Gender, Body Size and Social Relations in American High Schools

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To investigate the role of body size in social networks, this study estimated cross-nested multilevel network models (p_2) with longitudinal data from the 16 saturated schools in the National Longitudinal Study of Adolescent Health. As body mass index increased, the likelihood of being nominated by schoolmates as friends – but not the likelihood of nominating others as friends – decreased. This trend was more pronounced among girls. Moreover, similarity in body mass index strongly predicted friendship formation. These findings were not explained by correlates (e.g., academic achievement) of both body size and friendship dynamics. Thus, the connection between body size and high school social relations was largely a function of the stigmatization of heavier body sizes, especially for girls, and of homophily.

Although some cultures assign prestige to large bodies, American culture has historically stigmatized obesity. This stigmatization is so powerful that it encompasses not just the clinically obese or overweight but also any above-average (and even average) body size (Allon 1981; Anderson et al. 1992; Dejong 1980; Puhl and Brownell 2001). In this way, divergence from body size ideals creates a major disadvantage in the relationship market, especially during adolescence, a time in which physical appearance is extremely important. Because bodies are a readily apparent and widely held marker of value and status, larger individuals – even those who are not obese – often have trouble making and maintaining social relationships (e.g., friendships, romantic partnerships). As building blocks of social support and social capital, these relationships are integral to psychological well-being, family formation, socioeconomic attainment and other life

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course processes (Carr and Friedman 2006; Halpern et al. 1998). These social consequences of body size, then, suggest that the long-term implications of currently rising rates of obesity in the United States extend far beyond mortality, morbidity and other physical health issues that tend to generate the most press.

In this study, therefore, we assess multiple sociological mechanisms that link body size to social relations during adolescence, with a special focus on gender. We do so by analyzing the National Longitudinal Study of Adolescent Health (Add Health) with a cross-nested multilevel methodology that recognizes and exploits some of the inherent dependencies in network data.

Body Size, Stigma and Interpersonal Functioning

In the market of relationships, individuals have tastes and preferences for the personal traits of their potential romantic partners and friends that establish the dynamics of supply and demand. For example, Americans tend to prefer partners of the same race, and so one's market is, to some extent, limited by the number of same-race others in the social network (South 1991). Body size operates similarly. Because Americans have preferred physical types for themselves and their potential partners, they incorporate evaluations of body size into self-assessment and other assessments of attractiveness as well as intelligence, congeniality, work values and personal responsibility (Cahnman 1968; Granberg 2006; Lerner and Korn 1972; Quinn and Crocker 1999; Teachman et al. 2003). In this way, body size becomes a component of success and struggle in the relationship market. Like race, therefore, body size is a *physical* characteristic that has been used to construct a *social* status hierarchy in the United States that shapes an individual's social opportunities and personal development (Allon 1981; Crandall 1994).

This phenomenon is clearly seen in the association between body size and personal relationships across life. As body size increases, the number and quality of relationships both decrease (Carr and Friedman 2006; Cawley 2001). These social risks are especially strong for obesity. Yet, ample evidence suggests that even average body size poses such risks (Puhl and Brownell 2003). For example, Halpern and colleagues (1998) found that young girls who were at or slightly below average body size were less likely to date than very thin girls. Thus, the key distinction is not simply between obese and non-obese individuals but among people at different points of the entire body size continuum (Carr and Friedman 2006).

These social ramifications of body size help to explain the persistence of eating disorders in the United States as well as the linkage of excess weight with depression, academic performance and socioeconomic

attainment (Ball, Crawford and Kenardy 2004; Conley and Glauber 2006; Crosnoe and Muller 2004; Goodman and Whitaker 2002; Gortmaker et al. 1993; Pinhey, Rubinstein and Colfax 1997). Moreover, they also signal that the increasing average body size in the United States is not simply a health issue, public or otherwise (National Institutes of Health 2003).

Assessing the Social Consequences of Body Size

Given such long-term implications, these social correlates of body size warrant a closer look. Accurately assessing the role of body size as a commodity in the relationship market, however, is complicated. Simply modeling the number of relationships a person has as a function of her/his body size (and related characteristics) is misleading because such an approach does not take into account that relationships are the product of *two* individuals and that relationships are situated in larger social networks. For example, Bob is more likely to consider Lisa a friend if she considers him a friend and if they have mutual friends.

More than just a conceptual issue, focusing on only one person in a relationship ignores inherent dependencies in network data, which poses challenges for statistical estimation. P* network models correct these dependencies, treating them as noise in the equation that must be removed. Yet, that noise also sheds light on the mechanisms by which personal attributes affect relationships. For example, is the body size of one person in the relationship more important than the other, is it body size itself or a match of sizes that matter, are the apparent consequences of body size a function of clusters of homogeneity within larger networks?

Importantly, recent alternatives to p* methodology allow these dependencies to be modeled explicitly. In particular, the p_2 framework employs cross-nested modeling techniques to estimate how relationships at the level of pairs of actors are nested within nominators *and* nominees (Baerveldt et al. 2004; Lazega and Van Duijin 1997). The p_2 framework will be used here to more accurately quantify the effects of body size – on the nominator, nominee and pair levels – on changes in social relationships. Specifically, we will focus on the emergence of new friendships among high school students, with a special (although not exclusive) interest in girls. This focus is both justifiable and valuable for several reasons.

First, although a general phenomenon, the values attached to body size are heightened in two subsets of the population: 1.) females of all ages and 2.) adolescents of both genders. Women and girls face far more stringent standards of appearance than their male counterparts, so that normal, healthy body types, not just obesity, create social disadvantages (Martin 1996; Wardle, Waller and Jarvis 2002). Further, adolescents are

more likely than children or adults to punish difference and incorporate social feedback into their self-concepts (Eder, Parker and Evans 1995; Elkind 1967; McFarland and Pals 2005). Thus, adolescent girls represent the intersection of two vulnerable groups, where the social consequences of body size are most apparent.

Second, the high school is a vibrant arena of social activity (Barber, Eccles and Stone 2001; Coleman 1995). In this setting, friendships provide status, protection, identity and support for negotiating difficult transitions. Importantly, the nature of adolescent friendships can have a long-term impact, cultivating relationship templates for adulthood. Although romantic relationships become increasingly important during high school and play a major role in adolescent development, they are still less pervasive than friendships during this period and less central to high school social status. Unlike a youth who does not date, a youth without friends is clearly a social isolate (Crosnoe 2000; Giordano 2003; Moody 2001; Strauss and Pollack 2003).

Third, during adolescence, friendships start and end all the time (Giordano 2003). In particular, the emergence of a new friendship captures the relationship market at work. Because tastes and preferences are what bring people together at first, social markers (e.g., body size) matter a great deal early in a friendship before strong emotional bonds develop (Lawler and Yoon 1996). More practically, studying friendship formation also parcels out the feedback between friendships and adolescent development.[2]

The Role of Body Size in High School Social Networks

After the negative effects of body size on high school friendship formation – and gender differences in this process – are established, the next goal will be to assess why this occurs. To answer this question, we draw on some of the core concepts of sociology.

The first mechanism is social *stigma*. If a personal characteristic carries a stigma in a certain context, individuals will likely avoid forming ties with anyone who has it (Goffman 1963). Because they perceive the individual with the stigmatized characteristic to be unattractive or because they do not want to be associated with that stigma, they do not seek out such people as friends and reject relationship overtures from them (Link and Phelan 2001). As already mentioned, the stigma of obesity filters down to non-obese body sizes (Latner et al. 2005; Puhl and Brownell 2003). Consequently, adolescents may be less likely to consider large schoolmates as friends. Within the peer networks of high school, therefore, the stigma hypothesis suggests that the likelihood of receiving friendship nominations will decline with increasing body size.

The second mechanism is *withdrawal*. Individuals who have a personal characteristic that they believe is viewed negatively within their social contexts are likely to avoid the type of socializing needed to make new friends. Fear of rejection and ridicule, therefore, leads to withdrawal as a form of self-protection (Carr and Friedman 2006; Cooley [1902] 1983; Ross 1994). To apply this general *Looking Glass Self* scenario to the topic of this study, larger adolescents will likely engage in fewer attempts to make friends with schoolmates if they fear that these attempts will not be welcomed. Ultimately, they will have fewer friends. This mechanism applies as long as the adolescent believes that her or his body is devalued, regardless of whether it actually is. In network terms, therefore, the withdrawal hypothesis suggests that the number of friendship nominations "sent out" will decrease with increasing body size.

As for the third mechanism, *homophily*, individuals who share similar physical traits, demographic characteristics, personalities and interests are much more likely to connect. This powerful homophily is driven by several factors: a sense of familiarity, fear of differences, shared status and commonalities in social experiences (Billy, Rodgers and Udry 1984; Joyner and Kao 2000; South 1991). In high school, adolescents who have similar body sizes may be attracted to each other for these reasons. Moreover, those with similarly large body sizes may also lack social opportunities beyond each other. If larger body sizes are underrepresented in the school, then homophily would result in a smaller pool of potential friends for these students – fewer potential friends to nominate or be nominated by as body size increases.

Finally, the fourth mechanism is *profiling*. Any one personal characteristic is only a piece of an individual's holistic profile (Magnusson and Cairns 1996). Consequently, what appears to be the influence of one personal characteristic on relationship formation may in fact result from the presence of other characteristics that cluster with it. Confounding factors create the illusion that the characteristic in question is organizing social relations. As discussed above, body size and socioemotional development are related. For example, overweight adolescents tend to to come from more troubled family environments, have lower academic achievement, greater internalizing/externalizing symptoms and lower activity participation (Crosnoe and Muller 2004; Nolen-Hoeksema 1994; Strauss and Knight 1999). *All* of these personal and social factors are related to peer dynamics through their impact on social status and opportunities for interaction (Barber et al. 2001). Thus, the profiling hypothesis suggests that body size appears to influence friendship formation because it co-occurs with other personal characteristics that affect sociability and popularity, not because body size itself is meaningful.

To summarize, our conceptual framework views body size as a physical characteristic with social meaning. It affects how adolescents, especially girls, view themselves and others, which shapes the nature of high school peer networks. This conceptual framework leads to two basic research aims: 1.) the estimation of the number of new friendships among adolescents of different body sizes over a one–year period of high school and 2.) the assessment of whether these expected patterns of friendship formation are explained by the tendency for larger adolescents to receive fewer friendship nominations (stigma), the tendency for larger adolescents to send fewer nominations (withdrawal), the tendency for larger adolescents to send nominations to and receive nominations from other large adolescents (homophily), and the tendency for larger adolescents to have other personal characteristics that reduce the nominations they send and receive (profiling). We expect each of these sociological mechanisms – which are *not* mutually exclusive – to be more heightened for girls than boys.

Methods

Add Health is a representative study of American adolescents in 7th through 12th grades that began in 1994. Using a stratified sampling design, 80 high schools, most containing 9th through 12th grades but some containing 7th and/or 8th grades too, were selected from a list of American high schools based on region, urbanicity, sector, racial composition and size. All schools not containing 7th and 8th grades were then randomly matched to one middle school that fed into them, with the probability of the feeder school being selected proportional to its student contribution to the high school. Nearly all 90,000 students in these 132 schools completed the In-School Survey in the 1994-95 school year. Of these, 20,745 students, selected evenly across high school – feeder school pairs, participated in the Wave I In-Home Interview in 1995, the core analytical sample of Add Health. In 1996, a total of 14,736 adolescents (excluding the Wave I seniors) were followed up in the Wave II In-Home Interview.

At all data points, respondents were asked to nominate up to 10 friends (five male, five female). In Wave I, 16 of the 80 Add Health high schools were selected for saturated data collection. In these schools, all students – as opposed to a probability sample of students – were interviewed, allowing the network structures of the entire student body to be mapped. This study analyzed this saturated school sample. Effectively gauging the degree to which the odds of friendship formation are affected by body size requires body size information on the universe of possible friends over time. If the school population is operationalized as this universe, only the saturated schools contain such information across waves.

Table 1: Descriptive Statistics for Study Sample and Full Sample

	M (SD)	
	Full Wave I	Study Sample
Female	.51	.50
	(.50)	(.50)
Age (years)	16.16	16.26
	(1.73)	(1.49)
White	.50	.49
	(.50)	(.50)
African-American	.23	.20
	(.42)	(.40)
Latino/a	.17	.15
	(.18)	(.30)
Other race/ethnicity	.10	.16
	(.30)	(.37)
Parent education	2.91	2.87
	(1.24)	(1.20)
Wave I BMI	22.56	22.84
	(4.46)	(4.75)
n (adolescents)	20,745	2,728

Source: National Longitudinal Study of Adolescent Health
Note: Study sample included all students in the 16 saturated schools who participated in both Waves I and II.

The individual-level analytical sample for this study, therefore, contained all adolescents in saturated schools who participated in Waves I and II (n = 2,728). Table 1 presents the characteristics of this sample and the original Wave I sample. The analytical sample was older (due to the focus on high schools) and had slightly more educated parents. At the same time, the samples differed slightly in body size, probably because of the aforementioned age difference.

Measures

Most measures in this study were created with Wave I or Wave II data. By linking all adolescents to their friends (adolescents whom they nominated, adolescents who nominated them), we were able to create a version of each measure for both nominator and nominee. Below, we describe in detail the measures used to create these nominator and nominee measures.

Table 2: Descriptive Statistics for Key Study Variables

	M (SD)	
	Individual-Level	Pair-Level
Adolescent Factors [a]		
BMI	22.84 (4.56)	—
Academic achievement	2.71 (.70)	—
Emotional distress	.51 (.35)	—
Athletic status	.43 (.49)	—
Difference in BMI [b]	—	4.86 (4.43)
Difference in achievement	—	.78 (.56)
Difference in distress	—	.39 (.32)
Athletic-matching	—	.13 (.34)
Demographic Factors [c]		
Gender (female)	.50 (.50)	—
Age (years)	16.01 (1.49)	—
Race (white)	.49 (.50)	—
Parent education	2.80 (1.20)	—
Gender-matching	—	.50 (.50)
Difference in age	—	1.10 (.87)
Race-matching	—	.47 (.50)
Difference in parent education	—	1.34 (1.07)
N	2,728	1,837,516

Source: National Longitudinal Study of Adolescent Health

Notes: [a]As described in the Methods section, the first three adolescent factors represented the average of the Wave I and Wave II measures. Athletic status was measured in the In-School Survey only. [b]For all difference scores, the absolute value of the difference was presented. [c]All demographic factors were measured with Wave I data.

Friendship Formation

The dependent variable in all analyses was binary: 1 if adolescent *i* nominated adolescent *i'* as a friend at Wave II, 0 otherwise. To focus on the formation or emergence of new friendships, we selected only those pairs for which *i* did *not* report a friendship with *i'* at Wave I (including the In-School Survey).

Body Mass Index

Because past research suggests that the social risks of large body size are not confined to the obese, we chose to measure body size continuously (Halpern et al. 1998). A ratio of weight to height, body mass index is calculated by {weight (pounds) / height (inches)^2 x 703}. Although standards vary by age and gender, BMI estimates greater than 25 typically designate overweight high school students (Center for Disease Control 2002; National Institutes of Health 2003). Interviewer-measured weight and height was available in Wave II, but only adolescent-reported weight and height was available in both waves. This study, therefore, used the adolescent-reported measures, which correlate with the interviewer measurement at .90 (Goodman, Hinden and Khandelwal 2000).

Worth stressing is that the temporal sequence of the association between individual attributes, such as BMI, and friendship formation was ambiguous. For example, in testing homophily (e.g., BMI similarity leading to friendship formation), the effects of Wave I BMI on friendship formation at Wave II would likely be mediated by a friendship at Wave I, a key control in our analyses. As another example, if Wave II BMI was included as a predictor of friendship formation at Wave II, then the predictor and outcome would be contemporaneous. Thus, we could not be certain that BMI similarity contributed to friendship formation as opposed to the reverse. The ideal remedy would be to measure BMI at some point between Waves I and II. Although such a measure was not possible, we approximated it by averaging the Wave I and II measures, which was accurate to the extent that BMI changed linearly between the waves.

Adolescent Factors

In Waves I and II, adolescents reported their grades in math, science, English and social studies in the past year, which allowed the calculation of a standard four point grade point average. For the same reasons described above for BMI, we then took the average GPA across waves. The Center for Epidemiologic Studies-Depression scale measured emotional distress. This scale was designed to gauge depressive symptoms, such as depressed affect and feelings of guilt and worthlessness (Radloff and Locke 1986). Add Health contained a modified version of the CES-D with 15 of the 20 original items (Resnick et al. 1997). Adolescents were asked how often they

had felt certain things during the past week, with responses ranging from 0 (never or rarely) to 3 (most or all of the time). Examples included "You felt that you could not shake off the blues, even with help from your family and your friends" and "You felt lonely." The mean of these responses (α = .86) was then averaged across the two waves. Finally, we created a binary measure of athletic status (1 = adolescent self reported involvement in at least one athletic activity at school on the In-School Survey).

Of course, other adolescent characteristics might also be contained in a personal profile that includes body size. As a result, we followed Add Health conventions to create measures of parent-adolescent closeness, risky behavior (e.g., drinking), attachment to school, self-esteem and extracurricular participation (Crosnoe 2006). None played a significant role in our multivariate models. Thus, we took a more parsimonious approach to preserve statistical power, focusing on the three factors – academic achievement, emotional distress and athletic status – that were most associated with body size and sociability.

Sociodemographic Characteristics

Gender (1 = female) and age (in years) were measured with Wave I self-reports. We broke the sample into White (49 percent), African-American (20 percent), Latino/a (15 percent), and other (16 percent) categories and created parent-reported measures of family income and parent education (highest level in household, where 0 = no schooling, 1 = less than high school graduation, 2 = high school graduate, 3 = some college, 4 = college graduate, 5 = postgraduate). Income had substantial missing data and few significant effects when entered into multivariate models and, therefore, was dropped from analyses.

Plan of Analyses

The basic hypothesis of this study is that body size affects friendship formation by characterizing the type of adolescent who is designated by others as a friend, the type of adolescent who designates others as a friend, the salient similarity between two adolescents, or other personal factors related to body size and friendship formation. Thus, we estimated a multilevel model, defined by the pair of actors *i* and *i′* at the first level, which are then cross-nested within nominators (*i*) and nominees (*i′*) at the second level. This model parsed dependencies associated with nominators and nominees from effects of substantive characteristics (e.g., body size) between pairs of actors. Because of our focus on the pair level, the sample consisted of all possible pairs of adolescents in school 1, plus all possible pairs of adolescents in school 2, and so on (up through all possible pairs in school 16).

Following the hypothesized mechanisms, the probability that adolescent *i* nominated adolescent *i′* as a friend was a function of the gregariousness or withdrawal of *i*, and the attractiveness or stigma of *i′*. Thus, our formal model is:

$$\textit{level 1(pair)}$$

$$log\left[\frac{p(i \text{ nominates } i' \text{ as a friend})}{1 - p(i \text{ nominates } i' \text{ as a friend})}\right] = \alpha_i + \beta_{i'} \ ,$$

where α_i represents the tendency of *i* to nominate others and β_i represents the tendency of *i′* to be nominated by others.

Applying the multilevel framework with cross-nested random effects, the tendencies to nominate or be nominated are functions of overall tendencies, $\gamma_{\alpha 0}$ and $\gamma_{\beta 0}$, and individual effects for each nominator (u_i) and nominee ($v_{i'}$):

level 2a : nominator (i)

$$\alpha_i = \gamma_{\alpha 0} + u_i \ ;$$

level 2b : nominee (i')

$$\beta_{i'} = \gamma_{\beta 0} + v_{i'} \ .$$

The two random effects, u_i and $v_{i'}$, represent the cross-nesting of nominations, accounting for dependencies between pairs associated with a given nominator or nominee. The advantage of the multilevel framework is that only the variances of these effects need be directly estimated.

An important first step was to compare the unconditional variance of u_i (1.04) with the variance of $v_{i'}$ (1.57). In these data, the frequency with which adolescents were nominated by others had 51 percent more variation than the frequency with which they nominated others. These estimates were not perfect, as some adolescents nominated friends outside their schools or nominated in-school friends who, for some reason, did not participate in Add Health. Yet, the use of the saturated sample provided the best possible data for this analysis.

Two structural constraints also had to be controlled. First, following the original p_1 models (e.g., Holland and Leinhardt 1981) and the subsequent p^* (e.g., Wasserman and Pattison 1996) and p_2 models (Lazega and Van Duijn 1997), we controlled for reciprocity, the tendency for an adolescent to be more likely to nominate another as a friend if the other nominated her. Because we theorized that reciprocity in longitudinal data could be concurrent or lagged, we included whether *i′* had nominated *i* at Wave I (including In-School) or Wave II at the pair level:

$$level\ 1(pair)$$

$$log\left[\frac{p(i\ nominates\ i'\ as\ a\ friend)}{1 - p(i\ nominates\ i'\ as\ a\ friend)}\right] = \alpha_i + \beta_{i'} +$$

$$\delta_1(i'\ nominated\ i\ at\ time\ 1)_{ii'} +$$

$$\delta_2(i'\ nominated\ i\ at\ time\ 2)_{ii'} .$$

Thus, δ_1 and δ_2 represent the effects of lagged and concurrent reciprocity respectively.

Second, we accounted for the nesting of pairs within each of the sixteen saturated schools in Add Health. That is, we controlled for the fact that friendships may have been more common in some schools by including a set of dummy variables in the model for the nominator's school:

$$level\ 2a : nominator\ (i)$$

$$\alpha_i = \gamma_{\alpha 0} + \Gamma'_{\alpha S}[\,d1, d2, d3, \ldots d15\,]_i + u_i.$$

where *d1* through *d15* represent a set of indicators for the schools (school 16 is the default) and $\Gamma'_{\alpha S}$ is a vector of coefficients representing the school effects.

Controlling for nominator and nominee effects through the random terms u_i and $v_{i'}$ and for reciprocity and school effects through fixed effects associated with specific covariates accounted for key dependencies in the data, making other estimates more interpretable. Substantively, we evaluated the withdrawal hypothesis by including a term for nominator BMI, as well as a set of standard covariates related to one's social position (gender, race, parent education and age). Our model 2(a) is now:

$$level\ 2a : nominator\ (i)$$

$$\alpha_i = \gamma_{\alpha 0} + \gamma_{\alpha 1} BMI_i + \gamma_{\alpha 2} female_i + \gamma_{\alpha 3} parental\ education_i + \gamma_{\alpha 4} age_i + \Gamma'_{\alpha S}[\,d1, d2, d3, \ldots d15\,]_i + u_i.$$

Thus, $\gamma_{\alpha 1}$ represents the effect of an adolescent's BMI on the likelihood that she nominated someone else in her school as a friend, controlling for her background characteristics and structural constraints. A second model included an interaction term between the BMI of the nominator and the gender of the nominator.

To evaluate the stigma hypothesis, we constructed a comparable model for nominees:

$$level\ 2b : nominee\ (i')$$

$$\beta_{i'} = \gamma_{\beta 0} + \gamma_{\beta 1} BMI_{i'} + \gamma_{\beta 2} female_{i'} + \gamma_{\beta 3} parental\ education_{i'} + \gamma_{\beta 4} age_{i'} + v_{i'}.$$

Thus, $\gamma_{\beta 1}$ represents the effect of an adolescent's BMI on the likelihood that she was nominated by someone else in her school as a friend, controlling for background characteristics and structural constraints. Again, we then extended this model by adding an interaction term between the BMI and gender of the nominee.

The level 1 model for the homophily hypothesis is:

$$\textit{level 1(pair)}$$

$$\begin{aligned} \log\left[\frac{p(i \text{ nominates } i' \text{ as a friend})}{1 - p(i \text{ nominates } i' \text{ as a friend})}\right] = {} & \alpha_i + \beta_{i'} + \\ & \delta_1(i' \text{ nominated } i \text{ at time 1})_{ii'} + \\ & \delta_2(i' \text{ nominated } i \text{ at time 2})_{ii'} + \\ & \delta_3 \left| BMI_i - BMI_{i'} \right|_{ii'} + \\ & \delta_4(i \text{ and } i' \text{ are same gender})_{ii'} + \\ & \delta_5(i \text{ and } i' \text{ are same race})_{ii'} + \\ & \delta_6(i \text{ and } i' \text{ both play sports})_{ii'} + \\ & \delta_7 \left| \text{parental education}_i - \text{parental education}_{i'} \right|_{ii'} + \\ & \delta_8 \left| age_i - age_{i'} \right|_{ii'}. \end{aligned}$$

To evaluate this homophily hypothesis, we included terms for the absolute value of the difference between nominator and nominee in BMI in level 1 of our model. To control for alternative hypotheses associated with background characteristics, we also included covariates for whether *i* and *i′* were the same gender, race or athletic status, and the absolute value of the difference between *i* and *i′* in parent education and age. To complete the test, we re-estimated this model with the nominator measures (e.g., controls, BMI) and then with the nominee measures. To account for gender differences, we then interacted the BMI difference score with a set of dummy variables designating the gender composition of the friendship pair: both girls, both boys, boy nominator/girl nominee, girl nominator/boy nominee.

Evaluation of the profiling hypothesis required an elaboration of the withdrawal, stigma, and homophily models. To the withdrawal model, we added measures of the nominator's academic achievement and emotional distress, and we elaborated the stigma model in the same way with nominee measures. If such inclusions attenuated the BMI effect in the original models, then the profiling hypothesis would be supported; factors associated with body size were driving the observed BMI effects. Elaboration of the homophily model involved the inclusion of measures of the difference scores, between nominator and nominee, of achievement and distress and the examination of the attenuation of the coefficient for the BMI difference score.

These multilevel models were estimated in HLM (Bryk, Raudenbush and Congdon 2002). These models did not exactly have the p_2 framework (e.g., Hoff 2003; Lazega and Van Duijn 1997; Snijders and Bosker 1999), primarily because they did not estimate a correlation between the nominator and nominee effects nested within each respondent (e.g.,$p_{\alpha\beta}$, where $i = i`$). Unfortunately, popular software packages cannot handle correlated cross-nested random effects of this sample size. Model estimates, therefore, only approximated maximum likelihood since they depended on the assumption that the correlation between nominator and nominee effects was zero (conditional on the fixed effects included in the model).

Although accounting for correlated nominator and nominee effects would be ideal, we have two reasons to believe that the model estimates were reasonably robust with respect to violations of the assumption of uncorrelated effects. First, simulation studies that we conducted indicated that the primary consequence to our model estimates when $p_{\alpha\beta} \neq 0$ was a biased estimate of the reciprocity parameter. Although the tendency towards reciprocity in networks is strong, reciprocity was not a major focus of our study and the bias of our parameters of interest depended only indirectly on the correct estimation of reciprocity. Second, many of the factors that might explain the correlation between a respondent's tendency to send and receive ties were included in the models as fixed effects. To the extent that we could account for correlated nominator and nominee effects using measured covariates (e.g. demographic characteristics, lagged reciprocity, BMI, etc.), we reduced the potential that our model estimates were biased.

Worth noting is that the number of minority youth varied considerably across the 16 schools. Moreover, creating matching scores for race/ethnicity within pairs – necessary for the homophily models – resulted in six dummy variables. Both issues stretched statistical power. Consequently, we collapsed race/ethnicity into a single binary variable (1 = White, 0 = non-White), only after establishing that doing so did not affect other results of our models.

Results

Friendships in High School

The average BMI in the study sample ranged from 13.53 to 51.37, with a mean of 22.84. By gender, the average was 23.21 (range: 13.81-51.37) for boys and 22.47 (range: 13.53-44.30) for girls. These numbers, on par with national averages, reveal a good deal of variation in body size.

Table 3 presents statistics for three subgroups of adolescents, by gender: those with BMI at least one standard deviation below the mean,

within one standard deviation of the mean, and at least one standard deviation above the mean. For each, we calculated the average number of friends nominated by the adolescents (out-nominations) and the average number of times that adolescents were nominated as friends by others (in-nominations). The key distinction for out-nominations was between the low BMI group, who sent out the most friendship nominations, and all others. The key distinction for in-nominations was between the high BMI adolescents, who received the fewest nominations, and everyone else. Thus, increasing BMI was related to fewer friendships, but this trend differed somewhat depending on whom was asked about the friendship. Looking at gender, larger girls appeared more vulnerable to peer isolation.

Table 3: Friendship Nominations by Body Mass Index

	Low BMI	Average BMI	High BMI
All Students			
Mean number of out-nominations	2.69^{a}	2.29^{b}	2.32^{b}
Mean number of in-nominations	2.53^{a}	2.41^{a}	1.78^{b}
N	274	2067	387
Boys			
Mean number of out-nominations	2.71^{a}	2.31^{b}	2.35^{b}
Mean number of in-nominations	2.47^{a}	2.46^{a}	1.90^{b}
N	106	1045	210
Girls			
Mean number of out-nominations	2.67^{a}	2.27^{b}	2.28^{b}
Mean number of in-nominations	2.57^{a}	2.36^{a}	1.63^{b}
N	168	1022	177

Source: National Longitudinal Study of Adolescent Health

Notes: The sample was split into three BMI categories, with the breakpoints at one standard deviation below the mean and one standard deviation above the mean. Within categories, means with different subscripts were significantly different ($p < .01$), as determined by *t*-tests comparing any one group versus the other two.

Given the strong correlation between BMI and age, we re-estimated these statistics within each grade level. The only observed difference was that the advantage of the low BMI youth over the high BMI youth in both friendship indicators became less pronounced in the highest grade levels.

Before turning to the specific investigations of our four hypothesized mechanisms, we conducted some preliminary model-building that needs to be discussed. The unconditional multilevel model included no predictors of friendship formation (adolescent nominating another adolescent as a friend *for the first time* at Wave II) as a method of estimating the baseline variation in the outcome in the sample. As mentioned in the Methods section, the variation was 1.04 for out-nominations and 1.57 for in-nominations. This difference could reflect the fact that, by the nature of the data collection, the number of out-nominations was constrained to 10 while the number of in-nominations was not constrained; conceivably, all schoolmates could nominate the adolescent, but she or he could only nominate 10 schoolmates. Yet, examination of the range of friendship nominations made by adolescents in the sample has revealed little evidence that such constraints were problematic (Moody 2001). Moreover, variance estimates often favor in-nominations (Blau 1967). These statistics, therefore, suggest that more of the action to be explained occurred in how body size was assessed by others than by the self.

Next, we added the structural controls to this model in order to account for the school-based clustering and network dependencies. The school dummy variables had a significant collective effect, as did the two measures of reciprocity (especially the Wave II version). These latter findings indicate that Bob was more likely to nominate Lisa as a friend at Wave II if Lisa had nominated Bob as a friend at Wave II (contemporaneous effect) than at Wave I (lagged effect). This expected pattern supports the need to control for network dependencies. The tests of the hypothesized mechanisms were then built into this model.

Processes of Social Stigma and Withdrawal

The stigma model predicted the likelihood of friendship formation by the characteristics of the adolescent receiving the nomination (Model 1, Table 4). In addition to the basic demographic factors and BMI, this set of adolescent characteristics included athletic status because athletes, especially boys in football and basketball, often have large body sizes that are not devalued. In this model, the BMI of the adolescent being nominated predicted a new friendship nomination, regardless of that adolescents' own friendship nominations. Specifically, a one-unit increase in adolescent BMI was associated with a 3 percent decrease in the odds of making a new friend. Although small, this effect was five times larger

Table 4: Results of Social Stigma Multilevel Models

	Model 1		Model 2	
	Logistic Coefficient (*SE*)	Odds Ratio	Logistic Coefficient (*SE*)	Odds Ratio
Adolescent Factors				
Nominee BMI	-.03***	.97	-.03***	.97
	(.00)		(.00)	
Nominee athletic status	.13*	1.14	.14*	1.15
	(.06)		(.06)	
Demographic Factors				
Nominee gender (female)	-.07	.93	-.08	.92
	(.05)		(.05)	
Nominee age (years)	-.04	.96	-.04	.96
	(.02)		(.02)	
Nominee race (white)	-.08	.92	-.08	.92
	(.11)		(.11)	
Nominee parent education	.04	1.04	.04	1.04
	(.02)		(.02)	
Structural Factors				
Wave I reciprocity	1.34***	3.81	1.34***	3.81
	(.08)		(.08)	
Wave II reciprocity	4.27***	71.52	4.26***	70.81
	(.06)		(.06)	
Interaction Term				
Female x nominee BMI	—	—	-.03***	.97
			(.01)	
Nominator-level variance	.41	—	.39	—
Nominee-level variance	.61	—	.61	—
n (adolescents)	2,728	—	2,728	—
n (pairs)	1,837,516	—	1,837,516	—

Source: National Longitudinal Study of Adolescent Health

Notes: All models controlled for school location (with dummy variables for each of the 16 schools).

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

than the nominator effect. Also, BMI and athletic status were the only nominee characteristics related to friendship formation. The significant interaction between nominee BMI and gender (see Model 2) indicated that, as expected, this effect was more pronounced among girls.

The withdrawal model predicted the likelihood of friendship formation by the characteristics of the adolescent nominating others. Because neither the main effect of nominator BMI nor its interaction with gender was

Table 5: Results of Homophily Multilevel Models

	Model 1		Model 2	
	Logistic Coefficient (*SE*)	Odds Ratio	Logistic Coefficient (*SE*)	Odds Ratio
Adolescent Factors				
Nominee BMI	-.03***	.97	-.03***	.97
	(.00)		(.01)	
Nominee athletic status	.01	1.01	.02	1.02
	(.07)		(.06)	
Demographic Factors				
Nominee gender (female)	-.06	.94	—	—
	(.05)			
Nominee age (years)	-.04	.96	-.01	.99
	(.02)		(.03)	
Nominee race (white)	-.54***	.58	-.54***	.58
	(.12)		(.12)	
Nominee parent education	.07**	1.07	.07**	1.07
	(.02)		(.02)	
Nominator/Nominee Difference Scores[a]				
Difference in BMI	-.03***	.97	-.02***	.98
	(.01)		(.01)	
Athletic-matching	.23**	1.26	.21**	1.24
	(.06)		(.06)	
Boy-boy pair	—	—	.14*	1.15
			(.07)	
Boy-girl pair	—	—	-.13*	.88
			(.06)	
Girl-boy pair	—	—	-.14*	.87
			(.07)	
Difference in age	-.02***	.98	-.08***	.92
	(.01)		(.03)	
Race-matching	1.14***	3.13	1.15***	3.16
	(.06)		(.06)	
Difference in parent education	-.13***	.88	-.14***	.87
	(.02)		(.02)	
Structural Factors				
Wave I reciprocity	1.29***	3.63	1.16***	3.19
	(.08)		(.08)	
Wave II reciprocity	4.17***	64.71	3.99***	54.05
	(.06)		(.06)	
Interaction Terms				
Boy-boy x difference in BMI	—	—	.02	1.02
			(.01)	
Boy-girl x difference in BMI	—	—	.02	1.02
			(.01)	
Girl-boy x difference in BMI	—	—	.00	1.00
			(.02)	

Table 5 *continued*

	Model 1		Model 2	
	Logistic Coefficient (*SE*)	Odds Ratio	Logistic Coefficient (*SE*)	Odds Ratio
Nominator-level variance	.55	—	.49	—
Nominee-level variance	.62	—	.59	—
n (adolescents)	2,728	—	2,728	—
n (pairs)	1,837,516	—	1,837,516	—

Source: National Longitudinal Study of Adolescent Health
Note: All models controlled for school location (with dummy variables for each of the 16 schools). [a] The absolute value was used for all difference scores between continuous measures (BMI, age, parent education).
*p < .05 **p < .01 ***p < .001

significant, we have not presented the results of the withdrawal analyses. These null results indicate that, although larger adolescents – especially girls – were less likely to be nominated by others as friends, they did not differ from peers in the number of friends whom they nominated.

Body Size and Homophily

Because the strong human tendency towards homophily could also link BMI to friendship formation, we estimated a new set of multilevel models that included nominee measures (because the models described above revealed that the nominee effects were more important than nominator effects) and a measure of the absolute value of the difference between the BMI of nominee and nominator (as well as difference scores for each demographic factor and athletic status). This model demonstrates the advantage of the multilevel framework, which allows the disentangling effects at the individual level (nominee/nominator) from those at the pair level.

As seen in Table 5 (Model 1), the odds of a new friendship forming decreased slightly as the difference in BMI increased. Adolescents tended to nominate as friends those with their same demographic profile (e.g., age, race) and athletic status, and, to a lesser extent, those who had similar bodies. Because overweight students were less common in these schools, this homophily would logically constrain the size of their friendship networks. At the same time, the lack of attenuation of the nominee BMI measure by the pair-level BMI measure indicated that the processes of stigma and homophily were at work independently of each other. In Model 2, the interactions between gender composition of the friendship pair and

Table 6: Results of Two Profiling Multilevel Models

	Model 1 [a]		Model 2 [b]	
	Logistic Coefficient *(SE)*	Odds Ratio	Logistic Coefficient *(SE)*	Odds Ratio
Adolescent Factors				
Nominee BMI	-.03***	.97	-.03**	.97
	(.00)		(.01)	
Nominee athletic status	.12*	1.13	.02	1.02
	(.06)		(.07)	
Nominee academic achievement	.09*	1.09	.09*	1.09
	(.04)		(.04)	
Nominee emotional distress	.04	1.04	.11	1.12
	(.08)		(.09)	
Demographic Factors				
Nominee gender (female)	-.09	.91	-.09	.91
	(.06)		(.06)	
Nominee age (years)	-.04	.96	-.05	.95
	(.02)		(.02)	
Nominee race (white)	-.08	.92	-.53***	.59
	(.11)		(.11)	
Nominee parent education	.03	1.03	.06*	1.06
	(.02)		(.02)	
Nominator/Nominee Difference Scores [c]				
Difference in BMI	—	—	-.02***	.98
			(.01)	
Athletic-matching	—	—	.20**	1.22
			(.06)	
Difference in achievement	—	—	-.43***	.65
			(.04)	
Difference in distress	—	—	-.20***	.82
			(.08)	
Gender-matching	—	—	.20***	1.22
			(.04)	
Difference in age	—	—	-.02***	.98
			(.01)	
Race-matching	—	—	1.13***	3.09
			(.06)	
Difference in parent education	—	—	-.12***	.89
			(.02)	
Structural Factors				
Wave I reciprocity	1.33***	3.78	1.27***	3.56
	(.08)		(.08)	
Wave II reciprocity	4.27***	71.52	4.13***	62.17
	(.06)		(.06)	

Table 6 *continued*

	Model 1 [a]		Model 2 [b]	
	Logistic Coefficient *(SE)*	Odds Ratio	Logistic Coefficient *(SE)*	Odds Ratio
Nominator-level variance	.41	—	.53	—
Nominee-level variance	.62	—	.60	—
n (adolescents)	2,728	—	2,728	—
n (pairs)	1,837,516	—	1,837,516	—

Source: National Longitudinal Study of Adolescent Health
Notes: All models controlled for school location (with dummy variables for each of the 16 schools). [a]Elaboration of Stigma Model from Table 4. [b]Elaboration of Homophily Model from Table 5. [c]The absolute value was used for all difference scores between continuous measures (BMI, age, parent education).
*p < .05 **p < .01 ***p < .001

BMI difference revealed that homophily was similarly strong among cross-gender and same-gender friendships.

Body Size and the Personal Profiles of Adolescents

To test the possibility that spurious factors drove the observed associations between individual BMI and friendship formation, we re-estimated the models already presented with controls for athletic status (already included in the prior models) as well as academic achievement and emotional distress. Because the withdrawal model yielded no significant effects for nominator BMI, we only re-estimated the stigma and homophily models. Table 6 presents the results from these expanded models.

Beginning with stigma (Model 1), controlling for the achievement and distress levels of the adolescents nominated as friends did not attenuate the association between nominee BMI and friendship formation, although nominee achievement did predict a greater likelihood of new friendship formation. A similar pattern emerged in the expanded homophily model (Model 2), which included measures of the nominee's academic achievement and emotional distress as well as difference scores for achievement and distress between nominator and nominee. Although the odds of friendship formation declined with increasing differences in achievement and distress, controlling for these two factors did not attenuate the homophily effect of BMI. Finally, additional models with gender interaction terms (not shown) replicated earlier results; specifically, the stigma effect was stronger for girls even controlling for other adolescent factors, and the homophily effect did not differ by gender composition of the friendship pair.

Thus, the observed role of social stigma and homophily in organizing adolescent networks by body size did not appear to be a function of the clustering of body size with other desired or undesired personal characteristics. This pattern held for both genders.

Discussion

Beginning in earnest with the theoretical insights of Goffman (1963), sociologists have long been interested in the meanings and values attached to the body. Working from this rich literature, this study posited that body size would be an important component in the market of social relationships through a variety of mechanisms that tapped the interplay between self and other (Cahnman 1968; Carr and Friedman 2006; Dejong 1980). To test this basic hypothesis, we drew on longitudinal data and network techniques to map the emergence of friendships over the course of two years in a context – the high school – in which body size has heightened visibility.

To summarize our findings, we concluded that larger body sizes constrained the size of adolescents' friendship circles in high school, primarily because of the stigma attached to larger bodies (in-nominations decreased as BMI increased, especially for girls) and because larger adolescents were homophilous (in-nominations increased as BMI-matching increased). These findings did not hold for adolescents who were larger because of their athletic endeavors, and they were not driven by the other socioemotional factors, like academic achievement and emotional distress, that can covary with body size and that can also serve as bases for homophily.

These findings illustrate the tendency for physical characteristics with social meanings, like skin color, to influence how individuals view themselves and how they are viewed by others. Body size is a clear example. Because of widespread body type ideals in American culture, body size is an ingredient in the overall social status of any person in the United States but especially in subgroups for whom these social messages are acutely felt, such as adolescents in general and adolescent girls in particular (Crandall 1994; Puhl and Brownell 2003). Our findings suggest that larger adolescents try to engage in the social world of their high schools but that these attempts often go unanswered by their schoolmates. They are answered, however, by other similarly sized adolescents, some of whom are also likely to devalue large bodies despite their own physical profile (Davison and Birch 2004). Consequently, larger adolescents, especially girls, are likely to be somewhat segregated and isolated in their school networks.[3] This potential social marginalization is consequential because of its clear links to academic success and other aspects of healthy functioning and

adjustment (Crosnoe and Muller 2004; Ge et al. 2001). For these reasons, health interventions and programs targeting weight should address the socioemotional side of the issue, incorporate peer-based strategies, and recognize that the non-physical risks of body size are not simply confined to the highest end of the BMI continuum.

Of course, this general pattern likely varies considerably across different contexts and groups. The most obvious example is race/ethnic variation, but other questions need to be asked. Do the social risks of body size vary across other stages of the life course (e.g., adulthood)? This question seems particularly relevant given evidence reported here that these social risks decline with age. Do the social risks of body size vary across other sectors of the relationship market (e.g., romantic pairings) and as a function of different (and differently evolving) attachment patterns with parents and other adults? We also need to know more about the end results of these social patterns. For example, how might the experience of stigma affect mental health? Might it engender weight loss strategies? After all, losing weight over time was more common in Add Health than gaining it. Might such strategies be healthy or unhealthy? Such future research should pay close attention to the methodological challenges (e.g., reciprocity and other network dependencies, carry-over of relationships, feedback between relationships and individual functioning) that can complicate the accuracy of cataloging the impact of any personal characteristic, including body size, on relationship dynamics and their later consequences. Longitudinal data are needed, as are network techniques such as p_2 methodology.

Documenting, unpacking and understanding this connection between body size and social relations is a valuable enterprise. Not only does it touch on some of the core tenets of sociological theory (e.g., the social construction of the self), it also adds a layer of nuance to concerns about the expansion of the collective American waistline. As more people become overweight, their exposure to social stigma and its very real consequences will increase but so too will the pool of similar others who are potential friends and mates. As reflected in current debates in the media (see the recent *New York Times* feature by Kolata on the anti-fat phenomenon), the non-physical consequences (including risks) of this secular trend are real.

Notes

1. Add Health is a program project designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris and funded by grant P01-HD31921 from the National Institute of Child Health and Human Development, with cooperative funding from 17 other agencies. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design of Add Health. Persons interested in obtaining data files from Add Health should contact Add Health, Carolina Population Center, 123

W. Franklin St., Chapel Hill, NC 27516-2524 (www.cpc.unc.edu/projects/addhealth/data/contract).

2. Although not a central focus of this study, race and socioeconomic status are obviously intricately tied to the social consequences of body size (Crandall 1994; Latner, Stunkard and Wilson 2005). Body size itself as well as the values and meanings attached to it vary across these demographic lines. Thus, any consideration of the effects of body size on high school friendship formation should carefully take race and socioeconomic status into account.

3. This study focused on the number of relationships forming over time but cannot speak to the quality of those relationships. The quantity vs. quality issue needs to be evaluated carefully to determine the amount of social support that exists for individuals at different points on the body size continuum (Carr and Friedman 2006).

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