

**UNNECESSARY ROUGHNESS? YOUTH SPORTS, PEER NETWORKS AND MALE
ADOLESCENT VIOLENCE***

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Abstract

This study examines the extent to which participation in high school interscholastic sports contributes to male interpersonal violence. Deriving competing hypotheses from social control, socialization and masculinity theories, I use data from the National Longitudinal Study of Adolescent Health to test if 1) type of sport, 2) peer athletic participation, and 3) the presence of a school-sponsored contact sports program are related to subsequent male fighting. Contrary to the hypothesis that sports involvement reduces male adolescent violence, findings suggest that male athletes are at greater risk for future violence than other adolescents, particularly if they are involved in a contact sport. Additionally, the athletic involvement of male friends is significantly related to subsequent individual violence. Those male adolescents with a high proportion of friends playing contact sports are more likely than other students to behave violently. These findings are consistent with the expectations of socialization and masculinity arguments. However, schools without a contact sports program were not found to have reduced levels of violence. The theoretical and policy implications of these results are discussed.

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In many American schools, interscholastic sports play a fundamental role in structuring student status hierarchies and peer friendship networks. Athletes, particularly males playing popular team sports, are likely venerated by other students and their local communities, becoming core members of a school's "in-crowd" (Kane 1988; Holland and Andre 1994; Miracle and Rees 1994). Similarly, non-athletic friends of popular athletes tend to share elevated social status and gain membership in more exclusive peer groups (Eckert 1989). The predominance and visibility of sports in school culture encourages all students, regardless of gender or athleticism, to orient their behavior toward these activities and define their own positions and identities in relation to the most popular athletes and athletic cliques (Pascoe 2003; Eckert 1989).

Given the importance of sports in adolescent social development, it is not surprising that the previous four decades have witnessed an abundance of research on the topic. Along with being a vehicle for increased social status (particularly among males), research has generally found sports participation associated with a host of additional benefits; including increased self-esteem, locus of control, academic achievement, commitment to school completion, educational aspirations and economic attainment (Otto and Alwin 1977; Marsh 1992, 1993; Fejgin 1994; McNeal 1995; Mahoney and Cairns 1997; Eccles and Barber 1999). Much of this research has also found a negative relationship between high school athletics and delinquency (Landers and Landers 1978; Seagrave and Hastad 1982; Stark et al. 1987; Fejgin 1994; Mahoney 2000; Langbein and Bess 2002). Marsh (1993:35) sums up the area when he proclaims, "The broad general conclusions based on a large number of complicated analyses are simply stated: Participation in sport has many positive effects with no apparent negative effects and these

positive effects are very robust.” Such findings appeal to the positive views of youth sports held by the general public. They also provide support for theoretical perspectives arguing that sports participation 1) increases adolescents’ bonds to schools, conventional peers, and conventional activities (McNeal 1995; Mahoney and Cairns 1997; Larson 1994), 2) socializes adolescents into the basic values of American life, such as competition, fair play, self-restraint and achievement (Educational Policy Commission 1954; Evans and Davies 1986; Frey 1986; Jeziorski 1994), and 3) helps develop social and physical competence, leading to increased self-esteem and social capital (Spady 1970; Otto and Alwin 1977; Ewing et al. 2002).

Despite general findings that sports serve protective and integrative roles for adolescent development, many scholars remain cautious about the positive impacts of sports, contending that such benefits may be overstated or mask more nuanced and problematic relationships. One question of increasing debate is the relationship between sports participation and interpersonal violence. Contrary to the view that interscholastic sports help curb adolescent violence, critical scholars assert that the hypermasculine cultures of many athletic programs (particularly within male-dominated contact sports) teach violence as an acceptable means of maintaining valued identities. These theorists argue that, even though athletes tend to personally benefit from their participation in sports, these benefits are often gained at the cost of increased aggression toward perceived outsiders and the reproduction of gender and class inequalities. From this perspective, masculinized sports are socially sanctioned stepping stones toward privilege and power, sites where coaches, peers and parents foster aggression as a means of achieving team success while simultaneously increasing the likelihood of off-the-field violence.

The potential paradox of sports has not eluded the general public. Each high-profile physical and sexual assault involving a professional athlete fosters doubts about the social benefits of sports. Shocking behavior from venerated sports figures raises important questions

for parents entrusting their children to school sports programs. Are interscholastic sports promoting the fair play and sportsmanship outlined in their charters? Surprisingly, very little empirical research has addressed this issue. The few studies that have been conducted have used cross-sectional designs of college-aged populations and have been unable to distinguish selection from socialization effects or speak to the formative years of athletic careers (Nixon 1997; Jackson et al. 2002; Pappas, McKenry, and Catlett 2004). It therefore remains unclear how participation in high school athletics relates to off-the-field violence.

This study moves beyond prior sport and violence research with its clearly defined, theoretically grounded hypotheses and methodological rigor. I rely on three distinct theoretical perspectives – social control, socialization and masculinity theory – to derive competing hypotheses for the sport-violence relationship. I then test these hypotheses using data from the National Longitudinal Study of Adolescent Health (Add Health). The unique design of the Add Health survey not only allows for the longitudinal examination of sport outcomes, but also includes a wealth of individual background variables and sociometric data necessary for testing my stated hypotheses. Of particular interest are the measures of friendship networks, which allow me to move beyond prior research and gain leverage on a potential mechanism connecting sports to violent outcomes, i.e. that embeddedness in masculinized sports groups causes increased individual violence. Results from this study will not only illuminate the social consequences of youth sports, but also address the underlying assumptions of prominent theoretical perspectives. Does participation in sports serve to bond athletes to conventional behavior, or do the norms of masculinized sports promote violence while simultaneously elevating the status of aggressive males?

Control vs. Carryover

Social control theories, particularly Hirschi's (1969) social bonding theory, are commonly used to explain the relationship between delinquency and schools (Cernkovich and Giordano 1992). Rather than focusing on the motivations for anti-social behavior, control theorists posit that it is the constraining influence of conventional bonds which prevent adolescents from acting on naturally selfish and delinquent inclinations. These theorists traditionally view schools (and positive relationships with peers and adults within schools) as important sites for adolescent integration into conventional society. Accordingly, youth who are tightly bonded to school and their student peers are more likely to refrain from violent behavior than other, less bonded, youth.

Because interscholastic sports programs are institutionally sanctioned and governed by adults connected to schools, scholars have argued that participation in these activities should increase adolescents' bonds to conventional society and reduce anti-social behaviors (Larson 1994; McNeal 1995). Hirschi's (1969) elements of the social bond – attachment, involvement, commitment, and belief – also point to the integrative effects of sports. First, sports participation likely increases ties of affection between athletes and their teammates and coaches (Messner 1992; Coleman 1961). From a social control perspective, these attachments to others would reduce anti-social behaviors by constraining natural tendencies toward aggression and delinquency. Second, athletic participation should build athletes' commitment to conventional lines of action because the penalty for deviance would include the loss of athletic status and a related decrease in social standing. Third, the time required to practice and succeed in sports increases adolescents' involvement in conventional activities and necessarily reduces the time available for antisocial behavior (McNeal 1995). Finally, because the rules and values of sports are assumed to lie within the value system shared by conventional society, participation in sports

should increase adolescents' belief in the moral order and encourage pro-social behavior (Larson 1994). Supporting the last proposition, many youth sports programs have explicit written missions to promote fair play, teamwork and conventional values (Fine 1987). In sum, both the location of sports programs within the conventional structure of the school and the elements of the social bond present in sports contribute to a prediction that athletic participation should decrease the likelihood of adolescent anti-social behavior, including violence.

Hypothesis 1: Participation in interscholastic sports will decrease future violence.

As previously mentioned, much of the empirical evidence supports the view that sports help integrate youth into conventional society. Studies have generally found adolescent athletes to be less likely to drop out of high school (McNeal 1995; Mahoney and Cairns 1997), more likely to attend college (Holland and Andre 1987; Melnick, Vanfossen and Sabo 1988; Eccles and Barber 2004; Marsh 1993), and less likely to behave delinquently (Fejgin 1994; Stark et al. 1987; Landers and Landers 1978). However, none of these studies have adequately examined the relationship between youth sports and violence, nor have they addressed the possibility that not all sports are equal in their effects on antisocial outcomes.

Control perspectives assume that the motivation to commit delinquent acts is constant across persons and that group norms supportive of crime are weak or nonexistent (Matsueda 1997). Because organization in favor of crime is thought inconsequential, control theorists dismiss the possibility that individuals may be tightly bonded to institutions which promote antisocial behaviors. Following this logic, athletic male violence would be interpreted as evidence that either sports are not conventional activities or that violent athletes are not fully bonded to sports. As there is much evidence suggesting that sports involvement is generally associated with conventional behavior, we are left to conclude that violent male athletes are mavericks within their programs, alienated from other players, their coaches, and the

conventional institutions of school and family. It would be this lack of social integration which frees them to act on naturally violent and delinquent tendencies.

In contrast to social control theories, socialization and social learning perspectives allow for cultural variation in attitudes toward violence and law violation. According to these approaches, individuals learn anti-social values and techniques within intimate social relations, particularly among friends and family members (Sutherland 1947, Akers 1989). Because some individuals and social groups are thought to have positive attitudes toward criminal behavior, or justify such behavior under certain circumstances, socialization theorists assume that individuals may be tightly bonded to others while simultaneously holding attitudes favorable to law violation. It is this assumption which most separates socialization theories from those of the social control tradition (Matsueda 1997).

Robert Hughes and Jay Coakley (1991) extend socialization concepts to explain the seeming paradox of athlete crime. Rather than suggesting that athletes' antisocial behaviors result from social alienation or the rejection of cultural values, Hughes and Coakley argue that such behaviors stem directly from the norms of sports, a concept which they call "positive deviance." They state that the values associated with sports - striving for distinction, sacrificing for The Team, playing through pain, and refusing to accept limits - are generally associated with individual success and conforming behaviors. However, these norms may also create situations where athletes "do harmful things to themselves and perhaps others while motivated by a sense of duty and honor" (p. 311). They point to the widespread use of performance enhancing drugs as a primary example of such negative behavior. These drugs are clearly considered deviant by broader society, but the special environments within sports make using such substances acceptable and even encouraged at high levels of competition. Furthermore, athletes' elevated statuses and conformist images make it likely that parents, teachers, and coaches will overlook

deviant behavior, thus making a deviant label easily avoided while simultaneously contributing to future antisocial behavior.

Recent feminist scholars help clarify the connection between sport norms and violence, particularly for males participating in “hypermasculine” contact sports. These authors contend that aggression, physical domination, and the use of the body as a weapon are integral components of masculine sport culture and are reinforced as part of a “win at all costs” mentality (Messner 1990, 1992; Crosset 1999; Coakley 2001; Connell 1995). Within masculine sports, violent behaviors become the means of asserting a valued identity and demonstrating one’s place within the masculinity hierarchy. Coaches, parents, and peers further legitimate violent athletic identities by affording increased status to individuals who effectively use on-the-field aggression to achieve victory. Although careful to note that not all contact sport programs promote aggressive norms and “win by any means” philosophies (see Trulson, 1986), authors critical of “masculinized” sports state that it is rare not to find such conditions present in most high schools (Coakley 2001; Connell 1996). Furthermore, the combination of violent identities and aggression reinforcement has led several theorists to contend that on-the-field violence will extend to similar behavior off the field (Boeringer 1996; Crosset 1999; Pappas, McKenry, and Catlett 2004). According to this carryover hypothesis, violence outside of sports would be consistent with the training and reinforcement received throughout the careers of contact sports athletes. The carryover expectation provides a second hypothesis relating sports with male violence.

Hypothesis 2: Males participating in contact sports will have increased future violence.

Peer groups are thought to play an especially important role in socializing athletes to deviant norms. For individuals embedded in athletic groups, pressures to conform are increased and status within the group may depend on demonstrations of commitment to group norms. Within contact sport groups, research has repeatedly found that displays of toughness, courage

and willingness to fight are highly valued and are continuously modeled and reinforced by teammates (Smith 1979; Weinstein, Smith and Wiesenthal 1995; Messner 1990). Such reinforcement creates conditions supportive of off-the-field violence as a means of affirming group membership.

Hughes and Coakley (1991) also note that the tight bonds and distinct value systems held by athletes may result in feelings of uniqueness and separation from individuals outside the sports community. When combined with the high status afforded to them by peers, fans, and the media, this sense of distinction can increase feelings of superiority as well as disdain for those who have not made the sacrifices necessary for sports achievement. These feelings may not only result in male athletes feeling that they are above the law, but may also increase the likelihood that out-group members become victims of the aggressive behaviors advocated within contact sports groups.

Hypothesis 3: Males embedded in contact sport peer groups will have increased future violence.

Not all athletes may be equally likely to overconform to the sport ethic and engage in positive deviance. Hughes and Coakley (1991) argue that pressures to conform are most acutely felt by individuals who question their group status or who view sports as their sole means of social mobility. For individuals with low self-esteem, low SES or minority status, overconformity to group norms likely develops as a means of maintaining valued athletic identities. These athletes may feel forced to behave aggressively in order to conform to group norms and avoid rejection. When membership in the group is either precarious or essential, threats to group status contained in the terms “chicken” or coward may take on heightened significance and help shape off-the-field behaviors.

Hypothesis 4: Low self-esteem, low SES and minority status increase off-the-field violence of male contact sport athletes.

The above hypotheses assert that a direct causal relationship exists between sports and violent behavior. However, it is likely that factors present before an athlete participates in sports are influential in explaining subsequent outcomes. For example, it is possible that athletes are more likely to possess an underlying trait, such as a tendency toward aggression, which would also cause increased future violence. If this were the case, then the relationship between sports and violence may become spurious and primarily explained by the third variable, aggressiveness. Aside from shared propensities, there are several other potential causes of a spurious sports-violence relationship. Socialization occurring earlier in childhood is one example. Messner (1992) found that childhood experiences with fathers, brothers, uncles and peers all contributed to individuals' definitions of masculinity and subsequent desires to participate in sports. These definitions, as well as the environments encountered in early athletic teams, likely contribute to subsequent anti-social behavior and athletic participation. In addition, the actions of coaches and parents are influential in determining which adolescents are selected to participate. If parents encourage aggressive children to play sports and coaches use this trait to select players, again the sports-violence relationship would become largely spurious.

Hypothesis 5: The relationship between sports and violence is spurious and explained by prior violence.

Finally, we may create a hypothesis extending socialization arguments to the level of the school. Specifically, the extent of violence at the school level should be directly related to the predominance of a hypermasculine culture exemplified by contact sports. Also, building on the ideas of Hughes and Coakley (1991), we would expect less intergroup conflict in schools without contact sports because these groups would not isolate themselves from other groups within the

school and victimize outgroup members. Therefore, net of other school characteristics (such as school size, public vs. private, etc.), we would expect individuals attending schools lacking contact sports programs to show less violence than those in schools where such sports are offered.

Hypothesis 7: The presence of a contact sports program in a school should increase individual violence.

Data and Measures

Sample

To test the above hypotheses, I use data from the National Longitudinal Study of Adolescent Health (Add Health). Add Health is a school-based, nationally representative study of American adolescents in grades 7-12. From a list of all high schools in the United States, Add Health selected a stratified sample of 80 schools with probabilities proportional to size. Schools were stratified by region, urbanicity, school type, ethnic mix, and size. Additionally, for those high schools not covering grades 7-12, the study included in the sample an associated feeder middle school. The result is a sample of 144 schools of varying sizes, affiliations, and community contexts.

From 1994 to 1996, the study collected three waves of data from students, their peers and parents on a variety of health-related behaviors. For the current analyses, I utilize data from the first (in-school) and second (Wave I in-home) questionnaires. The in-school questionnaires were administered in the first year to all available students in each of the sampled schools. In total, 90,118 students (approximately 80% of those listed on school rosters) were surveyed. In each school, surveys were administered in a single day during one 45-60 minute class period. Included in the questionnaire were basic demographic characteristics, school-related activities (including sports participation), and risk behaviors (including violence). Also, students were asked to

nominate their five best male and five best female friends. The latter allowed for the construction of friendship data taken directly from friends, thereby avoiding possible measurement error associated with self-reported friend behavior. As 15 schools did not have sufficient numbers of students complete the nomination data, these schools were dropped from the analysis. The resulting sample of 75,871 students in 129 schools was not significantly different from the overall sample.

The Wave I in-home survey took place in the year following the in-school survey and consisted of a random sample of approximately 200 students from each of the originally sampled schools (N=20,745). The response rate for this survey was approximately 80%. Missing respondents, however, resulted primarily from students not being followed upon graduation. The 90-minute interviews were administered in individuals' homes and, to ensure confidentiality, questions were completed using laptop computers. The dependent variable for this study, interpersonal violence, is taken from the in-home survey and allows for the correct temporal ordering of the data. The sample that completed both the in-school and in-home interviews consisted of 13,000 students nested within 120 schools. As my hypotheses are primarily concerned with discerning the prevalence of male violence, I restricted the analysis to those 7,369 males who completed both surveys. Of these, 6,841 had post-stratification weights necessary for obtaining nationally representative estimates.¹

Dependent Variable

The dependent variable for this analysis is self-reported violence taken from the in-home interview. Specifically, the violence measure captures whether or not respondents report getting

¹ As with any large survey, missing data due to non-response can create biased and inefficient estimates. In the current analysis, list-wise deletion of missing values resulted in a final sample of 4,833 respondents (30% missing). To ensure estimates did not change due to non-random missing cases, I used multiple imputation techniques within SAS (proc mi and mianalyze) to gain unbiased and efficient estimates. Results were not significantly different from those reported and are available from the author upon request.

into a physical fight within 12 months prior to the in-home interview. Descriptive statistics for this outcome are listed in Table 1. The variable is coded as “0” if a respondent reported not fighting in the last 12 months and “1” if he reported fighting one or more times.² Approximately one-third of the male respondents reported getting into at least one fight in the prior 12 months.

---- Insert Table 1 about here----

Individual-Level Independent Measures

The independent variables of primary interest for this study are individuals’ sports participation, friends’ sports participation, and prior levels of violence and risk behaviors. Descriptives for these measures, as well as for the background control variables, are listed in Table 1. To measure individual sports participation, I create two dichotomous measures for “contact” and “non-contact” sports. As there is no general consensus as to what constitutes a “contact” sport, I operationalize this concept using two theoretically relevant criteria: 1) contact sports condone physical bodily contact and 2) are generally viewed as the sole domain of males. By capturing both physicality and masculine exclusiveness, I believe I capture those sports most associated with what feminist scholars term “hypermasculinity.” There are three sports measured in Add Health which fit these criteria: football, ice hockey, and wrestling. As a comparison category, I combine all other measured sports (i.e. baseball, basketball, soccer, swimming, tennis, track, and volleyball) into the non-contact sports category. I also create a binary measure of general sports participation with a value of “1” for males who report participation in either a contact or non-contact sport and “0” for those not involved in sports.

I operationalize friends’ contact sports participation as the proportion of the respondents’ male friends who report playing at least one of the contact sports (football, ice hockey or

² The original variable was ordinal in nature, with values ranging from “0” (never) to “4” (7 or more times). As this variable is ordinal, censored, and highly skewed, I chose to collapse the values into a binary measure capturing violence prevalence.

wrestling). These measures are ego-centric attribute variables capturing the mean contact sport participation reported by an individual's friends. Values for these variables range from "0", meaning that a respondent either 1) lacks friends or 2) has friends that do not play a contact sport, to "1", indicating that all of the respondent's friends play at least one contact sport. As a comparison category, I also constructed a similar peer measure for non-contact sports. Because the constructed peer-network measures are a function of the number of nominations, and each student was allowed to nominate only five male friends, I also control for the number of nominations in the final analyses.

In order to examine selection effects, I include two measures of prior anti-social behavior. The first measure, prior violence, is a lagged dichotomous measure of the dependent variable. The distribution for this variable is similar to the Wave I measure. However, a moderate correlation (.375) between the in-school and Wave I measures suggests that there remains sufficient variation to explain. The second measure, prior delinquency, is a mean index of six minor delinquency items (smoking, drinking, getting drunk, skipping school, doing something dangerous on a dare, and racing a vehicle) with possible responses ranging from "0" (never) to "6" (nearly everyday). Although the items in the scale obviously represent minor acts of delinquency, these activities are thought to be highly correlated with other deviant behaviors and are explicitly mentioned by Gottfredson and Hirschi (1990) as capturing the concept of low self-control. The index should therefore test for both the generality and stability of deviance. The Cronbach alpha for the prior delinquency index is .76. In order to control for friends' levels of fighting and minor delinquency, I also constructed measures that average these behaviors across respondents' male friends. The peer measure of violence captures the proportion of male friends who have been in a fight, while the peer delinquency measure captures the average delinquency among a respondents male friends.

To test the hypothesis that the sports-violence relationship is conditioned by individual's self-esteem and socio-economic status, I construct two indices for these concepts from items in the Add Health survey. The self-esteem measure is an index created from three items ("I have a lot of good qualities", "I have a lot to be proud of", and "I like myself just the way I am") with a Cronbach alpha = .76. The SES measure captures the higher of the mother's or father's combined educational and occupational status. Values for the index range from "0" (mother or father has no formal education and is employed in a low-wage job) to "10" (mother or father holds professional training beyond a college degree and is employed in a professional career).

I include individual background and demographic variables to control for concepts that prior research has found related to delinquency or sports participation. These variables include measures for age, race, family structure, attachment to parents, and commitment to school (How hard do you try and do your school work well? "1" I never try at all, to "4" I try very hard to do my best). Of the latter, parent attachment and school commitment are commonly viewed as indicators of social bonding and are therefore important controls for examining the potentially constraining effect of sports on violence.

School-Level Independent Measures

I include school-level measures to examine whether individuals' risks of violence are related to the presence of a contact sports program within school. To operationalize this concept, I created a dichotomous measure for whether or not the school had more than 10 students playing football, ice hockey or wrestling. If the school did not have 10 students playing one of these sports, I considered the school as lacking a contact sports program. 10 schools (containing 5% of the sample) were found to meet this condition. As this variable is a direct function of a school's size, I control for the total number of students in the school-level analyses. In addition, I control for other school covariates that research has identified as related to school violence, including

urbanicity, public school, socio-economic status, Southern location, and the percentage of males in the school. The urbanicity, Southern region, and public school measures were taken from the school-administrator questionnaires completed at the same time as the in-school survey. The SES variable was constructed by aggregating individual reports of parent education and employment to the school level. Schools' gender proportions were similarly calculated from aggregated individual responses.

Methods

The goals of my study are to examine the relationship between sports and violence at the individual and school levels and to test if these effects vary by peer setting. Hierarchical statistical models are ideally suited to meet these goals and also address Add Health's complex survey design.³ Hierarchical linear models (HLM) are extensions of the familiar multiple linear regression model meant to address observational dependence within nested data (i.e. students within schools) and estimate effects at higher levels of analysis (i.e. schools, communities, etc.). Observational dependence occurs in the Add Health data due to the likely correlation between the behaviors of respondents attending the same school. Failing to correct for correlated observations may bias both parameter estimates and their associated standard errors. Hierarchical models also make it possible to simultaneously estimate effects at the micro (i.e. student) level and effects stemming from the macro structure (i.e. schools). This capability allows for the identification of within- and between-school effects while also enabling the decomposition of the variance at each level. See Appendix A for a detailed discussion of the multi-level model and associated statistics (see also Guo and Zhao 2000).

³ An alternative approach for dealing with Add Health's complex survey design is to obtain weighted estimates with robust standard errors (ex. STATA's Survey commands). However, this method does not allow for the estimation of effects at the school level or the decomposition of the within- and between-school error variance. At the individual level, I replicated my model using STATA's Survey estimators and found similar results.

Due to the binary nature of my dependent variable, I use a generalized form of the multi-level model capable of predicting non-linear outcomes. I estimated models in SAS using the GLIMMIX (Generalized Linear Mixed Model) procedure. The GLIMMIX procedure allows for the estimation of random coefficient models for binary outcomes using quasi-likelihood maximization (Littell et al. 1996). In addition, this procedure allows for the application of individual sampling weights. Add Health's complex survey design means that individuals had unequal probabilities of selection into the survey (see Chantala and Tabor 1999). The post hoc individual sampling weights are therefore useful in gaining unbiased population estimates.⁴

Results

An important assumption of the socialization argument is that athletes gain increased social status from their involvement in team sports. To test this assumption, I compared the popularity (in-degree) of male adolescents with varying sport affiliations. Table 2 displays the mean popularity values for males who completed the wave I survey and are 1) not involved in sports, 2) play non-contact sports only, 3) play contact sports only, or 4) play both non-contact and contact sports. As can be seen, male athletes, regardless of the sports they play, are significantly more popular than their non-athletic male peers. The most popular group consists of male adolescents who play both contact and non-contact sports. Interestingly, males who only play contact sports are not as popular as those playing only non-contact sports or a combination of contact and non-contact sports. This is an unexpected finding given the exposure that football and ice hockey receive in the sports media and the large amount of community support generally provided for these activities (Foley 1990; Bissenger 1990). However, the fact that all athletes, regardless of their chosen sport, are more popular than non-athletic males does provide support

⁴ In addition to stratifying at the individual level, Add Health also stratified at the level of the school. To correct for this, I include in my final models all of the stratification variables used to select the sampled schools.

for the argument that athletes are central actors in schools' status hierarchies and therefore have something to gain by maintaining sports involvement.

---- Insert Table 2 about here----

Before examining individual-level predictors of violence, it is helpful to differentiate the amount of variation explained at the school-level versus that explained at the individual-level (ANOVA). Table 2 presents the variance components from an intercept-only model of violence. As can be seen, almost all of the variance is attributable to within-school differences. However, the between-school error term is significant, meaning that there is sufficient variation to justify evaluating school-level predictors. I will return to models with school-level predictors following models that introduce individual covariates.

---- Insert Table 3 about here----

Individual-Level Models of Violence

Table 3 presents the coefficient estimates and odds-ratios for four random intercept models predicting the risk of male violence from individual-level measures. The first model includes background control variables and a general measure of sports participation, the second model compares contact sports to non-contact sports, the third model adds the network measures of friends' sports participation, and the final model adds controls for prior individual and friends' violence and minor delinquency. From the deviance statistics, we can see that model fit improves significantly with each model step.

---- Insert Table 4 about here----

There are few surprises from the background variable estimates in Model I. As expected from prior research, attachment to parents, school commitment and increasing age are all significant negative risk factors for subsequent male violence. Blacks and those from low SES are also significantly more likely to get into fights. Although not significant, the coefficients for

Hispanic, intact family, and self-esteem are also in the expected directions. Of the background characteristics, school commitment appears to have the largest inhibitory effect on male violence. An increase of one unit in the school commitment index corresponds to a 36% decrease in the likelihood of fighting. This finding, along with the negative effect of parent attachment, lends further support to the social control argument that conventional bonds constrain anti-social behavior.

Turning to the effect of sport participation, I find little support for the hypothesis that involvement in sports inhibits male adolescent violence. In fact, sports involvement (either contact or non-contact) is positively associated with future violence ($p < .10$). Model II helps clarify the relationship by decomposing sports involvement into contact and non-contact sports. As can be seen, playing a contact sport significantly increases the odds of male adolescent violence, net of the effect of non-contact sports. Playing football, ice hockey, or wrestling increases the risk of future violence by 34%. The same cannot be said of non-contact sports. Net of playing a contact sport, the effect of playing a non-contact sport on future violence is negative and non-significant. Together, these findings are consistent with the socialization and masculinity arguments that the cultures promoted in contact sports contribute to male violence off the field.

To examine peer effects resulting from individuals' embeddedness in "hypermasculine" peer groups, Model III includes mean sports participation measures for respondents' male friends. Results appear to support Hypothesis 3. Males with a high proportion of their friends playing a contact sport are significantly more likely to behave violently than those without contact sport friends. Net of the number of nominated male friends and friends playing non-contact sports, individuals with all of their friends playing a contact sport are almost 40% more likely to fight than those without contact sport friends. The opposite is true of non-contact sports.

As the proportion of non-contact friends increases, the likelihood for individual violence decreases (although not significantly). These findings are consistent with the hypothesis derived from the socialization and masculinity perspectives suggesting that distinct processes occur in contact and non-contact athletic groups and that these differences explain subsequent levels of group-member violence. It is also interesting to note that the number of perceived male friends is negatively related to violence. This finding implies that having many friends helps protect youth from violence, although as already mentioned, this may not be true if those friends play contact sports.

To test if the effects of playing a contact sport or having contact sport peer networks differ by race or social class, I interact the black, Hispanic, self-esteem and SES variables with the sports variables (not shown). Although effects are in the expected directions, none of the interaction terms with contact sports are significant at $p < .05$, suggesting that the effects of individual and peer contact sports participation do not depend on respondents' race, self-esteem, or economic class. Although not hypothesized, an interesting interaction is found between *non-contact* sports and self-esteem. Non-contact athletes with high self-esteem are significantly less likely than other students to behave violently ($p < .05$). This effect may be worthy of future exploration. For those playing contact sports, no such protective effect is observed.

As stated in Hypothesis 5, the observed relationship between contact sports and violence may be explained by prior levels of violence or a propensity for risk. To address the selection argument, Model IV includes two measures of individual anti-social behavior and two measures of friends' anti-social behavior. In general, the lagged anti-social behavior measures (except for friends' delinquency) are strong and significant predictors of future violence, capturing the generality and stability of deviant behavior. In fact, the measure of prior violence is by far the strongest predictor in the model. Prior violence increases the odds of future violence by over five

times. Prior delinquency also significantly increases the likelihood of future violence, with an odds-ratio of 1.42. Together, the two individual measures of prior anti-social behavior increase the explained variance from .06 in Model III to .26 in Model IV. Friends' prior violence also has a significant effect on future violence risk. For male adolescents, having friends who have all committed acts of violence increases the odds of their own violence by 61% over similar students with non-violent friends. This finding lends support to Haynie's (2002) argument that the homogeneity of peer influences is an important indicator of antisocial behavior.

Including the measures of prior individual and friends' violence and delinquency completely attenuate the relationship between contact sports and violence. That is, once prior violence and delinquency are controlled, playing contact sports does not appear to increase an individual's risk of violence. Before fully embracing the selection argument, however, I note two reasons for caution: First, the measures of prior fighting and delinquency used here are both taken from the in-school survey, which makes it impossible to determine the causal direction between the lagged endogenous predictors and the measures of sports involvement. It could be that sports increase fighting, that fighting increases involvement in sports, or that the effects are reciprocal and occur in both directions simultaneously. Unless prior behavior *completely* explains involvement in sports, it is likely that the reported direct effects of sports are quite conservative.

Second, and more importantly, the attenuation of the contact sports effect does not preclude structural explanations for the sports-violence relationship. One way of interpreting the findings of Model IV is to say that the relationship between contact sports and violence is explained by some underlying individual trait, such as risk-taking, aggressiveness or Gottfredson and Hirschi's (1990) concept of low self-control. If this is the case, then sports are unimportant for predicting subsequent violence and are merely activities associated with aggressive youth.

However, it is equally - if not more - likely that prior experiences in youth sports and the actions of coaches in selecting players help explain the observed relationships. If the sports-violence relationship results from accumulated exposure to masculinized sport norms or from the actions of adults fielding contact sport teams, then options for intervention and social change are more easily accessible. Unfortunately, I am unable to disentangle these explanations given the limitations of the data. However, the finding that friends' contact sport involvement increases the risk of violence net of prior anti-social behavior does suggest that structural context is important in explaining subsequent aggressiveness. Even for male adolescents who do not participate in contact sports, having a high proportion of their friends playing these sports increases their own violent behavior. This finding suggests that the link between contact sports and violence does not rest exclusively on individual differences in aggressive tendencies.

In sum, the models predicting violence from individual-level measures show several interesting results. Contrary to the prediction derived from social control theory, participation in sports does not appear to inhibit personal violence. Furthermore, involvement in a contact sport appears particularly problematic for adolescent male violence. Net of background characteristics, contact sports increase the likelihood of violence whereas participation in a non-contact sport shows no similar effect. The latter finding is consistent with the socialization and masculinity arguments that the characteristics and culture of contact sports contribute to increased male aggression. In addition, peer athletic behavior appears highly predictive of subsequent violence. Net of their own athletic status, males with many contact sport friends are likely to be more violent than their peers without such friends. This finding is again supportive of socialization and masculinity theories, which argue that the pressures, hubris, and opportunities present in "hypermasculine" sports groups contribute to increased individual violence.

Including School-Level Predictors of Violence

As discussed previously, there appears some evidence that mean levels of fighting differ between schools. In order to model this between-group variability, I include several school-level contextual effects in predicting male violence. Table 5 lists the unstandardized estimates and odds-ratios for two models containing school-level measures. Model I contains only school-level measures, while Model II presents a full model with both individual and school-level predictors.

---- Insert Table 5 about here----

In Model I, I examine the hypothesis that the presence of a contact sports program contributes to student violence. Looking at the coefficient for schools lacking a contact sports program, there appears little evidence supportive of this hypothesis. Although the effect is in the right direction, having a contact sport in the school does not significantly affect the likelihood of male student violence. In fact, of the contextual variables, there is only one significant predictor, school size. As school size increases by 100 students, the likelihood of individual violence decreases by 3%. Even this variable, however, is attenuated to non-significance when individual predictors are included in the model (Model II). Most likely, the small number of schools and limited between-school variation in violence make it difficult to isolate school-level effects.

Discussion and Conclusions

This project represents an initial foray into the relationship between adolescent sports and male interpersonal violence. While prior research has demonstrated that sports participation is associated with many positive outcomes, no studies have focused on the connections between high school interscholastic sports and violence, despite compelling reasons to do so. The sports-violence relationship is a theoretically rich area containing competing expectations from prominent perspectives. Contrary to the hypothesis derived from social control theory, my research suggests that contact sports do not protect males from interpersonal violence and actually increase such behaviors for males in contact sport peer networks. These findings are

consistent with hypotheses derived from socialization and masculinity theories and provide important impetus for further research. Although there are limitations which must be considered when interpreting my results, this study provides insight into the paradox of youth sports and may better inform schools' sports policies.

Results of my analyses found that male adolescent participation in a contact sport directly affected the risk of subsequent violence, net of demographic controls. Consistent with the socialization and masculinity arguments, this finding provides general evidence for a positive relationship between “masculine” sports and violence. It remains uncertain, however, exactly what mechanisms explain this connection. Introducing a lagged measure of fighting significantly attenuated the effect of contact sports. However, the contemporaneous measurement of sports and prior violence make the direction of causation unclear. It is likely that aggressive kids enter contact sports, but even assuming this, it is unknown how much selection is due to aggressive kids pursuing contact sports and how much is due to coaches choosing the most aggressive kids to fill a more competitive team. More research is clearly needed to ascertain when and how the sport-violence relationship occurs. In either case, the finding that peer contact sport participation increases subsequent fighting does suggest that the link between masculine sports and violence has at least some social origins. The latter finding is best explained from a social learning perspective, which would argue that male friendship networks composed predominantly of contact sport athletes provide important sites for learning violent norms, constructing masculine identities, and reinforcing aggressive behaviors.

The theoretical implications of a positive sports-violence relationship are significant. If we believe that contact sport athletes generally lie at the center of a school's culture (as evidenced by their greater popularity), it is difficult to explain their increased violence as a function of weak social bonds. The social and human capital benefits accrued by athletes do not

suggest that they reject conventional norms or lie on the fringes of conventional society, and yet increased rates of violence from males in contact sports do suggest that they are not altogether conforming. Findings of the latter are much more consistent with the expectations of socialization and masculinity theories. From these perspectives, the local cultures and group dynamics within contact sports allow youth to maintain conventional goals and identities while simultaneously using violence to “do” masculinity, gain social status, and conform to group expectations. It is therefore over-conformity, rather than under-conformity, which best explains athletes’ violence.

A similar argument has often been applied to “white-collar” crime. More than 50 years ago, Edwin Sutherland (1940) argued that white-collar crimes result from over-conformity to the competitive norms of business and are unlikely to stem from a deviant identity, psychopathology, or isolation from conventional society. Like athletes in contact sports, businessmen are often reinforced for behaviors which are at odds with legal rules while conforming to group expectations. Because their behaviors occur within respected and high-status institutional settings, both businessmen and athletes are able to behave criminally while avoiding a criminal label. In fact, such behavior likely results in increased organizational status and the reproduction of social inequality. Corrupt business practices increase the monetary benefits and privilege of corporate executives, thereby solidifying their positions atop the social class structure. Likewise, through aggressive behaviors, male athletes place themselves at the top of the gender hierarchy and accrue the associated personal and social benefits.

It should be noted, however, that not all the hypotheses derived from socialization and masculinity approaches were supported. Although effects were in the expected directions, self-esteem, race, and SES did not significantly condition the relationship between contact sports and violence. This suggests that contact sports increase athlete violence irregardless of race, class, or

self-esteem. In addition, individuals in schools without contact sports programs were not found to have significantly lower levels of violence than other adolescents. This finding may be a function of the limited number of schools sampled. However, the lack of a school effect leaves open the question of how contact sports programs are related to school rates of violence. In schools without contact sports, are males finding alternative means of asserting masculine identities, resulting in equivalent rates of violence as those observed in other schools? This question is worth further exploration, as is the question of exactly how athletic and non-athletic groups interact and potentially conflict within schools.

While my findings contribute to our understanding of the relationship between sports and violence, there are obvious limitations of this study. First, although I have controlled for prior levels of fighting and minor delinquency, it remains possible that *unobserved* heterogeneity explains the association between peer athletic participation and violence. Unobserved heterogeneity is traditionally addressed using fixed effects models of longitudinal data (see Gordon et al. 2004 for a recent example). In a fixed effects approach, dependent and independent variables measured over time allow for examinations of change while controlling for time stable characteristics (such as low self-control). Unfortunately, such an approach was impossible for the current analysis due to a lack of longitudinal sports measures. Without longitudinal data on sports participation, population heterogeneity and selection effects can only be addressed by including theoretically relevant controls. The contemporaneous measurement of prior behavior and athletic participation further complicates matters and provides a conservative test of the relationship between sports and violence.

Second, this study is unable to identify the mechanisms explaining the observed relationships. Although some of the results are consistent with arguments derived from masculinity and socialization theories, an inability to identify specific mechanisms (i.e. subjects'

identification with masculine ideals, actual reinforcement for violence, identification of victims, etc.) leaves open the possibility for alternative explanations. This is a problem often associated with cultural, identity and values research. These concepts are illusive, open to interpretation, and constantly changing. My approach has been to use indirect measures to gain leverage on interesting theoretical ideas. With better measures, future research may be better able to isolate those processes observed in this analysis.

Finally, it is important to recognize that there exists a large amount of unexplained variance in my analysis. It is therefore likely that I have omitted important factors that explain the prevalence of adolescent violence. Further research and theory are necessary to better elucidate the processes identified in this study.

Despite these limitations, my findings suggest that sports, particularly those male-dominated sports emphasizing physical contact, have important consequences for male adolescent violence. These results may also have certain policy implications. As Connell (1996) states in his insightful look at gender and education, the most important step in addressing violence and bullying in schools is that school authorities become aware of the masculinizing practices contributing to gender privilege and hegemonic domination. Sport, he argues, is a major contributor to a school's gender regime. The results of this project clearly demonstrate a link between contact sports and violence, meaning that these activities would be appropriate sites for disrupting male violence. However, the potential selection effect also suggests that the connection between contact sports and violence occurs prior to individuals' high school athletic participation. This possibility makes it all the more important that coaches, parents, and school administrators are conscious of their gate-keeping roles and use their positions to prevent the continuation of athlete violence. Precluding problematic youth from playing contact sports, ensuring that violence by athletes is not tolerated, and fostering a more tolerant athletic

atmosphere are three means of breaking the connection between contact sports and violence. These changes necessitate de-emphasizing the “winning is everything” mentality, an unlikely proposition given the demands placed on coaches and players to make their schools and communities proud. However, the positive benefits for individual trajectories may outweigh the costs of a losing team record. As Trulson (1986) found when researching martial arts programs, contact sports that emphasize respect for others, self-control, patience and humility can serve to reduce the violence of aggressive male adolescents. Programs developed according to these ideals may not necessarily win as many matches as those built on aggression and competitiveness, but their attractiveness may lie in positively affecting the lives of problematic youth and fostering an environment of inclusiveness and respect.

Table 1. Variable Descriptives

Variable	N	Mean (%)	Std Dev	Minimum	Maximum
<i>Dependent Measure (Wave I in-home)</i>					
Violence	7369	0.41	0.49	0.00	1.00
<i>Individual-Level Predictors (in-school)</i>					
Age	7356	15.16	1.71	10.00	19.00
Black	7369	0.20	0.40	0.00	1.00
Hispanic	7369	0.20	0.40	0.00	1.00
Other Race	7369	0.14	0.35	0.00	1.00
Biological Parents	7045	0.71	0.45	0.00	1.00
Self Esteem	6483	1.86	0.79	1.00	5.00
Family SES	6673	6.23	2.65	0.00	10.00
Parent Attachment	6733	4.67	0.74	1.00	5.00
School Commitment	6966	1.86	0.74	1.00	4.00
Contact Sport	7369	0.30	0.46	0.00	1.00
Non-Contact Sport	7369	0.53	0.50	0.00	1.00
Prior Fighting	6521	0.57	0.50	0.00	1.00
Minor Delinquency	6859	1.37	1.21	0.00	6.00
<i>% Male Friends</i>					
Contact Sports	6959	0.25	0.34	0.00	1.00
Friends' Delinquency	6879	1.00	0.94	0.00	6.00
Friends' Violence	6822	0.42	0.39	0.00	1.00
Number of Friends	6959	2.27	1.76	0.00	5.00
<i>School-Level Predictors (in-school)</i>					
Urban	7086	0.27	0.44	0.00	1.00
School SES	7369	6.01	0.93	4.02	9.32
Public	7086	0.92	0.27	0.00	1.00
School Count (100's)	7369	9.45	6.17	0.29	25.59
% Female	7369	1.49	0.07	1.00	1.67
Southern Region	7051	0.37	0.38	0.00	1.00
No Contact Sport	7369	0.04	0.20	0.00	1.00
Normalized Weight	6841	0.92	0.94	0.01	5.66
Valid N (listwise)	4833				

Table 2. Mean Popularity Comparisons by Sports Involvement

<u>Sports Involvement</u>	<u>N</u>	<u>Mean^a</u>	<u>Std Dev</u>
None	2619	3.36	3.16
Non-Contact Sports Only	2198	4.42	3.74
Contact Sports Only	577	3.95	3.49
Both Contact and Non-Contact	1494	5.11	4.32
<u>Total</u>	<u>6888</u>	<u>4.13</u>	<u>3.71</u>

^a mean differences between all groups are significant at $p < .05$

Table 3. Analysis of Variance in an Intercept-Only Multilevel Logit Model of Male Adolescent Violence

(N=4833, Schools=112)

	Beta	S.E.
<i>Fixed Effect</i>		
Intercept	-0.353	0.052 ***
<i>Random Effect</i>		
Intercept	0.184	0.043 ***
Intraclass Correlation	0.053	
Deviance	6402.13	
Extradispersion	0.91	

***p<.001, **p<.01, *p<.05

Table 4. Random Intercept Logistic Regression of Male Adolescent Violence
(N=4833, Schools=112)

	Model I			Model II			Model III			Model IV		
	Beta	Std. Error	Odds Ratio	Beta	Std. Error	Odds Ratio	Beta	Std. Error	Odds Ratio	Beta	Std. Error	Odds Ratio
Individual-Level Measures												
Age	-0.052 *	0.021	0.95	-0.048 *	0.021	0.95	-0.053 *	0.021	0.95	0.003	0.023	1.00
Black	0.324 **	0.110	1.38	0.319 **	0.109	1.38	0.293 **	0.110	1.34	0.388 **	0.119	1.47
Hispanic	0.139	0.112	1.15	0.104	0.114	1.11	0.084	0.113	1.09	0.071	0.124	1.07
Other Race	0.084	0.101	1.09	0.093	0.101	1.10	0.102	0.101	1.11	-0.022	0.110	0.98
Intact Family	-0.105	0.076	0.90	-0.108	0.076	0.90	-0.088	0.077	0.92	0.031	0.083	1.03
Parent Attachment	-0.186 ***	0.049	0.83	-0.179 ***	0.049	0.84	-0.174 ***	0.049	0.84	-0.020	0.054	0.98
School Commitment	-0.303 ***	0.046	0.74	-0.293 ***	0.047	0.75	-0.289 ***	0.047	0.75	-0.028	0.052	0.97
Self-Esteem	-0.037	0.044	0.96	-0.035	0.044	0.97	-0.038	0.043	0.96	0.082	0.157	1.09
Family SES	-0.035 **	0.012	0.97	-0.035 **	0.013	0.97	-0.032 *	0.013	0.97	-0.034 *	0.014	0.97
Sports Participation	0.118	0.066	1.13									
Contact Sports				0.296 ***	0.068	1.34	0.233 **	0.072	1.26	0.062	0.079	1.06
Non-Contact Sports				-0.077	0.064	0.93	-0.038	0.066	0.96	-0.064	0.072	0.94
% Male Friends Contact							0.319 **	0.111	1.38	0.270 *	0.123	1.31
% Male Friends Non-Contact							-0.148	0.102	0.86	-0.122	0.112	0.89
Number of Male Friends							-0.057 **	0.022	0.94	-0.071 **	0.025	0.93
Prior Violence										1.633 ***	0.073	5.12
Prior Delinquency										0.354 ***	0.036	1.42
Friends Violence										0.478 ***	0.111	1.61
Friends Delinquency										-0.072	0.045	0.93
Intercept	0.953 *	0.032		0.919 *	0.438		1.092 *	0.444		-1.678 ***	0.483	
Deviance	6308.37			6296.39			6286.8			5481.7		
Between-Group Variance	0.174			0.164			0.155			0.163		
R-Square	0.049			0.053			0.057			0.264		

***p<.001, **p<.01, *p<.05

Table 5. Random Intercept Logistic Regression of Male Adolescent Violence, including Contextual Effects
(N=4833, Schools=112)

	Model I			Model II		
	Beta	Std. Error	Odds Ratio	Beta	Std. Error	Odds Ratio
Individual-Level Measures						
Age				0.00792	0.024	1.01
Black				0.3488 **	0.121	1.42
Hispanic				0.06193	0.125	1.06
Other Race				-0.0204	0.11	0.98
Intact Family				0.02327	0.084	1.02
Parent Attachment				-0.0504	0.055	0.95
School Commitment				-0.0535	0.053	0.95
Self-Esteem				-0.1219 *	0.048	0.89
Family SES				-0.0305 *	0.014	0.97
Contact Sports				0.04986	0.079	1.05
Non-Contact Sports				-0.0778	0.073	0.93
% Male Friends Contact				0.28 *	0.124	1.32
% Male Friends Non-Contact				-0.142	0.113	0.87
Number of Male Friends				-0.0711 **	0.025	0.93
Prior Violence				1.6277 ***	0.073	5.09
Prior Delinquency				0.363 ***	0.037	1.44
Friends Violence				0.473 ***	0.111	1.60
Friends Delinquency				-0.0685	0.046	0.93
School-Level Measures						
Urban	0.091	0.115	1.10	0.02636	0.124	1.03
SES	-0.094	0.059	0.91	-0.0753	0.065	0.93
Public	0.098	0.211	1.10	-0.0848	0.225	0.92
Number of Students ^a	-0.030 **	0.010	0.97	-0.012	0.012	0.99
Proportion Male	0.196	0.798	1.22	0.1419	0.838	1.15
Southern School	0.095	0.099	1.10	0.04281	0.106	1.04
No Contact Sport	-0.242	0.215	0.78	-0.053	0.231	0.95
Intercept	-0.014	1.205		-1.0415	1.358	
Deviance						
	6390.03			5481.18		
Between-Group Variance					0.144	
R-Square						0.270

***p<.001, **p<.01, *p<.05

^a Divided by 100 for consistent metric

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Appendix A: Hierarchical Logistic Regression Models

Hierarchical models begin with the regression model (for questions regarding notation, see Snijders and Bosker 2000):

$$Y_{ij} = \mathbf{b}_{0j} + \sum_{h=1}^p \mathbf{b}_h X_{hij} + e_{ij} \quad (1)$$

where Y_{ij} is the outcome for the i th individual in the j th level-two unit (i.e. school), \mathbf{b}_{0j} is the intercept for the j th group, X_{ij} is a vector of h explanatory variables (measured either at the group or individual level), \mathbf{b}_h are their effects, and e_{ij} is the individual-level error term. An important difference between this model and the familiar multiple linear regression equation is that the intercept (\mathbf{b}_0) is group-dependent at the second level (i.e. school). This group-dependent intercept can be further decomposed into:

$$\mathbf{b}_{0j} = \mathbf{g}_0 + u_{0j} \quad (2)$$

where \mathbf{g}_0 is the average intercept within the group and u_{0j} is its associated residual. Combining equations (1) and (2) gives us a simple two-level hierarchical model:

$$Y_{ij} = \mathbf{g}_0 + \sum_{h=1}^p \mathbf{b}_h X_{hij} + u_{0j} + e_{ij} \quad (3)$$

where u_{0j} is the residual at the group level, or the between-group error term, and e_{ij} is the residual at the individual level, or the within-group error term. Although we cannot directly observe u_{0j} , additional model assumptions, i.e. $E[u_{0j}] = E[e_{ij}] = 0$, u_{0j} and e_{ij} have known distributions (usually normal), and $\text{cov}(u_{0j}, e_{ij}) = 0$, allow the model parameters and joint residual to be estimated using traditional methods (usually generalized least squares).

The above model can be understood in two ways (Snijders and Bosker 1999). First, the between group error terms, u_{0j} , may be assumed to be fixed, meaning that each group is entered into the equation as a separate parameter. Alternatively, u_{0j} may be viewed as independent identically distributed random variables. A model with the latter assumption is called a random intercept model because the group-dependent intercept and error term are allowed to vary randomly between groups. Random intercept models measure the extent to which outcomes vary between second-level units and allow for this variation to be explained by characteristics at that level. For the current analysis, random intercept models are appropriate for two reasons. First, they allow for the identification of variation in school rates of violence and model this variation with school-level characteristics. And second, this model assumes that the sample of schools is taken from a larger population of normally distributed groups, which corresponds to the intent of Add Health's complex survey design.

By allowing the explanatory variable coefficients (\mathbf{b}_h) to vary between groups (i.e. \mathbf{b}_{jh}), we may also model between-group differences in effects and create random-coefficient, or random-slope, models. In the current study, random slope models would allow me to test if the effect of sports varies by school, which may be important given the hypothesis that sports cultures are locally constructed and defined through individual behavior.

The models presented above assume that the outcome variable is continuous and that the residuals are normally distributed. In cases where the outcome is binary, we may refine equation three by defining the probability of the event occurring, $p_{ij} = \Pr(Y_{it} = 1)$, as following a Bernoulli distribution that can be modeled using a logit link function:

$$\log\left[\frac{p_{ij}}{1-p_{ij}}\right] = \mathbf{g}_0 + \sum_{h=1}^p \mathbf{b}_h X_{hij} + u_{0j} + e_{ij} \quad (4)$$

Coefficient estimates from this procedure are thus interpreted in terms of log-odds, with predicted probabilities derivable for specific parameter values.

Goodness of Fit

For multilevel logistic regression models, goodness of fit and model selection is best approached by examining the deviance statistic and explained variance (R-square). Deviance is defined as:

$$D = 2(\ln f(y|\bar{\mathbf{q}}) - \ln f(y|\hat{\mathbf{q}})) \quad (5)$$

where $f(y|\bar{\mathbf{q}})$ is the loglikelihood for the saturated model and $f(y|\hat{\mathbf{q}})$ is the loglikelihood for the constrained model of interest (Guo and Zhao 2000). The value for this statistic therefore decreases as model fit improves. To test the difference between two nested models, we may subtract the deviance of the model with more parameters from the less constrained model. This difference approximates a chi-square distribution with degrees of freedom equal to the number of added constraints.

The proportion of the variance explained (R-square) is also useful in determining hierarchical logistic model fit (Snijders and Bosker 2000). For these models, R-square may be presented as a function of the variance of the linear prediction, $\mathbf{s}_{\hat{Y}}^2$, and the variances of the within and between group errors:

$$\mathbf{s}_{\hat{Y}}^2 \text{ where } \hat{Y}_{ij} = \mathbf{g}_0 + \sum_{h=1}^p \mathbf{b}_h X_{hij} \quad (6)$$

$$\text{R-square} = \frac{\mathbf{s}_{\hat{Y}}^2}{\mathbf{s}_{\hat{Y}}^2 + \mathbf{s}_u^2 + \mathbf{s}_e^2} \quad (7)$$

For multilevel logit models, the within-group error term, \mathbf{s}_e^2 , is fixed at $p^2/3 = 3.29$.

Intraclass Correlation Coefficient

A final useful statistic for hierarchical modeling is the intraclass correlation coefficient, $r = \mathbf{s}_u^2 / (\mathbf{s}_u^2 + \mathbf{s}_e^2)$. Given an intercept-only model, the intraclass correlation coefficient provides a good summary measure of error variance, with values ranging from “0”, when differences exist entirely within groups, to “1”, when all differences lie at the between-group level. As when determining the R-square, hierarchical models using a logit link have a fixed within-group variance of 3.29.