

**Whose influence matters:
Determinants of convergence in body weight among adolescent friends**

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Abstract

Social scientists have demonstrated that interpersonal contacts are important for several aspects of well-being, including health and health behaviors such as body weight. Whereas these studies have suggested that there is a relationship between one's contacts and weight, no comparable efforts have been dedicated to understanding how friendship influences on weight can occur. Using data from the nationally representative Longitudinal Study of Adolescent Health (Add Health) we adopt a 3-tier approach that includes characteristics of the individual, his/her friend, and their friendship to investigate the following questions: (1) Which personal characteristics are associated with reductions in weight differences between friends? (2) Which friends become more similar in terms of weight over time? And (3) which friendships are more likely to facilitate joint weight change in the friendship dyad? Preliminary findings show that friends become more dissimilar in terms of weight over time. Indicators of attractiveness and social well-being have the most potential to explain weight differences in friends over time. Social well-being seems to predict larger differences between friends several years later, while physical appearance tends to predict subsequent weight convergence.

Introduction

About one in five children and adolescents in the U.S. are categorized as obese (Flegal et al. 2010; Ogden and Carroll 2010). Extensive research efforts have been dedicated to exploring the reasons for the increasing prevalence of obesity over the past 30 years in the U.S. and around the world. An emerging interest is the possible role of social influences. Social scientists have demonstrated that interpersonal contacts are important for several aspects of well-being. Research to date has shown that friends' body weights are strongly correlated and that there is evidence at least consistent with friendship influences on weight (de la Haye et al. 2011). At the same time, very little is known about how influences might occur – most studies that have found strong evidence have looked only at friends' weights rather than at behaviour and changes in behaviour, and the few that have examined possible pathways of influence have found only limited evidence (e.g. Renna, Grafova and Thakur 2008). Yet, if we believe that friends influence obesity and that friendships can provide a tool for promoting healthier living, then we must understand how such influences take place. Further, we must also understand which relationships are influential and who in a relationship is the one exerting or receiving the influence. To take this important next step, our research uses a nationally representative longitudinal dataset, the National Longitudinal Study of Adolescent Health, to address the following research questions:

1. Which personal characteristics are associated with reductions in weight differences between friends?
2. Which friendships become more similar in terms of weight over time?

Social influences on health

Social connections can promote, discourage and sanction attitudes and behaviors (Crosnoe, Cavanagh and Elder 2003; Hallinan and Williams 1990; Urberg 1992) and thereby influence health and health behaviors (Bahr et al. 2009; Schlundt et al. 1990). Pressure and behavior modeling from these connections are predictive of smoking, delinquency, and substance use in adolescence among other behaviors (Glaser, Shelton and van den Bree 2010; Simons-Morton and Farhat 2010; Simons-Morton and Haynie 2003). Previous research also suggests that social contacts may influence participation in organized sports (Kohl and Hobbs 1998), dieting (Haines and Neumark-Sztainer 2006) and food choices (Cullen et al. 2004). Influences from peers and other close connections can manifest as social pressure, social modelling and imitation, social comparison and behavior approximation (Brechwald and Prinstein 2011), or a combination of these making friendships a powerful source to change and modify behaviors.

Influential relationships in health behaviors

Not all social relations are equally important: the closer and stronger the connection, the broader and stronger the possibilities for influence (Christakis and Fowler 2008; Duncan, Duncan and Strycker 2000; Lin 2001). The signalling and information exchanges that occur between friends - as individuals who know each other, trust each other, and have each other's well-being at heart - require special attention. Messages transmitted through this kind of connection are expected to be more clearly understood and more likely to be internalized, making friends potentially more influential for health behaviours than other social connections among peers (Berten and Rossem 2011; Crosnoe and Muller 2004; Schofield et al. 2007; Urberg 1992).

Further, findings from several studies suggested that the importance of friends is not equal across individuals and across types of friendships, with the significance of reported associations often hinging on the definition of friends selected by the researcher or available in the data employed.

With respect to the types of friendships that have may be more influential based on previous studies, the strongest empirical support was for friendships reported by the respondent and for reciprocal friendships, which are reported by both members of a friendship dyad (Schofield et al. 2007). Gender concordance mattered, with the BMIs and obesity of same-sex friends being strongly associated with each other, while cross-sex friends' weights were not significantly associated with respondent's weight (Christakis and Fowler 2007, 2008; Renna, Grafova and Thakur 2008). Other research has shown that the physical activity of the first-nominated friend, but not second- and third- nominated friends, significantly predicting respondent's physical activity (Schofield et al. 2007).

The characteristics of the individuals in a friendship dyad may matter as well. Some studies argue that influences from friends are stronger between females (Halliday and Kwak 2009; Renna et al. 2008; Valente et al. 2009), but there is evidence supporting the opposite (Christakis and Fowler 2007). However, there is no evidence supporting that friends' influences on BMI among underweight individuals, suggesting non-linear relationships between friends' and ego's weight.

Friend influences on body weight

A number of students have examined evidence of friends influence on body weight. However, these studies do not agree on their findings, some report that there is evidence of significant friend influences on body weight, while others report no significant associations in fully adjusted models, and even others report mixed results depending on the specific relationship under study or the model specification . The strongest and most consistent support for friendship influences on body weight is provided by the studies that investigate the relationships between *friends' own body weight* and respondent's weight and obesity risks. The majority of studies taking this approach used longitudinal analyses and rigorous study designs with extensive controls and multiple robustness checks. The magnitude of the association ranged from not significant to significant odds of obesity 3.5 times higher if a friend was obese compared with not obese.

Data and Methods

We use the National Longitudinal Study of Adolescent Health (Add Health), which is representative of the U.S. population enrolled in grades 7 through 12 in American schools in 1995. To ensure diversity, the sampling was stratified by region, urbanicity, school sector, size, and racial composition. Each high school in the sample was matched to one of its feeder schools, with the probability of the feeder school being selected proportional to its contribution to the high school. The resulting sample from this multistage design consisted of 132 schools from 80 communities. Baseline data, including information on friendships, were collected from over 90,000 students in 1994-95 and included all students in the selected schools (Harris et al. 2003). More detailed data, including health information, were collected in an In-Home survey in 1995, for which a sub-sample of students was recruited from each school. About 200 students from each school pair (High School and Middle School) were randomly selected to participate in the In-Home survey, resulting in a self-weighting sample of 20,745 adolescents (Harris 2003). Adolescents were asked to nominate up to five male and five female friends. They could choose friends from the school roster or they could nominate any of their non-school friends.

The analytic sample used here consists of the respondents who participated in Waves I and III of data collection and had "identifiable best friends," the resulting sample is reduced to 2,028. "Identifiable best friends" are respondents who were nominated as best friends in the In-School questionnaire and were also selected to participate in the In-Home Wave, thus also participated of the survey. Add Health interviewed all students within the sample schools, so that if the friend was a student in the school, he or she was included in the In School questionnaire. However, since only

about 200 students per school were selected for the In-Home survey, where health related items are asked, only those students in the In-Home waves have body weight information. After list-wise deletion the final sample consists of 1,003 respondents linked to at least one friend. The analysis is constructed of friendship dyads, with each respondent forming a dyad with each of his or her identifiable friends.

The main outcome for the study is the difference in BMI between the friends at each wave. This is predicted by individual characteristics of the respondent and of the friend (gender, age, race/ethnicity, GPA, parents' years of schooling, and whether the family received food stamps) and characteristics of the friendship (a measure of closeness of the friendship at Wave I, constructed with principal component analysis from respondent's reports of the frequency of hanging out with the friend after school and on weekends, of talking on the phone, and of talking about problems). We also include control characteristics of the friends' school environment (size of the student body, public or private school, and urban or non-urban location). Additional measures of health behaviors and personal characteristics at Wave III will be included in subsequent models (we will include measures of body image, dieting, exercise, etc. which are available from the Add Health datasets).

Linear regression models with survey weights and adjustment for clustering at the respondent level were estimated in the following general form:

$$BMI_{z_2} - FBMI_{z_2} = \beta_0 + \beta_1 s_c + (\beta_2 t_w - r_b) + \beta_3 v_h + \beta_4 w_s + e$$

where the left-hand side variable is the difference between own and friend's weight at each wave, predicted additively by own characteristics, friend's characteristics, characteristics of the friendship, and, for waves other than the first, the difference between the weight of the friends at the first wave.

In additional models, we calculated individual-level fixed effects to estimate, for a given individual, the characteristics of the friends and friendship that predict the greatest similarity.

Results

Differences in Weight

Table 1 presents linear regressions on the difference between own and friend's weight at Wave III, seven years after they were initially identified as friends. Most individual characteristics that are typically predictive of weight, such as gender, race, parental education are not strong predictors of difference in weight among friends. Rather, weight differences among friends are primarily related to self-image and social well-being. Most importantly, self-image and social well-being seem to operate in different directions. When the individual feels socially accepted or is rated as attractive by the interviewer, the differences between the respondent and their friend are smaller. However, when the best friend is considered physically attractive, the difference between the index child and his/her friend increases. That is not the case with the social well-being of the best friend, which, as with the respondent's social well-being it is related to a smaller gap between the friends' weight.

Who matters more?

Table 2 turns to the possible importance of differences between the respondent and the friend. We test a possible scenario in which the best friend may score higher in all characteristics when compared to the index respondent. When the best friend has more desirable physical traits, such as being more attractive, there are larger differences between the weight of the respondent and that of the friend. In contrast, social well-being measures such as feeling happy or accepted point in the opposite direction, that is, adolescents who are more engaged and satisfied with their social and personal life seem to be more accepting of different body sizes, as the difference between their body size and that of their friends seems to be larger.

Figure 1

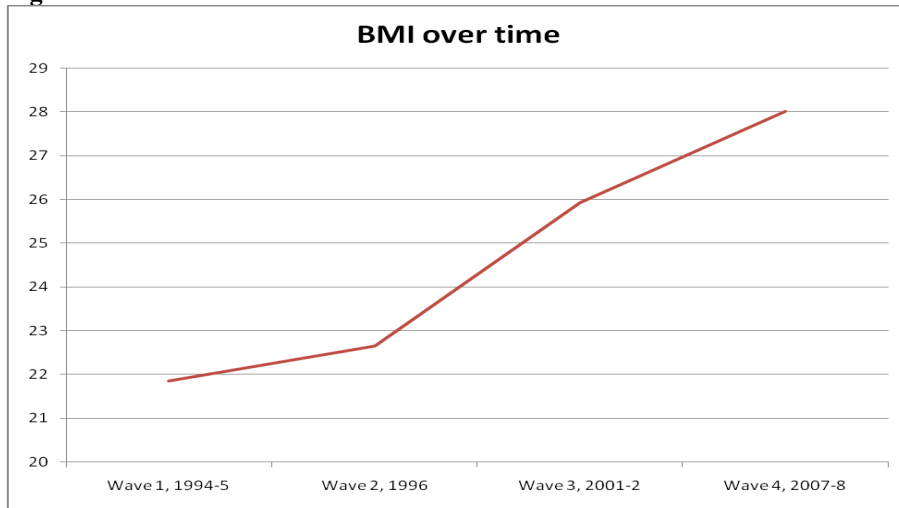


Figure 2

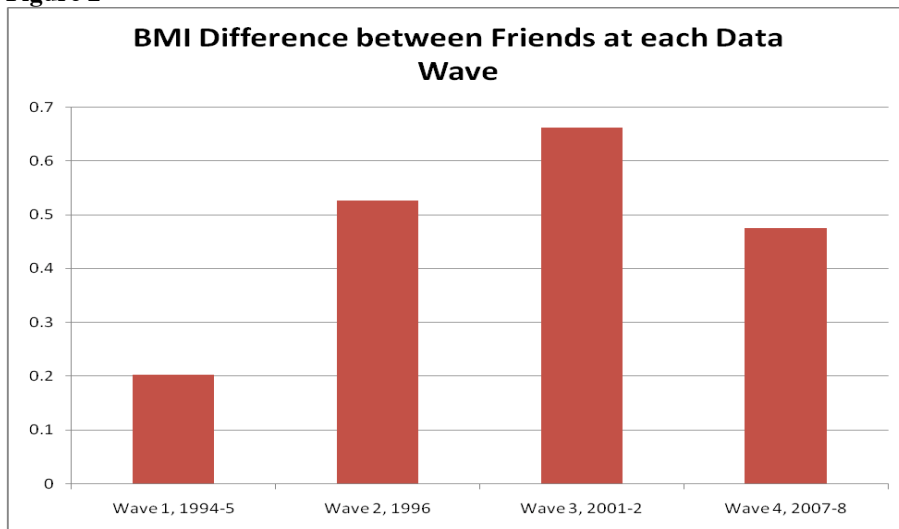


Table 1: Own, friend, and friendship characteristics as predictors of differences in BMI between the friends 7 years after baseline, N=1,003

	Model 1	Model 2	Model 3	Model 4
	Respondent characteristics	Friend's Characteristics	Friendship's Characteristics	Initial BMI Difference
Respondent's characteristics				
<i>Personal</i>				
Female	-0.86	-1.18+	-1.23+	-0.68+
Age	-0.08	-0.08	-0.09	0.01
White (reference)				
Black	2.12+	1.41	1.39	1.13
Hispanic	1.03	0.94	0.84	1.46+
Asian	-0.10	-2.60	-2.64	0.00
Other	1.18	0.88	0.81	0.1
<i>Family environment</i>				
Parental education	-0.18	-0.18	-0.19	-0.08
Received food stamps	0.74	0.84	0.80	0.27
<i>School environment</i>				
Urban school	-0.83	-0.64	-0.61	-0.51
Public school	-0.15	-0.18	-0.19	-0.37
School size	0.00	0.00	0.00	0.00
Years in School	0.34	0.42*	0.42*	0.35*
GPA	-0.20	-0.23	-0.23	0.00
<i>Adjustment and personality</i>				
Friendship nominations from schoolmates	-0.13+	-0.13	-0.14+	0.01
Number of reciprocated friendships	0.46	0.37	0.37	0.04
Feels socially accepted	-1.02*	-1.09*	-1.08*	-0.02
Feels close to schoolmates	0.32	0.25	0.22	0.12
Feels happy at school	0.26	0.37	0.4	0.01
Feels part of school	-0.69	-0.59	-0.59	-0.2
Is attractive (1)	-1.15**	-1.22**	-1.22**	-0.36
Is nice (1)	0.34	0.34	0.35	0.13
Is well-groomed (1)	-0.48	-0.52	-0.52	-0.32
Friend's characteristics				
<i>Personal</i>				
White (reference)				
Black		1.79	1.82	1.70
Hispanic		-0.25	-0.19	-0.19
Asian		3.70+	3.70+	0.81
Other		0.96	0.98	-0.02

<i>Family environment</i>				
Parents' education		-0.01	-0.01	-0.16*
<i>School environment</i>				
Years in school		-0.19	-0.19	-0.17
GPA		-0.06	-0.05	-0.09
<i>Adjustment and personality</i>				
Feels socially accepted		-0.53	-0.54	-0.26
Is attractive (1)		0.49	0.49	0.34+
Is well-groomed (1)		0.43	0.43	0.13
Friend's ranking among total		0.27**	0.28**	0.07
Friendship Characteristics				
Joint Activities (PCA)			0.24	0.03
Difference in BMI between friends (Wave I)				1.15**
Constant	13.99*	11.59+	12.11+	5.57
R-squared	0.09	0.12	0.12	0.62

Robust t-statistics in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Note: (1) Interviewer rated.

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Table 2: Own characteristics and differences between self and friend as predictors of differences in BMI between the friends 7 years after baseline, N=1,003

	Wave III
Respondent's characteristics	
<i>Personal</i>	
Female	-1.60**
Age	-0.11
White (Reference)	
Black	1.35
Hispanic	0.68
Asian	-0.38
Other	0.81
<i>Family environment</i>	
Parents education	-0.04
Receives food stamps	-0.13
<i>School environment</i>	
Urban school	-0.33
Public school	0.42
School size	0.00
Years in School	0.34*
GPA	-0.23
<i>Adjustment and personality</i>	
Number of Friends	0.36**
Number of friends at school from total	0.03
Nominations received from schoolmates	-0.1
Number of reciprocal friendships	0.31
Feels socially accepted	-1.13**
Feels close to schoolmates	0.42
Feels happy at school	-0.06
Feels part of the school	-0.45
Attractive (1)	-0.70+
Nice (1)	0.03
Well-groomed (1)	-0.13
Compared to Respondent, Friend...	
Is of the same race	-0.54
Is more attractive (1)	1.39**
Is Nicer (1)	-1.00
Is better groomed (1)	-0.01
Feels more socially accepted	-0.91+
Has higher GPA	0.39
Is Happier at school	-1.26**
Has more highly educated parents	0.39
Friendship Characteristics	
Joint Activities (PCA)	0.39*
Constant	9.75+
R-squared	0.13

Robust t-statistics in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Note: (1) Interviewer rated.

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