage in sexual intercourse and alcohol drinking, simultaneously, within Schools 1 and 2 from the Add Health dataset



School 1: 147 ties

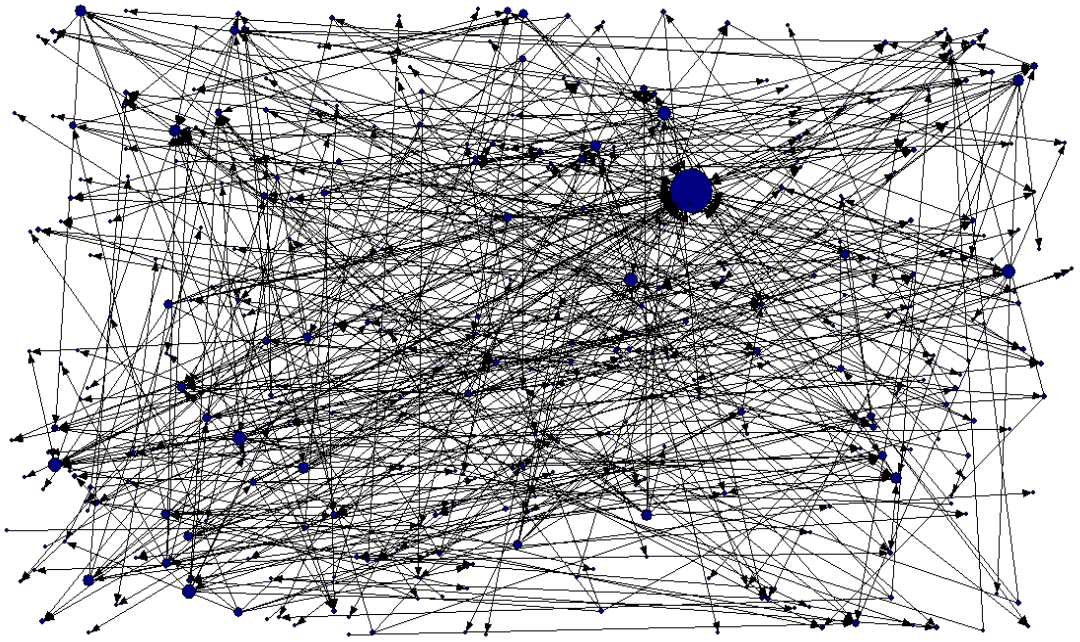


School 2: 41 ties

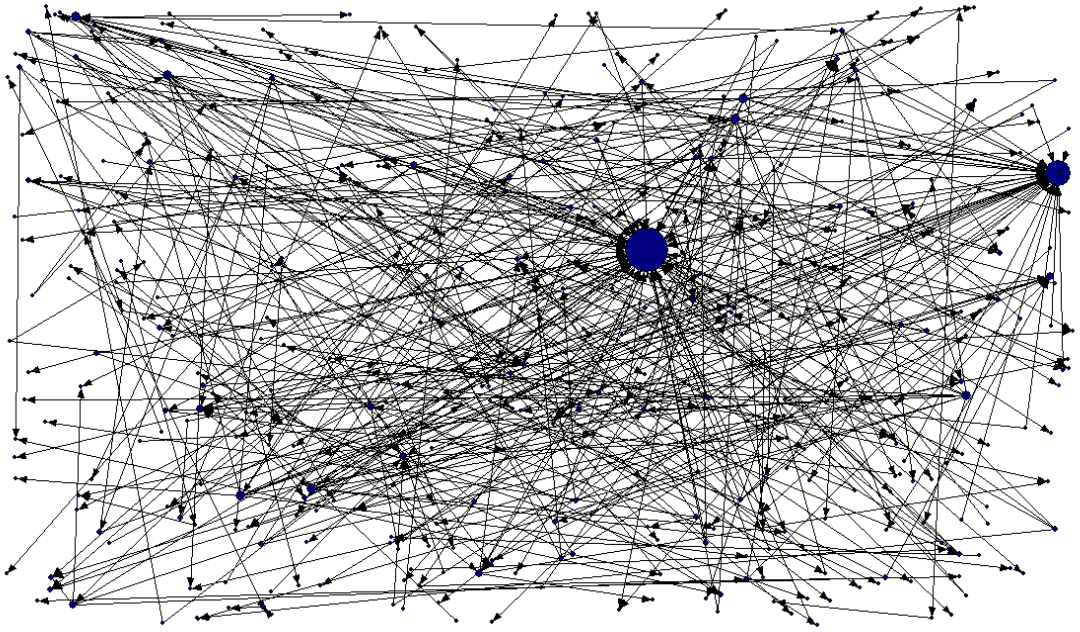
Figure 3(on next page)

Network of adolescents who do not engage in sexual intercourse and alcohol drinking in tandem

Figure 3. Network of adolescents who do not engage in sexual intercourse and alcohol drinking in tandem, within Schools 1 and 2 from the Add Health dataset



School 1: 524 ties



School 2: 448 ties

Table 1(on next page)

Descriptive statistics: gender, age, and race (n=901)

Table 1. Descriptive statistics: gender, age, and race (n = 901)

Characteristic	School 1 (n = 324)	School 2 (n = 577)
Gender		
Male	164 (50.62%)	312 (54.1%)
Female	160 (49.48%)	265 (45.9%)
Age*	18.75 (1.18)	18.60 (0.96)
14	1 (0.31%)	--
15	25 (7.72%)	3 (0.52%)
16	61 (18.83%)	107 (18.54%)
17	93 (28.70%)	196 (33.97%)
18	94 (29.01%)	207 (35.88%)
19	49 (15.12%)	57 (9.88%)
20	1 (0.31%)	6 (1.04%)
21	--	1 (0.17%)
Race		
White	17 (5.25%)	15 (2.60%)
Black/African American	1 (0.31%)	13 (2.25%)
American Indian/ Native American	2 (0.62%)	2 (0.35%)
Asian/Pacific Islander	--	6 (1.04%)
Other	--	10 (1.73%)
Refused	--	1 (0.17%)
Skip and/or N/A	304 (93.83%)	530 (91.85%)

Note: * includes mean (SD)

Table 2(on next page)

Descriptive statistics: "yes" and "no" groups from each school

Table 2. Descriptive statistics: “yes” and “no” groups from each school

Characteristic	School 1 (n = 324)		School 2 (n = 577)	
	“yes” (n = 50)	“no” (n = 274)	“yes” (n = 61)	“no” (n = 516)
Gender				
Male	31 (62%)	133 (48.5%)	40 (65.6%)	272 (52.7%)
Female	19 (38%)	141 (51.5%)	21 (34.4%)	244 (47.3%)
Age*	18.38 (1.03)	18.82 (1.19)	18 (1.00)	18.59 (0.96)
14	--	1 (0.4%)	--	--
15	1 (2%)	24 (8.8%)	1 (1.64%)	2 (0.4%)
16	5 (10%)	56 (20.4%)	12 (19.67%)	95 (18.4%)
17	17 (34%)	76 (27.7%)	25 (40.98%)	171 (33.1%)
18	17 (34%)	77 (28.1%)	16 (26.33%)	191 (37%)
19	8 (18%)	40 (14.6%)	6 (9.84%)	51 (9.9%)
20	1 (2%)	--	1 (1.64%)	5 (1%)
21	--	--	--	1 (0.2%)
Race				
White	3 (6%)	14 (5.1%)	3 (4.92%)	12 (2.3%)
Black/African American	--	1 (0.4%)	2 (3.28%)	11 (2.1%)
American Indian/Native American	--	2 (0.7%)	1 (1.64%)	1 (0.2%)
Asian/Pacific Islander	--	--	1 (1.64%)	5 (1%)
Other	--	--	2 (3.28%)	8 (1.6%)
Refused	--	--	--	1 (0.2%)
Skip and/or N/A	47 (94%)	257 (93.8%)	52 (85.25%)	478 (92.6%)

Note: * includes mean (SD)

Table 3(on next page)

Logistic regression analysis of predictors of sexual intercourse and alcohol consumption in tandom

Table 3. Logistic regression analysis of predictors of sexual intercourse and alcohol consumption in tandem: demographic and network centrality characteristics as predictors

	SCHOOL 1			SCHOOL 2		
Demographic predictors	**OR**	**SE**	**CI**	**OR**	**SE**	**CI**
Gender	1.0	.45	.42−2.42	**.46***	.15	.24−.88
Age	**.66***	.11	.47−.94	**1.43***	.24	1.04−1.98
Network predictors						
In-degree	.82	.13	.60−1.13	1.17	.76	.33−4.15
Out-degree	**1.39***	.19	1.05−1.84	.74	.32	.31−1.72
Betweenness	**1.01***	.00	1.00−1.02	1.21	.40	.63−2.30
Density	1.01	.01	.99−1.04	1.00	.02	.97−1.04
In-Bonacich Power	1.00	.00	.99−1.01	.83	.33	.38−1.81
Out-Bonacich Power	.99	.00	.98−1.00	.99	.02	.96−1.03

Note: Odd Ratio (OR), Standard Errors (SE), and upper and lower 95% Confidence Intervals (CI)

* $p < .05$