The presence of friends increases food intake in youth[1–3]

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ABSTRACT

Background: Friendship may be uniquely relevant and influential to youths' eating behavior.

Objective: This study examined how overweight and nonoverweight youths adjust their level of eating as a function of their familiarity with their eating partner.

Design: Twenty-three overweight and 42 nonoverweight youths had the opportunity to play and eat with a friend (n = 26) or with an unfamiliar peer (n = 39). The dependent variables of interest were the amount of nutrient-dense and energy-dense foods children consumed and their total energy intake.

Results: Participants eating with a friend ate substantially more than did participants eating with an unfamiliar peer. Furthermore, overweight youth, but not nonoverweight youth, who ate with an overweight partner (friend or unfamiliar peer) consumed more food than did overweight participants who ate with a nonoverweight eating partner. Matching of intake was greater between friends than between unfamiliar peers.

Conclusions: These results extend previous research by suggesting that the effect of the partners' weight statuses may add to the facilitative effect of familiarity and result in greater energy intake in overweight youth and their friends. Behavioral similarity among overweight youth may increase the difficulty of promoting long-term changes because the youths' social network is likely to reinforce overeating. This trial was registered at clinicaltrials.gov as NCT00874055. *Am J Clin Nutr* 2009;90:282–7.

INTRODUCTION

Friendship may be uniquely relevant and influential to children's and adolescents' eating behavior. Youths examine the behavior of their friends to determine whether to engage in behaviors such as smoking or drinking alcohol (1–3), and we contend that youths' eating behavior is also largely determined by the normative influence of their friends and peers.

Research in adults has shown that the effects of others on eating behavior is not ubiquitous and that the direction of these effects is related to the relation between the eating partners Shide and Rolls (4) found that males eating with friends ate significantly more than males eating alone, whereas males and females eating with strangers did not eat more. Similarly, de Castro (5) reported that social facilitation of eating [ie, the presence of others enhances the emission of a response—in this case eating (6) for research on social facilitation] occurred with the presence of friends and family members but not in the presence of unfamiliar individuals (*see* references 7 and 8 for the effect of familiarity). Conceivably, friends may act as "permission givers" and push upward the limit of acceptable eating, which results in increased consumption (9). Conversely, the presence of strangers may increase the salience of conveying a good impression and suppress food intake (10).

Overweight youths may be more sensitive to the characteristics of their partners than are nonoverweight children (11). On the one hand, they may attempt to decrease their food intake in front of unfamiliar peers to avoid incurring the stigma related to overweight individuals who eat excessively (10, 12, 13). On the other hand, the presence of an overweight eating partner may decrease the overweight youth's inhibition and result in greater food intake (14).

This study examined the effect of weight status and acquaintance on overweight and nonoverweight youths' food intake. On the basis of research in adults, we predicted that participants eating with a friend would eat significantly more than would participants eating with an unfamiliar peer and that the magnitude of this effect would be greater for boys than for girls (7). We further hypothesized that overweight youth, but not normal-weight youth, eating with an overweight friend or peer would have a greater energy intake than would overweight participants eating with a nonoverweight eating partner (14). We also predicted that the effect of a partner's weight status and the facilitative effect of familiarity would be additive and that overweight friends would eat more than would participants in all the other conditions.

A secondary aim was to assess whether acquaintance and a partner's weight status would influence the magnitude of matching of intake. On the basis of previous research on matching of intake as a function of familiarity in children (15), we expected a greater matching of intake among unfamiliar peers than among friends.

SUBJECTS AND METHODS

Overview and design

Overweight and nonoverweight boys and girls had the opportunity to play and eat with a friend or with an unfamiliar peer

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for 45 min. The dependent variables of interest were the amount of nutrient-dense and energy-dense foods the children consumed as well as their total energy intake.

Participants

The participants included 31 boys and 41 girls between 9 and 15 y of age (mean ± SD: 13 ± 1 y). Forty participants (22 girls and 18 boys) were between the 15th and the 85th body mass index (BMI) percentile, and 32 (13 boys and 19 girls) were at or above the 85th BMI percentile. Participants were excluded if they were below the 15th BMI percentile; did not report at least a moderate (5 on a 7-point Likert scale) liking for the foods used in the study; had dietary restrictions, food allergies, or religious or ethnic practices that limited their food choices; had a cold or upper respiratory distress; had current psychopathology or developmental disability; and/or were taking medications or had conditions that could influence their food intake (eg, methylphenidate).

Recruitment and randomization

The participants were recruited from an existing database, posted flyers, and mass mailings and then randomly assigned to an unfamiliar peer (n = 39 pairs) or a friend (n = 33 pairs) condition. The participants in the friend condition were recruited with a same-sex friend (≤1 y apart). The parent of the participant recruited was informed that the experiment required their child to bring a friend for the experimental session. To preserve the privacy of the friend's family, the parent of the recruited child was asked to give our contact information to the parent of their child's friend. The Children and Youth Institutional Review Board of the University at Buffalo approved all procedures used in this study, and all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

Procedures

On arrival to the laboratory, participants heard an assent script and were asked to sign if they were willing to participate. Parents were asked to read and provide written consent. Participants completed a 24-h food recall and were asked to rate their hunger level on a 5-point Likert scale. This was to ensure that the participants did not consume any food 2 h before their appointment as they were previously instructed. If the participants did consume food within the 2-h time period, the participants were rescheduled for another session. Participants and either their friend or an unfamiliar peer were accompanied to a room where they had free access to preweighed energy-dense and nutrient-dense foods (described below) as well as an assortment of games and puzzles (described below). The participants were instructed that they could eat as much or as little as they liked while they were playing. Children were observed by the experimenter from an adjacent room via a closed-circuit camera affixed to the wall of the laboratory room where time allocated to eating and active and passive leisure activities were recorded. At the end of the 45 min of free play, the remaining food was reweighed to determine the participants' food intake in kilocalories. The amount in grams of energy-dense and nutrient-dense foods was recorded. Next, the youths' height and weight were assessed, which was followed by a debriefing about the purpose of the study. The participants' friends and peers were compensated for their time with a $20 gift card to a local store.

Food and games

The participants had access to 2 energy-dense and 2 nutrient-dense foods (**Table 1**). These items were presented in large bowls (20 oz, 591.47 mL) to avoid any reference to portion size cues, which could have influenced food intake. Each participant was given individual preweighed bowls of snacks, and they were asked not to share their bowls with the other participant. The participants were also provided with 8 oz (236.50 mL) of fresh water and a 1.5-L pitcher of water to refill their cups as needed. As an alternative to eating, the participants were provided with different games and activities, including some books, puzzles, board games, and agility games (list available on request to the author).

Analytic plan

Because we used a free-eating paradigm, each youth was both a participant and a partner. The data were stacked following the Double Entry Method developed by Kenny et al (16). The data of each participant was entered twice: once as a "partner" and once as a "participant."

Individual characteristics

Double data entry and a quality check were performed before the statistical analysis was performed to ensure the accuracy of the data. Preliminary analyses of variance (ANOVAs) were performed on baseline variables (food intake before the session and hunger or liking of the study food) to determine whether there were differences between conditions. A Levene's test of equality of variance was performed to test the assumption of homogeneity of variance across conditions.

Food consumption data

This study examined how overweight and nonoverweight youths modify their level of eating as a function of their familiarity with their eating partner. The analysis of these data requires accounting for dyadic analysis, which violates the assumption of independence between observations required for

TABLE 1
Experimental foods used in the experiment

	Serving size	Energy	Fat	Carbohydrate	Protein
	g	*kcal*	*g*	*g*	*g*
Nutrient-dense foods					
Baby carrots[1]	250	103	<1	26	3
Grapes[2]	250	178	<1	44	2
Energy-dense foods					
Potato chips[3]	80	429	29	43	6
Cookies[4]	125	560	26	91	4

[1] Wegmans Food Markets Inc, Rochester, NY.
[2] Unifrutti of America Inc, Philadelphia, PA.
[3] Frito-Lay, Plano, TX.
[4] Mini Oreo cookies; Nabisco Kraft Foods Global Inc, Northfield, IL.

ANOVA. The analysis of these data was completed by using mixed regression models (MRMs; also called random-effects models). MRMs provide a useful approach to account for interdependence in 2-person relationships (17–19). These models allow simultaneous estimates of the parameters of the regression model and the variance components that account for the data clustering (17). MRMs, with SPSS software (20), were used to analyze the data.

Three mixed regression models were conducted to assess the relation between the youths' food intake (ie, total energy intake and consumption of nutrient-dense and energy-dense foods) and the following predictors:

$$\begin{aligned}\text{Total energy intake} = {} & a + b_1(\text{acquaintance}) \\ & + b_2(\text{weight status}) + b_3(\text{weight status partner}) \\ & + b_4(\text{sex}) + b_5(\text{acquaintance} \times \text{weight status}) \\ & + b_6(\text{weight status} \times \text{weight status partner}) \\ & + b_7(\text{acquaintance} \times \text{sex}) \qquad (1)\end{aligned}$$

To test the hypothesis that the effect of weight status (overweight youth eat more with overweight youth) and the facilitative effect of familiarity (friends eat more than unfamiliar peers) were additive, we conducted a likelihood ratio test. A chi-square test was used to compare the log-likelihood of the simpler model and the log-likelihood of the more complex model involving the weight status of the participant and the weight status of the eating partner and their interaction. We expected greater total energy intake when overweight participants were eating with an overweight friend.

Relation between co-eaters' food intake

The second question of interest was whether acquaintance and the weight status of the eating partners were related to similarities in intake. The assessment of relations between 2 measures via Pearson correlations applies only to situations in which members of a dyad are distinguishable (ie, one unequivocally belongs to the X group and the other unequivocally belongs to the Y group). When the designation of members of a pair is arbitrary (ie, when there is no way to disentangle variability due to a specific individual), intraclass correlation coefficients (ICCs) provide accurate estimations of the magnitude of the relations between variables (21, 22), and they are interpreted in the same fashion as were Pearson correlations (16). Matching of intake was indexed by the ICCs, which were calculated with the "reliability" procedure (20) by using a one-factor random model (23).

RESULTS

Individual characteristics

Characteristics of the study population are presented in **Table 2**. Three participants were African American and 5 were Hispanic or Latino. The remainder of the sample was white. The results of the ANOVAs indicated no significant differences between groups in self-reported hunger or liking of the study food ($P > 0.15$ for all).

Food consumption data

Our first hypothesis related to the effect of the relation between participants. The results of the regression models indicated that acquaintance predicted the participants' total energy intake [$F(1,24) = 18.75$, $P < 0.01$], intake of energy-dense foods [$F(1,123) = 19.81$, $P < 0.01$] as well as their consumption of nutrient-dense foods [$F(1,124) = 5.87$, $P < 0.03$]. Participants eating with a friend had a greater energy intake and consumed more energy-dense and nutrient-dense foods than did participants eating with an unfamiliar peer (**Figure 1**). We further predicted that the magnitude of this effect would be greater for boys than for girls. The interaction of sex by acquaintance was significant for consumption of energy-dense foods [$F(1,123) = 3.78$, $P = 0.05$]. Males (mean ± SD: 196 ± 193) and females (mean ± SD: 236 ± 197) eating with a peer did not differ in terms of energy-dense food intake. However, the male friends (mean ± SD: 483 ± 259) consumed significantly more energy-dense foods than did the female friends (mean ± SD: 298 ± 195).

We further hypothesized that overweight youths, but not normal-weight youths, eating with an overweight friend or peer would have a greater energy intake than would overweight participants eating with a nonoverweight eating partner. The interaction of participants' weight status by partners' weight status also predicted food intake [$F(1,124) = 8.74$, $P < 0.02$], consumption of energy-dense food [$F(1,123) = 5.67$, $P < 0.02$], and consumption of nutrient-dense foods [$F(1,124) = 5.74$, $P < 0.02$]. Overweight participants eating with an overweight partner had a greater energy intake and consumed more nutrient-dense and more energy-dense food than did overweight participants eating with a nonoverweight eating partner. In contrast, nonoverweight participants eating with other nonoverweight participants ate more energy-dense food than did nonoverweight participants eating with overweight youths (**Figure 2**). However, inspection of **Table 3** seems to indicate that nonoverweight participants were influenced by the weight status of strangers, but not by the weight status of their friends. Nonoverweight participants eating with an overweight unfamiliar peer had

TABLE 2
Age and BMI-for-age percentiles (SD) of the participants as a function of their eating partners' weight status and acquaintance[1]

	Peer		Friend	
	Overweight (n = 32)	Nonoverweight (n = 46)	Overweight (n = 14)	Nonoverweight (n = 38)
Age (y)	13.4 ± 1	13.1 ± 1	13.6 ± 1	13.5 ± 1
BMI-for-age percentiles	94.37 ± 4	55.7 ± 23	92.9 ± 5	55.9 ± 23

[1] All values are means ± SDs.

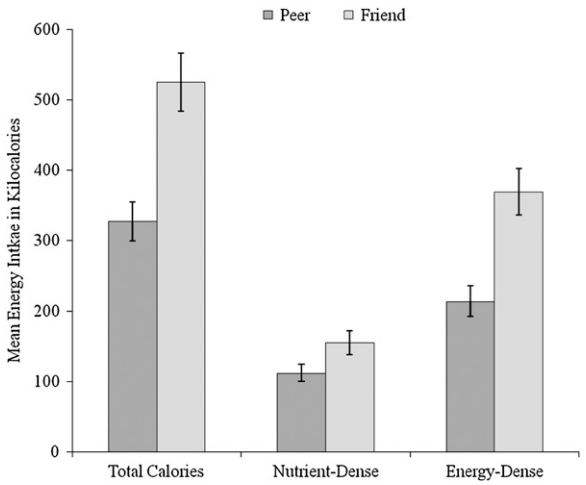

FIGURE 1. Mean (±SE) energy intake and consumption of energy-dense and nutrient-dense foods among peers (n = 78) and friends (n = 52).

a lower energy intake than nonoverweight participants who were eating with nonoverweight strangers; whereas this was not the case for nonoverweight participants eating with their friends.

The likelihood ratio test indicated that the effect of weight status of the co-eaters and the effect of acquaintance were additive. The more complex model involving the partners' weight statuses and the interaction of partner's weights status significantly improved the fit of the model [$\chi^2(3) = 40.6$, $P < 0.001$]. As expected, overweight participants eating with an overweight friend had a greater energy intake than did participants in all other conditions (Table 3).

Relation between co-eaters' food intake

The ICCs as a function of acquaintance and weight status of the eating partners are shown in **Table 4**. Matching of intake was high and statistically significant in all conditions, with the exception of the dyads of overweight unfamiliar peers and overweight friends for the consumption of nutrient-dense foods.

When comparing ICCs among friends and strangers, all coefficients were found to be statistically significant. However contrary to our expectations, the friends' matching of total intake (ICC = 0.81) was greater than the strangers' matching of total intake (ICC = 0.58, $Z = -2.5$, $P < 0.05$). The friends' matching of energy-dense foods (ICC = 0.81) was also greater than the peers' matching of energy-dense foods (ICC = 0.47, $Z = -3.4$, $P < 0.001$). Matching of intake among friends for consumption of nutrient-dense foods (ICC = 0.64) was only marginally higher than matching among unfamiliar peers (ICC = 0.55).

DISCUSSION

This study examined how overweight and nonoverweight youths modify their level of eating as a function of their familiarity with their eating partner. Findings indicate that both overweight and nonoverweight participants eating with a friend ate significantly more than did participants eating in the presence of an unfamiliar peer. These results are consistent with research in adults indicating that eating that takes place among strangers is in marked contrast with eating that occurs among friends and family members (4, 5, 8). This study further supports previous findings (12, 24), ie, that overweight participants eating with an overweight partner had a greater energy intake and consumed more nutrient-dense and more energy-dense food than did overweight participants eating with a nonoverweight eating partner. The present data further extend our previous work in showing that overweight friends ate more than participants in all the other conditions, which suggests that the effect of the partners' weight statuses may add to the facilitative effect of familiarity (friends eat more than unfamiliar peers) and result in greater energy intake in overweight youth and their friends. In contrast, nonoverweight participants seemed to be influenced by the weight status of strangers, but not by the weight status of their friends. Nonoverweight participants eating with an overweight unfamiliar peer had a lower energy intake than did nonoverweight participants who were eating with nonoverweight strangers; however, nonoverweight participants eating with their

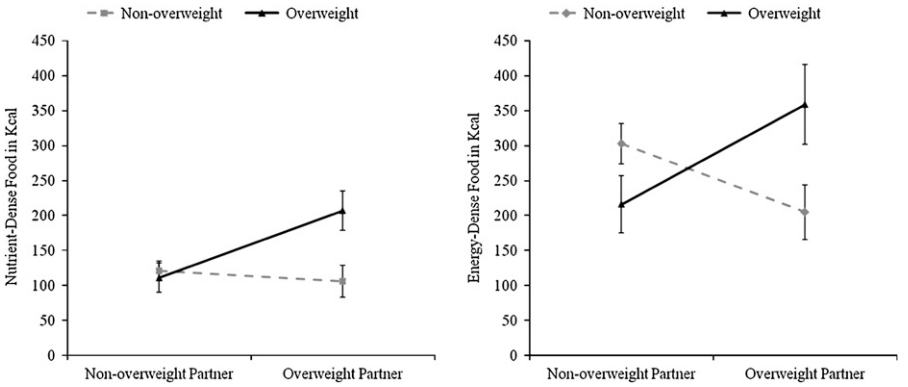

FIGURE 2. Mean (±SE) energy intake from nutrient-dense and energy-dense foods. Left panel: results of a mixed regression model indicated an interaction of the partners' weight status on consumption of nutrient-dense foods ($P < 0.02$). Overweight participants eating with an overweight partner (n = 20) consumed more nutrient-dense food than did overweight participants eating with a nonoverweight eating partner (n = 25). Nonoverweight participants eating with other nonoverweight participants (n = 60) consumed more nutrient-dense foods than did nonoverweight partners eating with an overweight eating partner. Right panel: interaction of partners' weight status on consumption of energy-dense foods ($P < 0.02$). Overweight participants eating with an overweight partner consumed more energy-dense foods than did overweight participants eating with a nonoverweight eating partner. Nonoverweight participants eating with other nonoverweight participants consumed more energy-dense foods than did nonoverweight partners eating with an overweight eating partner.

TABLE 3
Participants' energy intake (in kcal) as a function of their eating partners' weight status and acquaintance[1]

	Peers		Friends	
Participants	Overweight	Nonoverweight	Overweight	Nonoverweight
Overweight	493 ± 280 (14)	271 ± 257 (17)	738 ± 444 (6)	444 ± 323 (8)
Nonoverweight	216 ± 205 (17)	345 ± 207 (30)	515 ± 321 (8)	506 ± 248 (30)

[1] All values are means ± SDs; *n* in parentheses.

friends consumed more food regardless of the partners' weight status.

Because this study did not involve an "eat alone" comparison group, it is not clear whether overweight participants overate in the company of friends or whether they suppressed their intake in the presence of unfamiliar peers or both. One possibility is that friends decrease inhibition, act as a permission giver for indulging and overeating, and push upward the limit of acceptable eating. Conceivably, individuals interacting with well-known others (friends or relatives) are generally assured of their affection and have less need to monitor what and how much they eat to convey a good impression. Alternatively, it is possible that overweight participants paired with friends were eating as much as they would normally eat when at home, whereas overweight individuals paired with unfamiliar eating partners were restricting their intake. Regardless of the direction of the effect, however, the intake of one partner likely influenced the intake of the other youth, implicating some form of feedback loop or modeling as a causal factor.

In fact, matching of intake was high in all conditions with the exceptions of the dyads of overweight unfamiliar peers (for the consumption of nutrient-dense food, energy-dense food, and total energy intake) and overweight friends for the consumption of nutrient-dense foods. Furthermore, the relation between coeaters' food consumption was greater among friends than among unfamiliar peers. These results are important considering the role of friends as agents of change in childhood and adolescence. Christakis and Fowler (25) recently described the spread of obesity among adults with shared social networks, implicating some form of social influence as a causal factor. The present study shows that some more proximal factors may be involved, and that similarity in weight status may result, at least in part, from the normative influence of friends. Conceivably, children and youth use the amount of food eaten by their family and friends as an indication of appropriate eating, and repeated exposure to these norms presumably shapes eating habits and behaviors over time and contributes to similarity in weight status and behaviors. Research shows that friendship functions protectively when children are similar to their friends in terms of prosocial tendencies and as a risk factor when there is behavioral concordances in negative traits (26). Behavioral similarities among overweight youths may increase the difficulty of promoting long-term changes because the youths' social network is likely to reinforce overeating.

This study is not without limitations. First, it is important to note that our sample did not include an even distribution of participants across conditions, which may qualify the results. Observation of the means across experimental cells indicates that nonoverweight participants eating with an overweight participant consumed significantly less food than nonoverweight participants eating with a nonoverweight partner. However, the number of participants in this condition ($n = 6$) does not allow us to draw firm conclusions from this data. Second, our sample was small and homogenous in terms of ethnicity. Research shows some ethnic differences in terms of body-image concerns and pressure to be thin (27), and it is possible that these differences extend to the effect of social influence on eating behavior. These findings may not generalize to youth from other geographic regions, and the limited scope of this study prevents generalizing beyond the children who participated in the study. Finally, this study focused on youth's snack consumption, and it is not clear whether similar results would be obtained for mealtime behaviors or whether the effect of friends and unfamiliar peers on the youths' food intake is sustained over days across several eating episodes. Nevertheless, the data depict a coherent pattern of results that suggests new directions for research in the area of peer influence on youths' eating behavior. Research in adults described a similarity in weight statuses among friends (25). Future research would benefit from exploring mechanisms responsible for similarity in body weight and eating behaviors and whether friends and peers can be used to promote positive change in youth.

TABLE 4
Intraclass correlation coefficients (ICCs) between the partners' intake as a function of their eating partners' weight status and acquaintance[1]

	Total energy		Nutrient-dense energy		Energy-dense energy	
	Peers	Friends	Peers	Friends	Peers	Friends
Overweight/overweight	0.34 (14)	0.68[2] (6)	0.09 (14)	0.35 (6)	0.41 (14)	0.82[2] (6)
Nonoverweight/overweight	0.65[2] (34)	0.91[2] (16)	0.51[2] (34)	0.64[2] (16)	0.43[2] (34)	0.87[2] (16)
Nonoverweight/nonoverweight	0.48[2] (30)	0.79[2] (30)	0.53[2] (30)	0.73[2] (30)	0.65[2] (30)	0.79[2] (30)

[1] *n* in parentheses. Matching of intake was indexed by the ICCs, which were calculated with the SPSS Software reliability procedure (SPSS Inc, Chicago, IL) by using a one-factor random model.
[2] $P < 0.05$.

The authors' responsibilities were as follows—S-JS (Principal Investigator): conducted the data analyses, wrote the manuscript, and financed, conceptualized, and designed the study; MH: scheduled the participants, ran the study sessions, entered the data, and assisted with writing the manuscript; MR (Project Coordinator): ensured the data quality, prepared the data set for the statistical analyses, and assisted with writing the manuscript; and EM: scheduled the participants, ran the study sessions, and entered the data. All authors certified that they had no financial interests to disclose nor any conflict of interest.

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