The Role of Close Friends in Adolescent Obesity and Related Eating and Activity Behaviors

by

Carly Beth Slutzky

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Graduate Supervisory Committee:

Kimberly A. Updegraff, Chair
Bonnie Gance-Cleveland
Masumi Iida
David R. Schaefer
Sandra D. Simpkins

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ABSTRACT

Growing concern about obesity prevalence among youth has prompted the examination of socio-environmental influences that shape the development of eating and activity behaviors believed to regulate weight. Given the presumed significance of close friendships during adolescence, the present investigation assessed longitudinal relations between friends' physical activity, sedentary activity, and healthy eating behaviors and explored whether friends' obesity-promoting behaviors are linked to heightened obesity risk among adolescents. This prospective study utilized two Waves of data from 862 reciprocal and 1908 nonreciprocal same-sex friend dyads participating in the National Longitudinal Study of Adolescent Health. To account for nonindependence tied to membership in a particular friendship dyad, multi-level models were estimated for indistinguishable (i.e., reciprocal) and distinguishable (i.e., nonreciprocal) friend pairs using the Actor Partner Interdependence Model. Adolescents' self-reported physical activity and healthy eating were significantly associated with their own and their friends' physical activity and healthy eating one year later; the strength of socialization across friend dyads did not vary with the frequency of interaction between friends or the stability of friendships over time. Limited support was found for a cumulative risk model of obesity-promoting behaviors as a predictor of increased obesity risk; heightened risk for weight gain was found only for adolescents whose reciprocal same-sex friends reported a higher number of obesity-promoting eating and activity behaviors. Overall, study findings highlight the role of close friends for adolescents' obesity risk and obesity-related

behaviors. Stronger evidence of socialization resulted for adolescents that perceived their friends to be salient social models, as reflected by their acknowledgement of an existing friendship with such peers (i.e., reciprocal friends and nominators within nonreciprocal friend dyads).

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Introduction

The prevalence of overweight and obesity among youth have risen to alarming rates over the last four decades and now represent a significant public health concern (Lobstein, Baur, & Uauy, 2004; Skelton, Cook, Auinger, Klein, & Barlow, 2009). Estimates from the most recent National Health and Nutrition Examination Survey indicate that among U.S. children and adolescents ages 2-19, 32% over are overweight and 16.9% are obese (Ogden & Carroll, 2010; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). The magnitude of this growing health crisis is underscored by the numerous implications of excess weight in youth. For example, overweight youth are at heightened risk for developing various health problems, including cardiovascular disease, hypertension, sleep apnea, and Type 2 diabetes (Bibbins-Domingo, Coxson, Pletcher, Lightwood, & Goldman, 2007; Must, 2003; Vivier & Tompkins, 2008). Youth with excess weight also are more likely than their normal weight peers to experience social and emotional maladjustment characterized by social stigmatization, poor peer relationships, and lower self-esteem (Puhl & Latner, 2007; Strauss, 2000; Strauss & Pollack, 2003). Furthermore, the economic burden associated with obesity is significant, as hospital costs for treating pediatric obesity and related health complications have not only tripled since 1979, but overall health-care costs associated with treating obesity in the US are projected to rise to 950 billion dollars by 2030 (Wang & Dietz, 2002; Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). The far-reaching negative consequences of obesity necessitate the examination of factors believed to underlie the development of weight problems among youth.

Obesity, or excess body weight, purportedly emanates from a dynamic interplay between genetics, ecology, and socio-demographic characteristics (Burniat, Cole, Lissau, & Poskitt, 2002; Moreno, Pigeot, & Ahrens, 2011). Recent AMA guidelines stipulate that youth are categorized as overweight when their Body Mass Index (BMI) is between the 85^{th} and 95^{th} percentile for sex and age and obese when their BMI is $\geq 95^{th}$ percentile for sex and age (Barlow, 2007; CDC, 2010). BMI (i.e., weight/height^2) is considered the standard for classifying weight status among youth (Tyler & Fullerton, 2008). High BMI results from an energy imbalance in the body, in that there is superfluous energy intake (i.e., excess calorie consumption) and insufficient energy expenditure (i.e., exercise) to regulate weight (Fields & Higgins, 2008). Because eating is the primary source of energy intake and activity is the primary source of energy expenditure, these behaviors are believed to be key determinants of energy imbalance, or the development of excess weight.

The obesity-related eating and activity domains are multi-faceted, encompassing several specific behaviors that simultaneously contribute to excess weight (Moreno et al., 2011). Both physical activity (e.g., exercise and sports participation) and sedentary behaviors (e.g., watching TV and playing video games) represent key indicators of activity, whereas eating includes various indicators of dietary intake (e.g., fruit and vegetable consumption) and meal frequency (e.g., skipping breakfast; Jimenez-Pavon et al., 2011; Rodriguez, Sjoberg, Lissner, & Moreno, 2010). Extant data suggest that low physical activity, high sedentary activity, and unhealthy eating are unique and significant

antecedents of obesity risk, such that BMI is positively associated with unhealthy eating and activity behaviors (e.g., Nelson, Gordon-Larsen, Adair, & Popkin, 2005; Phillips, Bandini, Naumova, Cyr, Colclough, Dietz, 2004; Rosenberg, Norman, Sallis, Calfas, & Patrick, 2007; Sanchez et al., 2007; Singh, Kogan, Van Dyck, & Siahpush, 2008). Taken together, eating behaviors, physical activity, and sedentary behaviors characterize a constellation of behaviors that significantly contribute to overall energy balance and contribute to youth weight problems.

Adolescence and Obesity-Related Behaviors

Adolescence is a critical period during which youth are at heightened risk for developing both obesity and unhealthy obesity-related behaviors that may persist throughout adulthood (Adair, 2008; Dietz, 1994; Neumark-Sztainer, 1999). Research suggests that risk for obesity during adulthood increases throughout childhood and adolescence, such that overweight adolescents are at higher risk than younger children for future weight problems (Serdula et al., 1993; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Heightened risk for obesity and unhealthy eating and activity behaviors is likely tied to the myriad of developmental changes during adolescence (Adair, 2008; Dietz, 1994). Most notably, puberty triggers an increased demand for dietary intake and changes in body composition, with these changes likely dictating eating behaviors (Frelut & Flodmark, 2002). Additionally, adolescents' increased inclination to spend more time outside the home or without parental supervision and adolescents' increased need for autonomy likely explain their proclivity to make intrinsically gratifying (i.e., rather than healthy) choices about activity and eating (Lerner & Steinberg, 2009).

Adolescents' heightened vulnerability for developing unhealthy obesity-related habits is reflected by the high number of adolescents that reportedly do not adhere to recommendations for maintaining a healthy lifestyle and a normal weight (Munoz, Krebs-Smith, Ballard-Barbash, & Cleveland, 1997; Neumark-Sztainer, Story, Hannan, & Croll, 2002; Sanchez et al., 2007).

Despite national guidelines and health promotion initiatives, such as Healthy People 2010, that were established to improve obesity-related habits (DGA, 2005; USDHHS, 2000), the majority of adolescents both engage in less than the recommended sixty minutes of moderate-to-vigorous physical activity (MVPA) on most days of the week and engage in more than the recommended 2 hours or less a day of sedentary activities, such as watching TV (Gordon-Larsen, Nelson, & Popkin, 2004; Gordon-Larsen, McMurray, & Popkin, 1999). Less than optimal dietary intake also is evident among adolescents as, for example, many report consuming less than the recommended 5 daily servings of fruits and vegetables and fail to limit their fat consumption to less than 30% of their overall energy intake (Neumark-Sztainer et al., 2002; Sanchez et al., 2007). The significance of these prevalent obesity-promoting behaviors is furthered underscored by data indicating that unhealthy eating and activity behaviors tend to worsen as youth move through adolescence and also tend to cluster into an unhealthy lifestyle (Gordon-Larsen et al., 2004; Hardy, Bass, & Booth, 2007; Kahn et al., 2008; Lytle, Seifert, Greenstein, & McGovern, 2000; Sanchez et al, 2007.; Utter, Neumark-Sztainer, Jeffrey, & Story, 2003). Given adolescents' heightened risk for developing obesity and unhealthy obesity-related behaviors,

this study focused on their physical activity, sedentary activity, and eating behaviors.

Adolescent Obesity-Related Behaviors Develop within Context

Drawing on ecological theory, the development of obesity-related health behaviors would be best understood by examining the key contexts within which adolescents' lives are embedded (Bronfenbrenner, 1986, 1989; Davison & Birch, 2001). Adolescents develop within multiple, inter-connected contexts, with the family, peer group, and school representing key proximal contexts that are situated within more distal social contexts, such as the larger community. Specifically, adolescents' interactions with their immediate environment serve as the basis for learning social norms that purportedly shape their own behaviors (Bandura, 1977; Bronfenbrenner, 1986). Despite the significance of the peer context for socialization during adolescence, only a limited number of studies have examined whether close peer relationships, such as same-sex friendships, serve as sources of influence for obesity-related behaviors (e.g., Voorhees et al., 2005; Woodard et al. 1996). Yet, both social influence theories and empirical evidence of significant longitudinal links between friends' behaviors on a variety of outcomes point to the likelihood that friends could influence one another to exhibit healthy or unhealthy obesity-related behaviors (Berndt & Keefe, 1995; Berndt & Murphy, 2002; Kandel, 1978; Maxwell, 2002; Mercken, Candel, Williams, & de Vries, 2007).

As youth move through adolescence and strive to individuate from their parents, the emphasis on participation in close peer relationships significantly

increases (Lerner & Steinberg, 2009; Sullivan, 1953). Adolescent peer relations, unlike parent-adolescent relations, are voluntary and egalitarian in nature, thus affording youth opportunities to experience the mutual and mature exchanges characterizing adult relationships (Berndt, 1996; Hartup, 1993; Hunter & Youniss, 1982; Sullivan, 1953). Notably, close friendships are theorized as the most important form of peer relationship during adolescence because they are assumed to be characterized by high levels of interaction and connectedness and adolescents' primary source of support, validation, and social comparison (Berndt, 1996; Collins, 1997; Furman & Buhrmester, 1992; Suls, Martin, & Wheller, 2002; Weiss, 1974).

Friendships are most widely conceptualized as reciprocal ties formed between two youth that have voluntarily and mutually selected one another as friends (Bukowski & Hoza, 1989; Parker & Asher, 1993). Despite the increase in relations with opposite-sex peers during adolescence, the research literature has predominantly focused attention on reciprocal same-sex friendships. Notably, adolescents tend to spend more time with same-sex friends and reportedly prefer them, over cross-sex friends, for companionship and the fulfillment of various social needs (Buhrmester & Furman, 1987; Hand & Furman, 2009; Johnson, 2004; Lempers & Clark-Lempers, 1993; Richards, Crowe, Larson, & Swarr, 1998). Most boys and girls report participating in at least one same-sex friendship during adolescence, with these close friendships typically lasting 6 months to one year (Değirmencioğlu, Urberg, Tolson, & Richard, 1998; Hartup, 1993). Extensive empirical support has accumulated in support of studying reciprocal

same-sex friendships, as exemplified by research indicating significant links between reciprocal friends' behaviors (e.g., Jaccard, Blanton, & Dodge, 2005; Maxwell, 2002) and more positive academic, social, and emotional adjustment outcomes among youth with a reciprocal friend (e.g., Newcomb & Bagwell, 1995; Parker & Asher, 1993; Vaquera & Kao, 2008). In turn, the significance tied to reciprocal same-sex friends underscores their salience as social referents for obesity-related behaviors (Brown, Bakken, Ameringer, & Mahon, 2008; Hartup, 1993).

It is necessary to bear in mind that, although significant during adolescence, reciprocal friendships are often fleeting and replaced by newly formed ties with other peers within the social network (Brown et al., 2008; Brown & Klute, 2003; Hartup, 1996; Urberg, Degirmencioglu, Tolson, & Halliday-Scher, 2000). In particular, the formation and dissolution of friendships purportedly coincides with changing interests or needs, or simply emanates from adolescents' desire to associate with peers that they admire or perceive as similar to themselves (Hartup, 1993; Brechwald & Prinstein, 2011). Oftentimes, adolescents report involvement in nonreciprocal friendships, or friendships with peers that do not reciprocate their friendship nominations; despite their unilateral nature, these nonreciprocal friendships appear to represent another salient source of peer influence, as reflected by the nominator's perception that a friendship exists with the nominee (Brechwald & Prinstein, 2011). In fact, recent empirical findings indicate that friends' behaviors become more concordant over time within reciprocal, as well as, nonreciprocal same-sex friendships (e.g., Adams,

Bukowski, & Bagwell, 2005; Bot, Engels, Knibbe, & Meeus, 2005; Mercken et al., 2010). Thus, it is of value to investigate whether longitudinal links between friends' obesity-related eating and activity behaviors are evident within both reciprocal and nonreciprocal friendships.

Socialization within Adolescent Friendships

Peer socialization during adolescence presumably occurs as a result of reciprocal interactions that continue over time between close friends. These so-called proximal processes presumably have the strongest influence when they occur as regular, face-to-face interactions with salient role models or socialization agents (Bronfenbrenner, 1989; Bronfenbrenner & Crouter, 1983). Social learning theory has been widely used to guide the investigation into how key proximal processes, such as modeling, shape behaviors among youth (Bandura, 1977). Within the context of friendship interactions, socialization would encompass adolescents attending to, observing, and emulating their friends' behaviors; in turn, friends' behaviors serve as prompts that signify whether it is acceptable to engage in healthy or unhealthy behaviors. Regardless of the type of behavior, friends tend to influence one another to engage in behaviors that are similar to the behaviors they themselves exhibit (Berndt & Murphy, 2002).

Given the premise that socialization is tied to adolescents' perceptions of their peers as friends or referents for behavioral norms, both reciprocal and nonreciprocal friends represent potential sources of peer influence (Brown et al., 2008). Likewise, similar socialization processes during shared time with friends would presumably underlie increased concordance over time in friends' behaviors

within both reciprocal and nonreciprocal friendships. Yet, although reciprocal friend dyad members would purportedly be equally as likely to shape one another's behaviors, the same pattern would not be expected from nonreciprocal dyad members; in particular, social influence theories would presume that the nominators, or nonreciprocal friend dyad members whose friendship nominations were not reciprocated by the recipients, the nominees, would be more likely to be influenced by their friends because they acknowledged the tie with the nominee through friendship nominations, and in turn, are more likely to perceive their friends to be salient social models (Berndt, 1996; Brown et al., 2008; Bukowski & Hoza 1989). In fact, studies have found support for this notion, suggesting that the nominators are more likely to be influenced by the nominees, rather than vice versa (e.g., Christakis & Fowler, 2007).Thus, reciprocal and nonreciprocal friendships are not conceptualized as competing sources of peer influence in the present study, but rather, two unique types of peer relationships that may serve as contexts for the socialization of adolescents' eating and activity behaviors.

To date, limited research has focused on assessing the connection between obesity-related behaviors in same-sex friend pairs. Studies have primarily focused on friends' physical activity and unhealthy eating patterns, whereas little attention has been paid to sedentary behaviors. For example, extant findings indicate positive associations between friends' MVPA engagement and friends' reports of following a healthy diet or snack-food consumption (e.g., Ali, Amialchuk, & Heiland, 2011; Keresztes, Piko, Pluhar, & Page, 2008; King, Tergerson, & Wilson, 2008; Luszczynska, Gibbons, Piko, & Tekozel, 2004). Selection and

socialization effects have been well-documented as both playing important, but separate roles in explaining behavioral concordance between close friends (Bauman & Ennett, 1996; Kandel, 1978; Mercken et al., 2007). Because past research has predominantly utilized cross-sectional data, it is unclear to what extent significant links between friends' obesity-related behaviors are due to socialization or friendship selection (Bauman & Ennett, 1996; McPherson, Smith-Lovin, & Cook, 2001).

Another weakness of prior studies is the reliance on adolescents' reports of both their own behaviors and their friends' behaviors to assess socialization between friends. Asking adolescents to report on their friends' behaviors only yields adolescents' *perceptions* of their friends' behaviors, which are often biased and contribute to inflated estimations of links between friends' behaviors (Bauman & Ennett, 1996). Therefore, the first major Study Aim was to examine whether participation in same-sex friendships shapes adolescents' eating and activity behaviors over time, by utilizing both longitudinal data and separate self-reports from both adolescents in matched friendship dyads.

Additionally, it is of value to investigate whether features of adolescents' friendships dictate the degree to which friends are involved in the socialization of obesity-related behaviors (Berndt, 1996; Brown et al., 2008; Vitaro, Boivin, & Bukowski, 2009). In line with key tenets of social learning theory, the significance of friends as role models and the number of opportunities for shaping eating and activity behaviors would dictate patterns of socialization of these behaviors within adolescent friendships (Bandura, 1977). Because friendships that

persist over time or involve peers that spend a lot of time with one another would presumably afford dyad members more opportunities for socialization, the present study explored whether interaction frequency and friendship stability would moderate the strength of relations between friends' eating and activity behaviors.

Friends' shared interactions purportedly provide the context for the socialization of behavior habits over time; in turn, stronger levels of socialization would be expected between friends reporting higher interaction frequency (Bandura, 1977). Because interaction frequency varies across dyads, considering the extent to which adolescents interact with their friends serves to explicate why certain friend pairs are more or less concordant in their behaviors than other friend pairs. In fact, recent studies point to the significance of interaction frequency for socialization. For example, Barry and Wentzyl (2006) found that stronger longitudinal links between friends' self-reported prosocial behaviors were reported among same-sex friend pairs with higher, rather than lower, levels of interaction frequency. Yet, the role of interaction frequency for peer socialization of adolescents' obesity-related behaviors has yet to be examined. As part of the first major aim, this study explored whether interaction frequency within same-sex friend dyads moderates the strength of longitudinal relations between close friends' eating and activity behaviors.

In conjunction with interaction frequency, friendship stability also is posited to play a pivotal role in determining the strength of socialization within close friendships. Temporal stability, or the length of time adolescents participate in friendships, relates to the degree to which a close friend can serve as a source

of socialization (Poulin & Chan, 2010). Because stable friendships tend to be higher in relationship quality, it is reasonable to contend that peers in such relationships would represent more salient, and in turn, stronger sources of influence (Brown et al., 2008). Like interaction frequency, same-sex friendships vary considerably in their stability, and in turn, in the extent to which friends are afforded opportunities to shape one another's obesity related behaviors (Bandura, 1977; Hartup, 1993; Poulin & Chan, 2010). Past studies have assessed whether friendship stability moderates friends' influence on various adolescent behaviors; but, only some studies found stronger socialization within more stable friendships (Barry & Wentzel, 2006; Berndt, Hawkins, & Jiao, 1999; Jaccard et al., 2005; Popp, Laursen, Kerr, Stattin, & Burk, 2008; Urberg, Degirmencioglu, & Pilgrim, 1997). Yet, the role of friendship stability for the socialization of obesity-related behaviors is unclear because it has yet to be addressed empirically. The present study examined friendship stability a moderator, as part of Study Aim 1, to see whether friends' obesity-related behaviors are more strongly linked in stable, or longer-lasting, friendships.

Assessing Socialization between Friends with the Actor-Partner Interdependence Model

Innovative methodological tools, such as dyadic data analyses and the Actor-Partner Interdependence Model (APIM), are now being used to better understand relations between individuals in dyadic relationships. The APIM is particularly useful for studying socialization within adolescent friendships because it models mutual influence between friends and is applicable for studying

both reciprocal (i.e., indistinguishable) and nonreciprocal (i.e., distinguishable) friend dyads (Kenny & Cook, 1999; Kenny, 1996). A key premise of the APIM is that dyad members are interdependent, with their beliefs and behaviors being linked in ways that are unique from other dyads. Because close friends' data are correlated and more congruent than non-dyad members' data, the APIM addresses nonindependence, which can lead to biased standard errors and biased significance testing (Cook & Kenny, 2005; Kenny & Cook, 1999; Kenny, Kashy, & Cook, 2006).

In line with the contention that each dyad member represents both the source and the target of peer influence, the APIM simultaneously assesses self-reported stability in behaviors and friends' influence on one another's outcomes (Kenny et al., 2006). As displayed in Figure 1, the basic APIM model includes a predictor variable (X1 and X2) and an outcome variable (Y1 and Y2) for each member of the dyad and models the effect of adolescents' predictor variables on their own outcome variables (i.e., actor effects) and the effect of adolescents' predictor variables on their friends' outcome variables (i.e., partner effects). The APIM method also calculates both correlations between dyad members' predictor scores and correlations between the unexplained variance in dyad members' outcome scores to account for nonindependence (Laursen, Popp, Burk, Kerr, & Stattin, 2008). Although originally developed to estimate concurrent links between dyad members, the APIM has been adapted to assess longitudinal socialization (Gonzalez & Griffin, 1999; Kenny et al., 2006).

The utility of the APIM has been supported by recent research indicating significant longitudinal links between friends' self-reported health behaviors, such as problem drinking (e.g., Popp et al., 2008). A key advantage of utilizing the APIM is that it allows for the assessment of unique influence tied to each dyad member within nonreciprocal friendships; the separate examination of nominators and nominees can shed light on whether the perception of a peer as a friend is what underlies adolescents' susceptibility for peer influence and potentially similar patterns of socialization for reciprocal friends and the nominators within nonreciprocal friend dyads (Berndt, 1996; Brown et al., 2008). Thus, the present study drew on the APIM to frame the examination of whether eating and activity behaviors are significantly associated over time within close same-sex friendships. In addition to stability in adolescents' self-reported behaviors (i.e., actor effects), significant links between friends' obesity-related behaviors were expected (i.e., partner effects) for reciprocal friends and nonreciprocal friends, particularly the nominators.

Close Friends' Eating and Activity Behaviors and Obesity Risk

Building on the examination of close same-sex friends as shaping obesity-related behaviors, it is of value to examine whether adolescents' friends also are a source of risk for obesity. Considering the growing consensus that obesity among youth is deeply embedded in the environment within which they develop, obesity research is increasingly conceptualized through an ecological framework (Bronfenbrenner & Crouter, 1983; Davison & Birch, 2001; Gorin & Crane, 2008). Particular focus has been placed on investigating the role of key environmental

contexts, such as the family, schools, neighborhoods, and more recently, the peer group, in promoting the development and maintenance of obesity. Namely, 'obesigenic' environments, or environments that support or reinforce unhealthy eating and activity behaviors have become the focus of recent research examining the antecedents of obesity (Davison & Birch, 2002; Gordon-Larson et al., 2006; Gorin & Crane, 2008). Given the contention that close friends within the peer context can shape one another's obesity-related behaviors through continued friendship participation, it is reasonable to conceptualize adolescents' friends as obesigenic if they report obesity-promoting behaviors (Berndt & Murphy, 2002). Extant research reinforces the idea that adolescents have obesigenic friends, as past research indicates similarity in friends' weight status and positive longitudinal links between friends' changes in weight status (Bahr, Browning, Wyatt, & Hill, 2009; Christakis & Fowler, 2007; Trogdon, Nonnemaker, & Pais, 2008). These data point to the value of exploring whether obesigenic friends, in addition to adolescents' self-reported obesity-promoting behaviors, represent risk factors that increase or decrease the likelihood that adolescents would experience an increase in BMI over time. The present study was the first to empirically assess the role of close same-sex friends for adolescents' obesity risk.

A risk-focused framework serves as a useful heuristic for examining the link between friends' obesity-related behaviors and future obesity risk (Jessor, 1991; 1992; Rex, 2005). Notably, Jessor's (1991; 1992) problem behavior theory is exemplary in guiding research on adolescent risk because it highlights the role of salient social models, such as friends, that presumably influence the

development of risky behaviors, that in turn, lead to negative outcomes. Past research underscores the value of examining close friends as a source of risk, as findings indicate that friends' risky or unhealthy behaviors predict adolescent' risk for adverse outcomes (e.g., (Jessor & Jessor, 1977; Jessor, Turbin, & Costa, 1998; Maxwell, 2002).

To best capture the risk associated with multiple risk factors, past research has often examined their influence within the context of a cumulative risk model (Rutter, 1979). The cumulative risk hypothesis posits that independent risk factors carry more weight when examined together because they incrementally contribute to overall risk. Extensive data support using the cumulative risk approach, as various studies have found that adolescents' risk for adverse outcomes, such as depression (e.g., Roberts, Roberts, & Xing, 2010) or early sexual activity (Price & Hyde, 2009) is higher when a higher number of risk factors are reported. Extant evidence suggests that obesity-promoting eating and activity behaviors may predict obesity risk in an additive manner, as they are reportedly linked to heightened obesity risk when they co-occur among adolescents (Rosenberg et al., 2007; Sanchez et al., 2007). Thus, it is reasonable to conceive that a cumulative index of adolescents' self-reported obesity-related behaviors would serve as a significant predictor of own adolescents' future obesity risk.

The link between close friend's obesity-related behaviors and later obesity risk has yet to be assessed empirically; however, recent research focused on the role of parents' obesity-promoting behaviors highlights the value of focusing on close friends in the present study. In one longitudinal study, findings showed that

significant increases in BMI over time were only evident among children with parents that reported both poor eating and poor physical activity habits (Davison & Birch, 2001; Davison et al., 2005). In turn, it is reasonable to contend that adolescents' risk for later weight problems may be higher if their close friends also report multiple obesity-promoting behaviors. For the second study goal, separate cumulative indicators of adolescents' and their close friends' self-reported obesity-related behaviors were assessed as risk factors predicting changes in BMI over time among reciprocal and nonreciprocal friend. The APIM aptly framed the assessment of positive associations between adolescents and their friends' obesity-related behaviors and obesity risk because it addresses nonindependence tied to friend dyad membership (Kenny et al., 2006; see Figure 2).

Study Aims

To reiterate, there were two primary study goals. The first study goal was to examine whether same-sex friends' eating behaviors, physical activity, and sedentary behaviors are significantly associated over time; longitudinal links for each of the three key obesity-related behaviors were examined separately. Additionally, as part of this first study goal, interaction frequency between friends and friendship stability were examined to assess whether the longitudinal relations between close friends' eating and activity behaviors vary across friend pairs with high versus low interaction frequency and stable versus unstable friendships. The second major Study Aim was to explore whether friends' obesity-promoting eating and activity behaviors additively predict later obesity risk, while also

accounting for the role of adolescents' own obesity-related behavior. Both Study Goals 1 and 2 were tested with reciprocal and nonreciprocal same-sex friend dyads and with the APIM. Because demographic and individual indicators, such as age, gender, family SES, adolescent obesity status, parental obesity status, and ethnicity, purportedly underlie variation in both obesity prevalence and reported obesity-related behaviors among adolescents (Davidson & Birch, 2001; Gordon-Larsen et al., 2004; Neumark-Sztainer, 1999), this study controlled for the contribution of these factors, so that the nature of peer influence would be assessed beyond these factors. Given the dearth of research focused on the role of close friends for obesity and obesity-related behaviors, this investigation made a considerable contribution to available literature. Notably, this study was the first to (a) empirically address whether adolescents' physical activity, sedentary behaviors, and eating behaviors are shaped over time in the context of both reciprocal and nonreciprocal same-sex friendships and (b) to conceptualize and assess friends' obesity-promoting behaviors as obesity-related risk factors.

State of the Literature

The present study aimed to advance knowledge about the role of same-sex friendships for adolescents' obesity-related behaviors and obesity risks. The two primary study goals were first to assess the socialization of physical activity, sedentary behaviors, and eating behaviors in adolescent friend pairs, and second to explore whether friends' obesity-related eating and activity behaviors are significant predictors of later obesity risk. To establish a basis for the present study, this literature review summarizes available data highlighting both the

prevalence of unhealthy eating and activity behaviors and their link to obesity among adolescents, as well as, pertinent findings indicating significant links between friends' behaviors; this review illustrates friends' significant role as socialization agents during adolescence. As part of the first study goal, interaction frequency and friendship stability were assessed as moderators to further clarify the circumstances under which socialization of obesity-related behaviors occur. Thus, extant data indicating whether the frequency of shared time between friends and friendship length moderate the strength of relations between friends' risky behaviors also were reviewed. Finally, past research highlighting the link between multiple risk factors and heightened risk for negative outcomes during adolescence was reviewed to establish a basis for the second study goal, which focused on links between adolescents' and their friends' obesity-promoting behaviors and obesity risk.

Prevalence of Obesity-Related Behaviors and Interrelations with Obesity

This section summarizes empirical findings highlighting adolescents' engagement in physical activity, sedentary activity, and eating behaviors. Given that obesity risk is associated with unhealthy eating and activity, extant evidence linking these behaviors to obesity among adolescents also is discussed. Establishing adolescents as a group at heightened risk for unhealthy eating and activity behaviors, and in turn, obesity, provides a basis for examining the role of close friends for both the socialization of obesity-related behaviors and future obesity risk in the present study.

Activity behaviors encompass both physical activity and sedentary behaviors, as both contribute to total energy expenditure (Burniat et al., 2002). Activities vary in their intensity level and energy cost and are assigned a metabolic equivalent (MET) value based on the extent of energy cost during participation (Ainsworth et al., 2000; Schutz & Maffeis, 2002). Lower intensity activities are assigned a lower MET value, whereas higher intensity activities are assigned a higher MET value. The present study focuses on moderate-to-vigorous physical activities (MET value above 3), as well as, sedentary behaviors (MET value below 1.5).

Physical activity. A myriad of activities, including household chores, occupational activities at work or school, as well as, sport and exercise, constitute physical activity (Schutz & Maffeis, 2002). Physical activity increases the body's resting metabolic rate, compensates for energy intake, and in turn, promotes energy balance and weight maintenance; engagement in MVPA has been the focus of most studies, given its role in promoting healthy physical development (Hills, King, & Armstrong, 2007). Despite national guidelines for physical activity, self-reported data indicate that only 30-45% of adolescents engage in the recommended 60 minutes of MVPA 5 or more times per week (Gordon-Larsen et al., 2004; Sanchez et al., 2007), whereas adherence estimates based on accelerometer data indicate even lower rates (Troiano et al., 2008). These findings indicate that as a group, adolescents engage in an inadequate level of physical activity that would presumably be associated with higher obesity risk (Must & Tybor, 2005; Reichert et al., 2009). In fact, numerous cross-sectional and

longitudinal studies highlight adolescents' physical activity engagement as a risk factor for obesity, given consistent significant links between lower levels of MVPA and higher BMI (Bandini, Must Spadano, & Dietz, 2002; Forshee, Anderson, & Storey, 2004; Gordon-Larsen et al., 2002; Kimm et al., 2005; Menschik, Ahmed, Alexander, & Blum, 2008; Miech, Kumanyika, Stettler, Link, Phelan, & Chang, 2006; Mota et al., 2008; Patrick et al., 2004). Thus, extant data underscore the role of physical activity for the development of obesity among adolescents.

Sedentary activity. Sedentary behaviors also have been targeted as behavioral risk factors for obesity, particularly because the low energy expenditure associated with such activities does not compensate for energy intake (i.e., calories from food and beverage consumption), and in turn, enables excess weight gain (Fields & Higgins, 2008). Various leisure activities, such as talking on the phone, doing homework, reading, and listening to music constitute sedentary activity; however, screen-based media activities, such as watching TV and videos and playing computer and video games, are considered most significant for adolescent obesity risk (Ainsworth et al., 2000; Hills et al., 2007; Kline, 2005; Marshall, Gorely, & Biddle, 2006; Snoek, van Strien, Janssens, & Engles, 2006; Zabinski, Norman, Sallis, Calfas, & Patrick, 2007). The American Academy of Pediatrics (2001) recommends that adolescents spend no more than 2 hours of a day engaged in screen-based sedentary activities.

As evident with physical activity, the majority of adolescents reportedly exceed this recommended time limit, with levels of sedentary behavior increasing

with age (Crossman Sullivan, & Benin, 2006; Delva, O'Malley, & Johnston, 2006; Driskell, Dyment, Mauriello, Castle, & Sherman, 2008; Hancox, Milne, & Poulton, 2004; Marshall et al., 2006; Norman, Schmid, Sallis, Calfas, & Patrick, 2005). Moreover, past research also suggests that adolescents' excessive engagement in sedentary behaviors predicts their obesity risk; notably, studies have reported positive links between adolescent BMI and sedentary activity (Berkey et al., 2000; Boone, Gordon-Larsen, Adair, & Popkin, 2007; Burke et al. 2006; Forshee et al., 2004; Hancox et al., 2004; Schneider, Dunton, & Cooper, 2007; Vandewater, Shim, & Caplovitz, 2004) and have shown that decreasing the amount of time spent watching TV and playing video games results in significant reductions in BMI over time (Epstein, Valoski, & Vara, 1995; Robinson, 1999). Taken together, adolescents' tendency to spend excessive time in sedentary behaviors signifies their heightened risk for developing obesity.

In summary, extant research highlights that low levels of physical activity and high levels of screen-based sedentary activity, are not only prevalent, but more importantly, significantly associated with increased risk for obesity among adolescents. Consistent findings indicate that physical activity and sedentary behaviors are not only uniquely associated with obesity, but also not inversely linked as would be expected (Feldman, Barnett, Shrier, Rossignol, & Abenhaim, 2003; Eisenmann, Bartee, Smith, Welk, & Fu, 2008; Nelson, et al., 2005; Wong & Leatherdale, 2009); thus, it was useful to examine physical activity and sedentary behaviors as separate indicators of activity in the present study. Given the leisure nature of these activities, there would likely be ample opportunities for

coactivity, and in turn modeling, in the company of close same-sex friends; thus, a close same-sex friendship is a pertinent developmental context to examine as a source of socialization of obesity-promoting activity behaviors (Bronfenbrenner, 1989; Bronfenbrenner & Crouter, 1983; Larson, Richards, Moneta, Holmbeck, & Duckett, 1996).

Eating Behaviors and Their Relationship with Obesity

In addition to activity behaviors, eating behaviors, particularly dietary intake and breakfast consumption, presumably play an equally significant role in the regulation of weight among adolescents (Newby, 2007; Rodriguez et al., 2010). In accordance with the Dietary Guidelines for Americans (health.gov, 2005), the ideal diet for adolescents consists of meeting caloric needs by consuming the recommended servings of nutrient-dense foods, such as fruits, vegetables, dairy, whole grains, and low-fat protein, while limiting the intake of energy-dense (i.e., high calorie and lacking nutrients) and high-fat foods and beverages. Similar to activity patterns, adolescents' diets tend to be nutrient-deficient, significantly high in energy-dense food consumption, and in turn, deviate significantly from the USDA dietary recommendations (Bauer, Larson, Nelson, Story, & Neumark-Sztainer, 2009; Field et al., 2004; Neumark-Sztainer et al., 2002; Sanchez et al., 2007).

Notable trends in healthy eating indicate that the majority of adolescents do not consume the recommended five daily servings of fruits and vegetables, the recommended two or more daily servings of dairy, the recommended 6 daily servings a day of whole grains, and do not regularly eat breakfast (Delva et al.,

2006; Driskell et al., 2008; Neumark-Sztainer et al., 2002; Sanchez et al., 2007; Videon & Manning, 2003). Additional findings further highlight adolescents' obesity-promoting eating habits, indicating that the majority of adolescents report a diet high in fat (> 30% of their overall energy intake; Sanchez et al., 2007), consume fast food 2 or more days per week (Bauer, Larson, Nelson, Story, & Neumark-Sztainer, 2009; Larson et al., 2008; Neimeier et al., 2006, and report that nearly 25% of their daily calorie intake comes from sugary drinks (Harrington, 2008; Troiano, Briefel, Carroll, & Bialostosky, 2000) and energy-dense snacks (Field et al., 2004; Phillips et al., 2003). Thus, available data suggest that, obesity-promoting eating behaviors are highly prevalent among adolescents, in turn, signifying the groups' heightened obesity risk.

Numerous studies have assessed whether adolescents' unhealthy eating behaviors are significantly associated with higher weight. Findings indicate that fast food consumption (Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006; Thompson et al., 2004) sugary drink consumption (Ebbeling et al., 2006; Harrington, 2008; James, Thomas, Cavan, & Kerr, 2004; Ludwig, Peterson, & Gortmaker, 2001; Miech et al., 2006), and breakfast skipping (Albertson, Anderson, Crockett, & Goebel, 2003; Berkey et al., 2003; Crossman et al., 2006; Miech et al., 2006; Niemeier et al. 2006; Timlin, Pereira, Story, & Neumark-Sztainer, 2008) are all significant antecedents of higher BMI among adolescents. Studies have not, however, consistently reported that dairy, fruit, or vegetable consumption are directly linked to adolescent weight (Berkey, Helain, Willett, & Colditz, 2005; Burke et al., 2006; Lin & Morrison, 2004; Phillips et al., 2003).

Despite the null findings, these key nutrient-dense foods presumably play a significant, role in weight regulation, as there is evidence that youth tend to decrease their excess consumption of high fat/high sugar foods, when they increase their fruit and vegetable consumption (DGA, 2005; Epstein et al., 2001). In summary, extant research suggests that adolescents' eating habits are unhealthy and play a significant role in weight regulation. Given that the significant amount of time adolescents spend with their friends likely includes many shared meals and snacks, it also is necessary to examine socialization of eating behaviors within close same-sex friendships (Shanahan & Flaherty, 2001).

To establish a basis for the present study, available data on prevalent obesity-eating and activity behaviors and links between these behaviors and obesity among adolescents were reviewed. The overall picture of adolescent eating and activity behaviors suggests that adolescents as a group tend to engage in low levels of *protective* and high levels of *risky* eating and activity behaviors that increase their risk for excess weight. Both the prevalence of obesity-promoting behaviors among adolescents and the tendency for youth to spend increasingly more time in the presence of close friends during adolescence (i.e., salient role models) necessitate examining same-sex friendships as a source of socialization. Shared time with close friends is premised to afford adolescents opportunities to model and observe one another's eating and activity behaviors, which in turn, presumably results in increased concordance between friends' behaviors. The following section reviews findings exemplifying the significance

of close friends for adolescent behaviors to further reinforce the value of examining friends as socialization agents in this investigation.

Socialization of Adolescent Behaviors

The premise that same-sex friends play a significant role in adolescents' adjustment has spurred decades of empirical research aimed at measuring influence between close friends (Hartup, 1996; Sullivan, 1953). Adolescents' friends were long believed to be primarily a source of negative influence (Berndt, 1992; Berndt & Murphy, 2002); however, theory and empirical evidence suggest that friends can influence both positive adjustment outcomes, such as prosocial behavior and academic achievement (Barry & Wentzel, 2006; Crosnoe, Cavanagh, & Elder, 2003), and negative adjustment outcomes, such as aggression and substance use (Adams et al., 2005; Hartup, 1996; Prinstein, Boergers, & Spirito, 2001). Key processes of social learning theory, such as modeling, observational learning, and reinforcement, have been argued as best explaining socialization between friends (Bandura, 1977; Berndt & Murphy, 2002). In particular, repeated face-to-face interactions are presumed to be the central mechanism through which friends shape one another's behaviors and attitudes to become more similar to their own (Berndt & Murphy, 2002; Bronfenbrenner, 1989; Hartup, 1996; Vitaro et al., 2009).

Extant research on socialization between friends has predominantly focused on reciprocal same-sex friendships, particularly because mutually-chosen friends reportedly hold one another in higher regard than other peers, and in turn, would purportedly be more inclined to engage in similar behaviors to maintain the

friendship (Hartup, 1996; Hundley & Cohen, 1999; Sullivan, 1953). Yet, there is increasing emphasis on assessing the role of additional peers such as nonreciprocal same-sex friends, as sources of peer influence during adolescence (e.g., Mercken et al., 2007; 2010). Although reciprocal and nonreciprocal friendships likely differ in length and friendship qualities, such as intimacy, adolescents also may be motivated to behave similarly to their nonreciprocal friends if such peers are viewed as salient peer models (Berndt, 1996; Brown et al., 2008). A study by Bot and colleagues (2005) reinforces such a contention, indicating that the most significant source of influence on changes in adolescents' binge drinking were popular nonreciprocal friends. Two additional studies reportedly found that reciprocity did not dictate whether friends' level of aggression and smoking behaviors were longitudinally linked, in turn, further highlighting the role of nonreciprocal friends (Adams et al., 2005; Mercken et al., 2010). Thus, it is reasonable to contend that similar processes of social learning occur within the context of both nonreciprocal and reciprocal friendships, as long as adolescents highly value their friends and are motivated to attend to and copy their behaviors (Bandura, 1977; Brown et al., 2008).

A multitude of studies focusing on various indicators of adolescent adjustment have been conducted to assess relations between friends' behaviors, and in turn, illustrate socialization between friends. The majority of past research has examined either concurrent or longitudinal associations between friends' behaviors, by testing links between adolescents' own self-report and their reported *perception*s of their friends' behaviors. Findings have typically indicated

significant and positive links; for example, adolescents are more likely to report higher levels of risky behaviors, such as smoking, sexual promiscuity, binge drinking, substance use, and violent behavior, if they perceive higher levels of these behaviors among their friends (e.g. Hussong, 2002; Nofziger & Lee, 2006; Prinstein et al., 2001; Sieving, Perry, & Williams, 2000; Wang, Fitzhugh, Westerfield, & Eddy, 1995; Wills & Cleary, 1999). Despite evidence of concordance between friends' behaviors, the aforementioned investigations were limited in their assessment of socialization within friendships because some studies used cross-sectional data, although they all used behavioral reports provided by only one adolescent, rather than from two peers in a matched friendship dyad. Thus, it is difficult to ascertain whether participants' friendships were reciprocal or nonreciprocal and also whether behavioral similarity was reflecting socialization or friendship selection and bias related to adolescents projecting their own behaviors onto friends (Bauman & Ennett, 1996).

Both the utilization of longitudinal data that reflect repeated opportunities for socialization with friends over time and the utilization of self-reports from both members in a friend dyad are critical for illustrating socialization between friends. Kandel's (1978) landmark study was exemplary in illustrating the value of assessing the longitudinal link between best friends' self-reports of risky behaviors within reciprocal friendships; findings suggested that, although adolescents choose friends with similar levels of marijuana use, adolescents in stable friendships also reportedly became more similar to one another over time. Similar findings have been reported for delinquency (Selfhout, Branje, & Meeus,

2008), binge drinking (Jaccard et al., 2005; Urberg et al., 1997), cigarette use (Mercken et al., 2007; Urberg, 1992) and sexual activity (Maxwell, 2002), such that adolescents are more likely to engage in risky behaviors if they had reciprocal same-sex friends who also reported engaging in similar risky behaviors themselves in the past. These longitudinal investigations provide more solid evidence of socialization because they point to the role of shared experiences with friends for shaping friends' behavior through socialization processes, such as modeling or observational learning (Bauman & Ennett, 1996; Berndt & Murphy, 2002). Although similar processes are premised to underlie socialization across same-sex friendships, the dearth of research conducted with nonreciprocal friends precludes concluding that friends' behaviors can become significantly linked over time, regardless of the nature of the friendship (Brown et al., 2008).

Recent advances in data analytical techniques have enabled peer relationship researchers to better address peer influence within friendship dyads (Kenny et al., 2006). Past studies have been criticized for treating adolescents participating in a friendship as independent cases, rather than as part of an interdependent dyad; this oversight, in turn, results in nonindependence, or shared variance, not being accounted for in the data (Card, Selig, & Little, 2008; Kenny et al., 2006). The APIM better addresses the issue of nonindependent data by partialing out shared variance associated with being a member of a specific dyad, which results in providing unbiased estimates of mutual influence (Kenny et al., 2006; Little & Card, 2005).

To date, the APIM has not been used in many investigations focused on same-sex friend pairs (e.g., Adams et al., 2005; Cillessen, Jiang, West, & Laszkowski, 2005; Gileta et al., 2011; Popp et al., 2008). Three longitudinal studies are exemplary, given their longitudinal assessment of socialization between adolescent friends: Adams et al., (2005) assessed links between friends' aggressive behaviors over a six-month period, Popp and colleagues (2008) followed friend pairs (i.e., one older and one younger dyad member) over a 3-year period to assess relations between friends' reported binge drinking, and Gileta et al. (2011) examined links between friends' depressive symptoms over a one year period. Findings from all three studies indicated significant partner effects (i.e., friends' behaviors were related over time) and significant actor effects (i.e., adolescents' self-reported behaviors were related over time). For example, in the Popp et al. (2008) study, younger friends' level of binge drinking became more similar to their older friends' level of binge drinking behaviors over time, suggesting that older friends were modeling binge drinking while hanging out together. Collectively, findings across these three studies point to the role of socialization processes in explaining links between adolescent friends' behaviors. The ability of the APIM to account for nonindependent data among friend pairs further strengthens the validity of drawing conclusions about socialization processes occurring within the context of repeated interactions with reciprocal or nonreciprocal friends over time (Bronfenbrenner, 1989; Kenny et al., 2006).

In summary, this section reviewed a multitude of studies that highlighted the significance of close friends as socialization agents during adolescence. The

review illustrated how the ability to draw conclusions about socialization between friends is strongest in longitudinal investigations that account for selection effects and utilize matched self-reports from two adolescents in a friend dyad. Further, the issue of nonindependence necessitates the use of tools such as the APIM when examining socialization within friend dyads. Empirical evidence from recent studies (Adams et al., 2005; Popp et al., 2008) provides support for using the APIM, and in turn, underscores its use in the present study. This Study Aimed to assess whether reciprocal and nonreciprocal same-sex friends shape one another's obesity-related eating and activity behaviors (i.e., partner effects), while accounting for stability in adolescents' self-reported eating and activity behavior patterns (i.e., actor effects).

Close Friends and Socialization of Obesity-Related Behaviors

The previous section highlighted empirical evidence of significant, positive links between friends' behaviors across various domains of adjustment (e.g., Adams et al., 2005; Crosnoe et al., 2003; Jaccard et al., 2005). An extensive number of studies indicate that adolescents are more likely to engage in behaviors exhibited by friends, with significant longitudinal links reflecting the role of socialization processes for increased behavioral concordance between friends over time. Given that the significant amount of leisure time adolescents spend with friends likely includes eating, physical activity, and sedentary activity (Dunton, Whalen, Jamner, & Floro, 2007; Shanahan & Flaherty, 2001; Zick, 2010), friends' shared interactions may afford opportunities for shaping one another's obesity-related behaviors. Yet, because few studies have assessed whether same-

sex friends' levels of physical activity, screen-based sedentary activities, and eating are significantly associated over time, the role of friendships for obesity-related behaviors is not well understood. The next section reviews the limited extant evidence linking friends' obesity-related behaviors to provide an empirical basis for the present study.

Socialization of physical activity between friends. Thus far, physical activity has been the predominant focus of studies assessing relations between friends' obesity-related behaviors. In line with social influence theories, adolescents would presumably model, observe, and reinforce their friends' unhealthy or healthy physical activity habits in the context of repeated reciprocal interactions (Bandura, 1977). Adolescents participating in either reciprocal or nonreciprocal same-sex friendships would purportedly be motivated to engage in similar levels of physical activity as their friends, primarily to maintain or strengthen their bond (Berndt & Murphy, 2002). It also is reasonable to contend that adolescents, particularly those with nonreciprocal friends, may emulate physically active friends because popularity or higher social status is often tied to being athletic and physically fit (Brechwald & Prinstein, 2011; Holland & Andre, 1994; Lindstrom & Lease, 2005). Past studies have demonstrated that adolescents modify their engagement in antisocial or risky-health behaviors as a means to gain higher social status or friendships with popular peers (Allen, Porter, McFarland, Marsh, & McElhaney, 2005; Mayeux, Sandstrom, & Cillessen, 2008). Given the social benefits associated with physical activity during adolescence (i.e., popularity tied to athletic participation or physical attractiveness), friends likely

play an important role in shaping one another's engagement in physical activity. Akin to socialization research in other behavioral domains, extant empirical findings indicative of socialization of physical activity habits are limited because studies have predominantly examined concurrent relations between friends' engagement in physical activity (e.g., Vilhjalmsson & Thorlindsson, 1998; Vorhees et al., 2005).

The majority of studies have reported positive, concurrent links between adolescents' self-reported physical activity and their perceptions of friends' levels of physical activity or sports participation. These findings suggest that adolescents are more likely to engage in higher levels of physical activity or sports participation when they perceive that their friends are regularly physically active (Keresztes et al., 2008; King et al., 2008; Luszczynska et al., 2004; Plotnikoff, Bercovitz, Rhodes, Loucaidesm & Karnunamuni, 2007; Sabiston & Crocker, 2008). Two cross-sectional studies examined similar links in physical activity, but eliminated the bias associated with adolescents reporting on their friends' behaviors by using matched self-reports from reciprocal friend pairs; consistent with past research, findings from these two studies indicated that same-sex friends engage in similar levels of organized physical activity (Ali et al., 2011; de la Haye, Robins, Mohr, & Wilson, 2010a). Collectively, these cross-sectional studies at best signify homophily in physical activity levels between friends (Hartup, 1993; McPherson et al., 2001), as the cross-sectional data cannot speak to whether socialization during shared interactions led to behavioral concordance between friends (Bauman & Ennett, 1996; Bronfenbrenner, 1989).

To date, a few studies have used longitudinal data to better address whether socialization underlies significant links between friends' physical activity habits (Duncan, Duncan, Strycker, & Chaumeton, 2007; Lau, Quadrel, & Hartman, 1990). Utilizing a cohort-sequential longitudinal design, Duncan et al. (2007) found that friends' perceived physical activity significantly predicted change in 12- to 17-year-old adolescents' self-reported physical activity. Two additional longitudinal studies provide stronger evidence of peer socialization because matched self-reports were used to examine links between friends' physical activity levels. Lau and colleagues (1990) found significant, positive links over time between reciprocal same-sex friends' self-reported exercise habits during the early college years; likewise, de la Haye, Robins, Mohr, & Wilson (2011a) found that above and beyond selecting friends with similar physical activity habits, friends' physical activity levels became more concordant over the course of their eighth grade school year. Collectively, findings across these three studies point to peer socialization because they illustrate that increases or decreases in physical activity may be tied to interacting with close friends that model, observe, reinforce or discourage physical activity. Thus, these limited longitudinal data highlight the role of social learning in explaining parallels between close friends' physical activity habits; it is unclear whether significant links in physical activity exist among nonreciprocal friend pairs because no study to date has examined socialization of physical activity within nonreciprocal friendships. The present study is the first to assess links between reciprocal and nonreciprocal same-sex friends' physical activity levels.

In summary, available findings appear to support the contention that close friendships serve as significant socialization contexts shaping physical activity behaviors during adolescence. The significance of close friends for adolescent physical activity is not surprising given that physical activity is leisure in nature and most adolescents spend a significant amount of their free time both with friends and engaged in leisure activities (Shanahan & Flaherty, 2001; Zick, 2010). Limited longitudinal data provide the strongest empirical evidence of socialization of adolescent physical activity because they can show whether friendship participation contributes to concordance in behaviors above and beyond initial similarity tied to friendship selection. Yet, despite evidence indicating positive links between same-sex friends' physical activity levels, it is unclear whether socialization of physical activity is limited to reciprocal friendships or rather a process found within both reciprocal and nonreciprocal friendships. The present study utilized the APIM to assess longitudinal relations between both reciprocal and nonreciprocal same-sex friends' physical activity engagement. Based on past research, close reciprocal same-sex friends' physical activity levels were expected to be significantly and positively associated with both their own and their friends' later self-reported physical activity habits. Given the contention that similar processes underlie socialization in both reciprocal and nonreciprocal friends, significant, positive links were expected for nonreciprocal friends' physical activity levels, particularly for the nominators.

Socialization of screen-based sedentary activity between friends. Although sedentary behaviors comprise the other key domain of leisure activity,

studies examining the socialization of sedentary behaviors within same-sex friendships are largely nonexistent. Yet, the substantial amount of leisure time adolescents reportedly spend both in screen-based activities and in the company of close friends, necessitate examining whether close friends shape adolescent sedentary behaviors (Zick, 2010). Despite the tendency for adolescents to befriend peers with similar leisure sedentary behavior habits, social learning principles would suggest that adolescents' sedentary behaviors would be further shaped within the context of repeated interactions with friends over time (Bronfenbrenner, 1989; Bronfenbrenner & Crouter, 1983; McPherson et al., 2001). Adolescents in both reciprocal and nonreciprocal friendships would presumably be motivated to reinforce and engage in similar levels of sedentary behaviors as their friends to increase commonalities and strengthen their friendships; matching a friend's level of sedentary behaviors also would allow adolescents to establish their value as a friend, particularly in the case of nonreciprocal friendships (Bandura, 1977; Berndt & Murphy, 2002). Given the dearth of studies focused on socialization of sedentary behaviors, the role of friends is unclear. The present study was the first to empirically assess longitudinal links in sedentary activity with reciprocal and nonreciprocal same-sex friend pairs.

To date, only a few cross-sectional investigations have examined links between peers' screen-based sedentary behaviors (Ali et al., 2011; de la Haye et al., 2010; Fletcher, 2006). Despite the focus on school-level relations between peers' TV viewing habits, Fletcher (2006) found that adolescents' self-reported

level of weekly TV viewing was higher in schools where, on average, adolescents spent an overall higher amount of time watching TV. Even though these significant peer links can only speak to school-level norms for watching TV, social influence perspectives would presume that interactions with specific peers, such as close friends, provide the means through which relations between adolescents' TV viewing habits, and in turn, school norms for TV viewing become established (Berndt & Murphy, 2002; Bronfenbrenner, 1994).Two additional investigations utilized a social network framework to examine cross-sectional links between friends' levels of screen-based sedentary activity (Ali et al., 2011; de la Haye et al., 2010). Neither study found significant, positive between friends' self-reported TV viewing habits; however, de la Haye and colleagues (2010) found that female friends are similar in the amount of time they spend in other sedentary activities, such as playing video or computer games and surfing the internet. Collectively, extant data provide little evidence of homophily in friends' sedentary activity engagement and cannot speak to whether adolescent friendships serve as a source of peer socialization for sedentary activities. Yet, definitive conclusions about the role of friends for adolescents' sedentary activity engagement cannot be drawn based on findings from these three cross-sectional studies. Thus, additional research is needed to understand the role of adolescents' friends in shaping sedentary behaviors.

In summary, the role of same-sex friends for adolescent sedentary behaviors is not well understood. The paucity of empirical evidence precludes drawing definitive conclusions regarding whether friends engage in similar levels

of sedentary behaviors and more importantly, regarding whether these behaviors are shaped via socialization processes within the context of reciprocal and nonreciprocal friendships. Scant past research underscores the significance of theories of social influence for forming expectations about the socialization of sedentary activity among adolescents in the present study (Berndt & Murphy, 2002). Because friends purportedly shape one another's behaviors to become more similar to their own, positive relations between friends' level of sedentary activity would be expected (Berndt, 1992; Berndt & Murphy, 2002; Hartup, 1996; Vitaro et al., 2009). The present study expected reciprocal and nonreciprocal same-sex friends' screen-based sedentary behaviors to be significantly and positively associated over time (i.e., partner effects), while accounting for individual stability in these activities (i.e., actor effects). The APIM provided a statistical tool for the assessment of socialization within reciprocal and nonreciprocal friendships.

Socialization of eating behaviors between friends. Adolescent eating behaviors comprise the other significant domain of obesity-related behaviors, necessitating their examination in the context of same-sex friendships. Like physical and sedentary activity, the significant amount of time adolescents spend with same-sex friends likely involves countless opportunities for sharing a meal or snack both in- and out-of school (Shanahan & Flaherty, 2001). The role of social influence is perhaps most salient in the eating domain, as extensive data consistently point to its significance in dictating adults' food intake patterns in the presence of family and friends (Herman, Roth, & Polivy, 2003). Both social

learning theory and extant research highlight processes, such as modeling and observational learning, as primary mechanisms of socialization of eating behaviors between friends (Bandura, 1977; Herman et al., 2003; Salvy, Howard, Read, & Mele, 2009).

Socialization of eating behaviors would be expected to occur through repeated shared interactions with reciprocal and nonreciprocal friends. Provided that adolescents perceive their friends as salient role models for behavioral norms, they would presumably attend to their friends' food choices and intake, note similarity or dissimilarity in their eating behaviors, and in turn, modify their eating behaviors to increase concordance (Bandura, 1977; Berndt & Murphy, 2002; Bronfenbrenner, 1989). Akin to the socialization of physical and sedentary activities, adolescents would reinforce and emulate their friends' eating behaviors primarily with the goal of maintaining and strengthening their friendship (Berndt & Murphy, 2002). Additional motivation for assimilating to friends' eating habits may stem from adolescents' drive to become closer to popular peers that they admire, particularly in the case of adolescents with nonreciprocal friends (Brechwald & Prinstein, 2011). Given the association between physical attractiveness and popularity among adolescents, modifying their eating habits may be perceived as a way to improve their appearance, gain acceptance from a popular friend, and in turn, improve their social standing (Jones, Vigfusdottir, & Lee, 2004; Rancourt & Prinstein, 2010). Little is currently known about the socialization of eating behaviors within reciprocal or nonreciprocal same-sex

friendships as few studies to date have thoroughly addressed the role of same-sex friendships in the eating domain.

Extant research focused on assessing links between friends' eating behaviors is both scant and predominantly characterized by the same methodological weaknesses evident for physical activity and sedentary behaviors (e.g., cross-sectional data and having adolescents report on friends' behaviors). Studies tend to be inconsistent in their assessment of links between friends' eating behaviors as some studies provide evidence of significant links for single indicators of eating behaviors (e.g., Dejong, van Lenthe, vander Horst, K. & Oenema, 2009; de la Haye et al., 2010), whereas other studies provide evidence of concordance between friends' intake of specific food and beverage items (e.g. soft drinks, fruit, cereal, cake; Woodard et al., 1996). For example, available findings indicate that youth are more likely to follow a healthy diet and regularly eat breakfast, fruits, or vegetables when they perceive their friends to engage in these healthy eating behaviors (Cullen et al., 2001; Dejong et al., 2009; Luszczynska et al., 2004). Additional evidence of homophily in friends' eating behaviors was illustrated in two studies examining links between reciprocal friends' self-reported eating behaviors within their social networks (Ali et al., 2011; de la Haye et al., 2010; Feunekes, de Graaf, Meyboom, & van Staveren, 1998). Significant, positive links were reported for friends' consumption of high-calorie snacks, fast food, and soft drinks; yet, findings were mixed with respect to relations between friends' healthy eating behaviors, such as eating fruits and vegetables and eating breakfast. Collectively, these cross-sectional findings suggest that adolescents

have friends with similar eating behaviors; yet, there is little indication that friends' eating behaviors became similar as a result of socialization.

A study by Lau and colleagues (1990) underscores the need to further assess the role of friends for adolescent eating behaviors using longitudinal data. To date, Lau et al. (1990) have conducted the only investigation to illustrate that socialization between close friends is significant for adolescent eating behaviors. Notably, reciprocal same-sex friends' self-reported breakfast consumption and intake of various foods, such as fruits, vegetables, cereal, and junk food, were significantly and positively associated across the first three years of college. This finding coincides with the premise that spending time in the company of friends who exhibit particular eating behaviors increases the likelihood that adolescents will later engage in similar eating behaviors; socialization processes such as modeling and reinforcement would purportedly represent the key mechanisms through which friends shape obesity-related behaviors during adolescence (Bandura, 1977; Berndt & Murphy, 2002). The lack of additional empirical evidence highlights the value of the present study for substantiating whether socialization underlies the significant links reported for same-sex friends' eating behaviors.

In summary, extant research focused on the socialization of eating behaviors is insufficient for drawing definitive conclusions about the role of adolescent friendships. Not only are available studies inconsistent in their assessment of eating behaviors, but empirical findings are at best indicative of friendship selection effects (Bauman & Ennett, 1996; Hartup, 1996). As

highlighted by Lau et al. (1990), the examination of socialization within friendships is best captured by longitudinal data because they reflect the passage of time through which adolescents repeatedly interact with their friends, and in turn, presumably model eating behaviors in the presence of one another (Bandura, 1977; Bronfenbrenner & Crouter, 1983). Thus, it is important to further assess whether the significant concurrent associations in friends' eating behaviors are a reflection of socialization using a longitudinal design. Additionally, because both reciprocal and nonreciprocal friends can serve as salient role models for eating behaviors through shared meals and snacks, it is worthwhile to investigate longitudinal links between friends' eating behaviors in both reciprocal and nonreciprocal friend pairs (Herman et al., 2003; Salvy et al., 2009). Thus, the present study assessed longitudinal links between reciprocal and nonreciprocal same-sex friends' eating behaviors using the APIM. As suggested for activity behaviors, friends' self-reported eating behaviors were expected to be positively linked over time (i.e., partner effects), while also accounting for individual stability in eating behaviors (i.e., actor effects).

Role of Moderators for Socialization within Same-Sex Friendships

Socialization within dyadic friendships has been characterized thus far as a dynamic process that occurs through repeated interactions with friends (Bronfenbrenner, 1989; Bronfenbrenner & Crouter, 1983). Within the context of these reciprocal interactions, same-sex friends purportedly shape one another's behaviors through various processes, such as modeling and reinforcement (Bandura, 1977). The capacity of either reciprocal or nonreciprocal same-sex

friends to serve as significant sources of socialization is purportedly dictated by their perceived salience as social referents (Berndt, 1996). Various factors tied to the characteristics of each individual friendship impact the degree of influence friends can have on adolescents' behavior patterns (Brechwald & Prinstein, 2011; Brown et al., 2008; Bukowski & Hoza, 1989; Hartup, 1996). Notably, interaction frequency between friends and friendship stability have been identified as key moderators that can further explicate variation in peer socialization across same-sex friend pairs.

Interaction frequency. Adolescents presumably spend a significant amount of time hanging out with or in shared activities with close same-sex friends (Hartup, 1993). Regardless of the nature of the friendship (i.e., reciprocal or nonreciprocal), the amount of time close friends spend together would presumably be associated with the amount of opportunities for socialization adolescents are afforded within their friendships (Bandura, 1977; Vitaro et al., 2009). In turn, reciprocal influence between friends would purportedly be stronger within dyads reporting more shared time. The present Study Aimed to elucidate whether the strength of links between friends' obesity-related eating and activity behaviors vary with the amount of time adolescents spend with their friends.

Few studies to date have considered the effect that interaction frequency between same-sex friends has on the socialization of adolescent behaviors. Two recent longitudinal investigations examined whether higher interaction frequency is associated with stronger links between friends' behaviors (Barry & Wentzel, 2006; Jaccard et al., 2005). Although one study reported that friends' prosocial

behaviors were significantly linked over time among friendship dyads reporting high, rather than low, interaction frequency (Barry & Wentzel, 2006), the second study failed to find that the strength of relations between friends' risky health behaviors varies with the amount of shared time with friends (Jaccard et al., 2005). Although not focused on adolescent friendships, a third study by Tucker, McHale, and Crouter (2008) helps to reinforce the significance of interaction frequency within dyadic relationships; reflecting the tenets of social learning, adolescent siblings reportedly became more concordant over time in their social-emotional adjustment when they reported spending more time together in shared activities (Bandura, 1977). In summary, there is currently limited empirical evidence supporting the premise that having more opportunities over time to both interact with and shape friends' behaviors through key proximal processes, such as modeling, would be associated with stronger concordance between friends' behaviors (Bandura, 1977; Bronfenbrenner, 1989). Yet, given the strong theoretical underpinnings of interaction frequency for peer socialization, it is likely that stronger socialization of obesity-related behaviors may be evident for same-sex friends that frequently spend time together (Bandura, 1977).

The only investigation to have tested the premise that interaction frequency moderates socialization of obesity-related behaviors failed to find that the strength of relations between same-sex friends' self-reported food and beverage intake varies across dyads with differing levels of shared time (Feunekes et al., 1998); however, that study's small sample and concurrent data hindered drawing definitive conclusions about whether higher levels of shared time in

friend pairs is associated with stronger socialization of eating and activity behaviors. Additional empirical findings focused on indicators akin to interaction frequency (i.e., coactivity and the presence of a friend while eating or engaging in physical activity) point to its significance as a moderator (e.g., Romero, Epstein, & Salvy, 2009; Salvy, Romero, Paluch, & Epstein, 2007; Springer, Kelder, & Hoelscher, 2006). Notably, findings appear to suggest that socialization processes, such as modeling and reinforcement, are at play as friends coordinate their eating and activity behaviors. For example, studies have reported significant, positive relations between coactivity with friends and adolescents' level of physical activity; adolescents also tend to match their friends' intake of unhealthy foods and consume more food in the presence of friends (Salvy et al., 2008; Salvy et al., 2009; Voorhees et al., 2005).

Drawing on the findings of Tucker et al. (2008) and Barry & Wentzyl (2006), higher interaction frequency between friends would likely afford adolescents more opportunities to engage in obesity-related behaviors together, and in turn, result in stronger patterns of socialization (Bandura, 1977). Given the strong theoretical premise underlying the role of interaction frequency as a moderator and the lack of related past research, it was pertinent that the present study addressed whether shared time with close friends influences the strength of relations in adolescents' eating and activity behaviors (Bandura, 1977). Guided by social learning principles, this study expected longitudinal links between friends' physical activity, longitudinal links between friends' sedentary behaviors, and

longitudinal links between friends' eating behaviors to be stronger among friend pairs that interact more frequently.

Friendship stability. Adolescent friendships vary dramatically in their temporal stability, with longer-lasting ties presumably reflecting higher friendship quality and stronger compatibility (Hartup, 1993). Given the premise that stable friendships are better equipped to meet adolescents' social-emotional needs, adolescents conceivably place greater value on such relationships and hold longer-term friends in higher esteem (Poulin & Chan, 2010). In turn, friends in more stable friendships would represent particularly salient sources of socialization for adolescents' behaviors. In line with social influence theories, it is reasonable to expect that peer influence would be stronger within longer-term friendships because adolescents would be afforded a greater number of opportunities to model and emulate one another's behaviors within shared interactions over time (Bandura, 1977; Bronfenbrenner & Crouter, 1983). As part of the first Study Aim, this Study Aimed to assess whether socialization of eating and activity behaviors was stronger within more stable same-sex friendships.

Past research indicates that friendship stability is a significant predictor of social-emotional and school adjustment in youth (Berndt, Hawkins, & Jiao, 1999; Parker & Seal, 1996; Poulin & Chan, 2010); yet, it is less clear whether stronger peer socialization is associated with participation in more stable friendships. Some recent studies assessed friendship stability in relation to longitudinal links between close same-sex friends' levels of binge drinking, sexual activity, and depression (Giletta et al., 2011; Jaccard et al., 2005; Popp et al., 2008). All three

studies reportedly found stronger links between friends' risky behaviors when friendships were maintained for at least one year; these data point to the link between temporal stability and the degree of socialization opportunities adolescents are affording within their friendships (Bandura, 1977; Bronfenbrenner, 1989). In contrast, two additional studies failed to find similar patterns, in that the longitudinal relations between friends' prosocial behavior and substance use did not vary with the longevity of adolescents' friendships (Barry & Wentzyl, 2006; Urberg, et al., 1997). Conflicting findings across studies warrant further examination of the premise that socialization varies with the temporal stability of same-sex friendships.

Given the significance of repeated interactions with friends over time for social learning, it is of value to explore whether the degree of peer influence on adolescents' obesity-related behaviors is contingent upon friendship longevity (Bandura, 1977; Bronfenbrenner, 1989). The role of friendship stability for the socialization of adolescents' eating and activity behaviors has yet to be empirically addressed; however, both evidence of longitudinal socialization of eating and physical activity within matched same-sex friend dyads and key tenets of social learning theory point to the likelihood that friends' influence on obesity-related behaviors would depend on how long the relationship is maintained (Bandura, 1977; Lau et al., 1990). Thus, the present study expected to find stronger concordance in eating and activity behaviors among adolescents in more stable same-sex friendships.

As evident in this review, an extensive amount of research has been conducted to examine whether adolescent behaviors are shaped in the context of close friendships. Collectively, extant data suggest that across various domains of adjustment, adolescents are likely to engage in behaviors exhibited by close friends; yet, past research, particularly with respect to obesity-related behaviors, is limited in illustrating that adolescents engage in particular behaviors because they were consistently modeled or encouraged by friends throughout the friendship. Studies have predominantly reported positive, concurrent links between friends' eating and friends' physical activity behaviors and have largely neglected to assess relations between friends' sedentary behaviors, which in turn makes it difficult to draw definitive conclusions about the extent to which adolescent friendships serve as a source of socialization for obesity-related behaviors; however, prominent ideas about social influence would suggest that reciprocal and nonreciprocal friends would influence one another to engage in similar healthy or unhealthy eating and activity behaviors through processes of social learning (Bandura, 1977; Berndt & Murphy 2002). The present study extends past research by using the APIM in the context of a longitudinal design to test whether same-sex friends' self-reported eating and activity behaviors are associated over time. The additional tests of moderation aimed to clarify whether socialization of obesity-related behaviors is stronger in reciprocal and nonreciprocal friend pairs with higher interaction frequency and more stable friendships.

In line with the first major Study Aim, the following hypotheses were tested: adolescents' prior physical activity behaviors would significantly and

positively predict their own physical activity one year later (i.e., actor effect), whereas each adolescents' prior self-reported physical activity would significantly and positively predict their same-sex friends' self-reported physical activity one year later (i.e., partner effect); adolescents' prior sedentary behaviors would significantly and positively predict their own sedentary behaviors one year later (i.e., actor effect), whereas each adolescents' prior self-reported sedentary behaviors would significantly and positively predict their same-sex friends' self-reported sedentary behaviors one year later (i.e., partner effect); and adolescents' prior eating behaviors would significantly and positively predict their own eating behaviors one year later (i.e., actor effect), whereas each adolescents' prior self-reported eating behaviors would significantly and positively predict their same-sex friends' self-reported eating behaviors one year later (i.e., partner effect). Finally, interaction frequency and friendship stability were expected to moderate the strength of longitudinal associations between friends' physical activity, sedentary activity, and eating behaviors; stronger links were expected among same-sex dyads reporting high as compared to low interaction frequency and stable as opposed to unstable ties. All study hypotheses were tested with reciprocal and nonreciprocal same-sex friend dyads, with similar findings are most likely to occur for reciprocal friends and the nominators within the nonreciprocal friend dyads.

Same-Sex Friendships and Obesity Risk

An ecological perspective is increasingly being adopted to frame the investigation of the environmental underpinnings of obesity risk (Davison &

Birch, 2001; Gorin & Crane, 2008). Notably, studies are focusing on key developmental contexts, such as the family or neighborhood, that through supporting and reinforcing engagement in obesity-promoting behaviors, are premised to increase obesity risk (e.g., Davison & Birch, 2002; Davison et al., 2005; Gordon-Larson et al., 2006). These contexts are labeled 'obesigenic' as they presumably promote unhealthy eating, such as excessive consumption of fast food and sugary beverages, and unhealthy activity, such as high levels of watching TV or low levels of exercise (Gorin & Crane, 2008; Fisher & Kral, 2008; Hill & Peters, 1998). This notion can be extended to the peer context, as adolescents may participate in close peer relationships, such as same-sex friendships, with obesigenic peers that predominantly engage in obesity-promoting eating and activity behaviors.

Obesity Risk in the Peer Context: Obesigenic Friends

Close friends have been highlighted thus far for their presumed role in shaping behaviors during adolescence; of particular importance, are same-sex friends who engage in unhealthy or risky behaviors because they presumably influence their adolescent friends to engage in similar maladaptive behaviors (Berndt & Murphy, 2002; Bronfenbrenner, 1989). Drawing on theories of risk, risk factors are conceptualized as any characteristic or influence that increases the likelihood that adolescents will experience an adverse outcome (Jessor, 1991, 1992; Rex, 2005). In turn, friends that exhibit behaviors, such as unhealthy eating and activity behaviors could represent heightened obesity risk because associating

with them over time would purportedly increase the likelihood that adolescents experience future weight problems (Jessor, 1991, 1992; Rex, 2005).

Given the dearth of research focused on friends' obesity-related behaviors, it is important to clarify the conceptualization of obesigenic friends. Obesigenic friends would include peers that engage in multiple obesity-related behaviors that either exceed recommended limits on unhealthy dietary intake and activity or that fall below the recommended amount of healthy dietary intake and activity presumed necessary to maintain a healthy weight (AAP, 2001; DGA, 2005; Gidding et al., 2005; Gorin & Crane, 2008). In turn, same-sex friends could be conceptualized as having obesity-promoting activity levels if they fail to engage in the recommended 5 or more bouts of physical activity a week or if they report more than 2 hours of screen-related sedentary activity a day. Likewise, because adolescents are encouraged to eat breakfast daily, consume a particular number of servings a day of fruit, vegetables, and dairy, and limit their daily intake of high-fat or high-calorie foods and beverages, obesity-promoting eating behaviors would reflect a lack of adherence to these dietary recommendations. Available literature is of value when further defining specific types of unhealthy dietary intake as obesity-promoting; in particular, recent research suggests that there is a dose-response relationship between eating behaviors, such as skipping breakfast, consuming fast food, and consuming sweetened drinks, and excess weight, in that each additional serving of fast food or sweetened beverages or each day that breakfast is skipped predicts higher obesity risk or weight gain (e.g., Ludwig et al., 2001; Niemeier et al., 2006). The present study considered the additional role

of friends' obesity-promoting physical activity, sedentary activity, and healthy eating behaviors because adolescents' obesity risk could presumably be higher if their friends model and reinforce any of these behaviors in their presence (Bandura, 1977; Davison & Birch, 2002). The connection between friends' obesity-promoting behaviors and obesity risk, however, remains unclear as studies have yet to assess this link.

Nevertheless, findings indicating positive associations between friends' obesity status point to the significance of friends for obesity risk. For example, past research suggests that adolescents with overweight friends are significantly more likely to be overweight themselves (Bahr et al., 2009; Halliday & Kwak, 2009; Trogdon et al., 2008; Valente, Fujimoto, Chou, & Spruijt-Metz, 2009); but more importantly, data from a longitudinal study examining interrelations in weight gain among adults in large social networks suggests that individuals were more likely to become obese if friends, siblings, or spouses became obese, with the strongest links in weight gain resulting for reciprocal same-sex friends (Christakis & Fowler, 2007). Together, these empirical findings point to the likelihood that in spite of selection effects (Bauman & Ennett, 1996; de la Haye, Robins, Mohr, & Wilson, 2011b; McPherson et al., 2001), participation in friendships with peers that engage in obesity-promoting eating and activity behaviors is predictive of future weight gain (Davison & Birch, 2001; Gorin & Crane, 2008).

Given the lack of prior research examining the risk associated with obesigenic friends, analogous research conducted within another key

developmental context, the family, is useful for illustrating the value of assessing whether key social referents engaging in obesity-promoting behaviors heighten obesity risk in youth (Davison & Birch, 2002; Davison et al., 2005). Notably, one longitudinal investigation reported that only daughters with obesigenic parents (i.e., parents engage in above average unhealthy dietary intake and below-average physical activity) were found to have significant increases in BMI and body fat percentage over time. This finding appears to support the contention that salient role models that presumably promote unhealthy eating and activity habits during shared interactions over time serve as significant risk factors for obesity (Bronfenbrenner, 1989; Davison & Birch, 2001; Davison et al., 2005; Gorin & Craine, 2008). Thus, it was of value for the present study to explore whether friends that engage in obesity-promoting behaviors also play a significant role in predicting future obesity risk.

A risk-focused approach. Jessor's (1991; 1992) conceptual risk framework aptly guides the exploration into whether adolescents that have close friends with poor eating and activity behaviors are at increased risk for future weight problems. A key theoretical premise posits that risk behaviors and risky lifestyles thought to compromise health outcomes develop through adolescents' reciprocal interactions in five significant risk domains (Jessor & Jessor, 1977). Notably, the perceived environment domain is considered the source of significant social role models, such as close friends, that are believed to shape risk behavior, and in turn, predict the likelihood of adverse outcomes (Jessor, 1991; 1992; Rex, 2005). Past research highlights the use of a risk-focused approach, as

adolescents' close friends have been indicated as significant risk factors for poor health outcomes (e.g. Hussong, 2002; Maxwell, 2002; Prinstein et al., 2001). One study, in particular, focused on risk associated with friends who engage in obesity-promoting behaviors, finding that adolescents are more likely to report an overall unhealthy lifestyle when their close friends are perceived to regularly consume junk food and engage in high levels of sedentary activity (Jessor et al., 1998). Thus, extant data align with the notion that friends' poor health behaviors are associated with heightened risk for adverse health outcomes, and in turn, underscore the need to examine whether friends' obesity-related behaviors are risk factors for weight problems (Jessor, 1991; 1992).

Friends' obesity-promoting behaviors and cumulative risk for obesity. As previously noted, low physical activity, high screen-based sedentary activity, and unhealthy eating behaviors are each significantly and uniquely associated with obesity risk (Moreno et al., 2011; Niemeier et al., 2006; Sanchez et al., 2007). Thus, obesity risk would purportedly be higher when at least one of these three markers of obesity risk is present. Given evidence indicating that these obesity-promoting behaviors tend to co-occur among adolescents (e.g., Driskell et al., 2008; Kremers, van der Horst, & Brug, 2007; Wong & Leatherdale, 2009), it is important to consider the additive or cumulative risk associated with engaging in multiple obesity-promoting behaviors. In line with the cumulative risk hypothesis (Appleyard, Egeland, Manfred, van Dulman, & Sroufe, 2005; Rutter, 1979), independent risk factors are believed to incrementally heighten risk for negative outcomes, and in turn, carry more weight when investigated together.

In fact, extensive data illustrate that the number of risk factors best captures overall risk for adverse outcomes (e.g., Deater-Deckard, Dodge, Bates, & Pettit, 1998; Price & Hyde, 2009; Roberts et al., 2010). For example, studies indicate that the likelihood that adolescents engage in early sexual activity, (Price & Hyde, 2009), develop externalizing and internalizing behavior problems (Appleyard et al., 2005; Deater-Deckard et al. 1998; Gerard & Bueler, 2004a), become increasingly depressed (Gerard & Bueler, 2004b) or attempt suicide (Roberts et al., 2010) increases as the number of risk factors increase. Given past research, there is strong support for the contention that the cumulative effect of risk factors, rather than the independent contribution of any particular risk factor, better predicts the likelihood that adolescents will experience negative outcomes (Rutter, 1979). In turn, past research underscores the value of examining a cumulative risk model in the present study.

A small number of studies have assessed whether different patterns of obesity-promoting eating and activity vary in their association with adolescents' BMI or weight status. For example, Wong and Leatherdale (2009) found adolescents who engaged in both high levels of sedentary activity and low levels of physical activity were more likely to be overweight than peers that reported engaging in unhealthy levels of only one type or neither type of obesity-related activity; in two additional studies, adolescents that reported engaging in a higher number of unhealthy obesity-related eating and activity behaviors were more likely than their peers to have a higher BMI and be categorized as overweight or obese (Kosti et al., 2009; Sanchez et al., 2007). Together, extant findings suggest

that adolescents' unhealthy eating and activity behaviors are incrementally related to their own obesity risk; such patterns are expected for the link between adolescents' obesity-promoting behaviors and BMI, in that adolescents reporting more obesity-promoting behaviors will be more likely to experience increases in BMI over time.

The role of close friends for adolescents' obesity risk is unclear because no study to data has examined whether obesigenic friends are associated with adolescents' increases in weight or obesity status. A study by Prinstein and colleagues (2001) highlights the value of assessing the additive risk associated with friends' risky behavior patterns. In line with the cumulative risk hypothesis, adolescents were at higher risk for reporting substance use, deviant behavior, or suicidal behaviors, if they perceived their friends engaged in a higher number of risky behaviors. Closer to the focus of the present study, Davison and colleagues (2002; 2005) found children with parents that engage in multiple obesity-promoting behaviors were more likely than their peers have increases in weight over time; these findings not only underscore the validity of assessing a cumulative risk model for obesity, but also point to the role of other salient role models, such as friends, for obesity-related outcomes among adolescents. Drawing on past research, it is reasonable to conceive that adolescents with friends that engage in a higher number of unhealthy eating and activity behaviors would be at increased risk for obesity. For Study Goal 2, significant actor and partner effects were expected within reciprocal and nonreciprocal friend pairs., such that adolescents' self-reported obesity-promoting behaviors were expected

to be positively and additively associated with their own and their close friends' increases in BMIz over time.

The present study represents a significant advancement over past research because no study has utilized the APIM to test the role of close friends for obesity-related outcomes, such as engagement in sedentary activity or BMI (Kenny et al., 2006). As previously discussed, a growing number of studies (e.g., Adams et al., 2005; Cillessen et al., 2005) have adopted the APIM with the goal of accurately illustrating mutual influence within friend dyads. Significant partner effects have been reported within both reciprocal same-sex friendships and distinguishable friend pairs (Gileta et al., 2011; Popp et al., 2008) and with respect to both friends' self-reports on the same behavior (e.g., both friends report on physical activity) and relations between adolescents' self-reported behaviors or characteristics and their friends' adjustment on a related, but different, outcome (Adams et al., 2005; Peters, Cillesson, Riksen, Walraven, & Haselager, 2010). Thus, the APIM was applicable for testing longitudinal relations between friends' obesity-promoting behaviors and weight gain because it could account for both nonindependence in friends' data and actor effects (Kenny et al., 2006).

In summary, the present Study Aimed to build on the examination of socialization of obesity-related behaviors between friends by exploring whether adolescents' close friends also represent a significant source of risk for later obesity. Both theory and extant research point to the utility of cumulative risk models for delineating whether a higher number of risk factors is associated with poorer outcomes among adolescents (Appleyard et al., 2005; Prinstein et al.,

2001; Rutter, 1979). Given extant evidence indicating that adolescents' eating and activity behaviors are cumulative in their prediction of obesity (e.g., Sanchez et al., 2007; Wong & Leatherdale, 2009), the number of unhealthy obesity-promoting behaviors reported by close friends was expected to be positively predict adolescents' future obesity risk. Thus, in line with the cumulative risk hypothesis, a higher number of obesity-related behaviors reported by either reciprocal or nonreciprocal same-sex friends were expected to be related to a heightened risk for weight gain.

Study Covariates

Finally, to appropriately address the major Study Aims, it is critical to account for key individual and environmental factors that are independently tied to the development of obesity and related eating and activity behaviors. Extant literature suggests that individual differences among adolescents dictate prevalence patterns (Davison & Birch, 2001; Ogden et al., 2006). Most notably, adolescents' age, gender, ethnicity, adolescent obesity status, and family contextual indicators, such as parental obesity status and family SES, have been consistently highlighted as key covariates (Adair, 2008). By adjusting for the unique variance tied to these independent predictors, the present study was better able to assess whether close friends' eating and activity behaviors are linked and serve as risk factors predicting future obesity risk. This section briefly discusses the role of key covariates to provide a basis for their inclusion in the present study.

Age. As adolescents get older (i.e., move through the stages of adolescence), they strive for increased autonomy, which in turn, means more independent decision-making and less parental supervision; adolescents' increased independence would presumably affect the likelihood that they would engage in less optimal levels of activity and consume less healthy foods (Zimmer-Gembeck, & Collins, 2003). Empirical findings appear to reflect this premise suggesting that adolescents' obesity-related habits worsen over time (e.g., Bauer et al., 2009; Kahn et al., 2008). For example, studies consistently report declines in physical activity as youth move through adolescence (Duncan, et al., 2007; Kahn et al., 2008; Janz, Dawson, & Mahoney, 2000; Nader, Bradley, Houts, McRitchie, & O'Brien, 2008; Nelson et al., 2005). Likewise, the consumption of fruits, vegetables, and breakfast is lower, whereas sugary soft drink and fast food consumption is higher among older, rather than younger adolescents (Bauer et al., 2009; Lien, Lytle, & Klepp, 2001; Niemeier et al., 2006; Neumark-Sztainer et al., 2002; Young & Fors, 2001). Although less consistent, empirical evidence also suggest age-related trends in screen-based sedentary behaviors, as higher levels of screen-based sedentary activity are evident among older, rather than younger, youth (Gorely, Marshall, & Biddle, 2004; McGuire, Neumark-Sztainer, & Story, Hannan, Tharp, & Rex, 2003; Zabinski et al., 2007). Further, although studies have yet to assess age-related trends in obesity prevalence *during* adolescence, similar age-related trends for obesity are likely, given the significant link between obesity and related eating and activity behaviors (e.g., Ogden et al., 2002; Ogden

et al., 2006). In summary, the significance of age for obesity-related behaviors, underscores its inclusion as a covariate in the present study.

Gender. It also is critical to adjust for the independent contribution of gender, particularly because gender socialization and the physical changes associated with pubertal development presumably promote the development of gender-specific activity and food intake behaviors among adolescent boys and girls (Adair, 2008; Davison & Birch, 2001; Eccles, 1993; Sweeting, 2008). Studies consistently indicate that adolescent boys engage in higher levels of physical activity and are more likely to meet the recommended physical activity guideline than are adolescent girls (Gordon-Larsen et al., 2002; Janz et al., 2000; Nader et al., 2008; Samdal et al; Sanchez et al., 2007). In addition, extant findings appear to suggest that adolescent boys also engage in higher levels of unhealthy sedentary activity, such as watching TV and playing video games (Norman et al., 2005; Sanchez et al., 2007). Gender differences also are evident with respect to adolescents' eating behaviors, but vary across indicators of food intake. For example, male adolescents not only consume higher amounts of fast food, snacks, and sweetened soft drinks than do adolescent females (Bauer et al. 2009; Bere et al., 2007; Field et al., 2004; Forshee & Story, 2003; Larson et al., 2008; Phillips et al., 2003; Story, Forshee, & Anderson, 2006), but male adolescents also are more likely to meet dietary recommendations for dairy, protein, and whole grain intake and regularly consume breakfast than are adolescent females (Affenito et al., 2005; Delva et al, 2006.; Munoz et al. 1997; Neumark-Sztainer et al., 2002; Niemeier et al., 2006; Sanchez et al., 2007; Young & Fors, 2001). In summary,

available data collectively imply that gender transmits a separate, but significant, influence on the development of obesity-related behaviors; thus, gender was included as an additional covariate in the present study.

Adolescent and parent obesity status. Both adolescent obesity status and parental obesity status need to be included as covariates when examining links between friends' obesity-related behaviors and the links between friends' behaviors and obesity risk. Two key empirical patterns underscore the inclusion of adolescent obesity status; in particular, data indicate stability in obesity status throughout childhood and adolescence (Adair, 2008; Serdula et al., 1993; Whitaker et al., 1997) and indicate covariation between obesity-related behaviors and obesity status among youth (Delva et al., 2006; Gordon-Larson et al., 2002; Sanchez et al., 2007). Thus, because adolescents' obesity status would be expected to independently account for variation in obesity-related outcomes and independently predict change over time in obesity and related behaviors, it was included as a covariate in the present study.

Additionally, the significance of parental obesity status is tied to both the genetic underpinnings of obesity and parents' role in the socialization of obesity-related behaviors, particularly through processes such as modeling and instrumental support (Davison & Birch, 2001, 2002; Davison et al., 2005). Notably, extensive data indicate that adolescents are significantly more likely to become obese when one or both parents are obese (Crossman et al., 2006; Francis, Ventura, Marini, & Birch, 2007; Haines, Neumark-Sztainer, Perry, Hannan, & Levine, 2008; Margarey et al., 2003; Stice, Presnell, Shaw, & Rohde, 2005;

Whitaker et al., 1997). This significant, positive link is likely a reflection of parents creating a familial environment that promotes and reinforces obesity-promoting eating and activity behaviors, in turn, increasing concordance between parents' and adolescents' obesity-related behaviors (Davison & Birch, 2001, 2002; Davison et al., 2005). Thus, parental obesity status is another key covariate that independently dictates variation in adolescents' obesity-related behaviors and obesity status, and thus needed to be accounted for in the present study.

Ethnicity. Belief systems and behavioral norms associated with physical appearance, eating habits, and leisure activity are presumably tied to the particular cultural traditions and values of different ethnic groups (Crawford, Story, Wang, Ritchie & Sabry, 2001; Wickrama, Wickrama, & Bryant, 2006). Thus, the unique social experiences and interactions characterizing a particular ethnic group would presumably play a key role in shaping obesity-promoting behaviors, and in turn, predicting obesity risk (Davison & Birch, 2001). Available data do in fact highlight the role of ethnicity, indicating disproportionate trends among adolescents (Gordon-Larsen et al., 1999; Singh et al., 2008; Wang & Beydoun, 2007).

Notably, both obesity prevalence and engagement in unhealthy activity behaviors are reportedly highest among adolescents from minority groups, such as African American, Native Americans, and Hispanic adolescents (Brodersen, Steptoe, Williamson, & Wardle, 2005; Caballero et al., 2003; Gordon-Larsen et al., 1999, 2000; 2002, 2004; Gorely et al., 2004; Ogden et al., 2006; 2010; Nelson et al., 2005; Neumark-Sztainer et al., 2003; Richmond, Hayward, Gahagan, Field,

& Heisler, 2006; Wang & Beydoun, 2007). Available data indicate that unhealthy eating behaviors are not consistently more prevalent among adolescents from particular ethnic groups, yet minority youth do report high levels of particular types of eating behaviors; for example, African American youth reportedly consume the most fat and skip breakfast most frequently (Affenito et al., 2005; Neimeier et al., 2006; Neumark-Sztainer et al., 2002; Troiano et al., 2000). Collectively, past research not only suggests that ethnicity predicts individual differences in obesity and related eating and activity behaviors, but more importantly suggests that minority youth are high-risk groups. In turn, it was necessary to account for ethnic group membership in the present investigation.

Family socioeconomic status. The present study also accounted for the role of family SES because indicators of family resources tend to predict the extent to which families can create a developmental context that is conducive to healthy eating and activity behaviors (Braverman et al., 2005; Davison & Birch, 2001; Story, Neumark-Sztainer & French, 2002). Extensive data have accumulated suggesting that SES (e.g., parent education and family income) is an independent risk factor dictating obesity prevalence among adolescents, as overweight prevalence appears to be disproportionately higher among lower SES youth (BeLue, Francis, Rollins, & Colaco, 2009; McLaren, 2007; Miech et al., 2006; Shrewsbury & Wardle, 2008; Singh et al., 2008; Wang & Beydoun, 2007). Likewise, past research also has consistently found that SES is inversely associated with both unhealthy eating and activity habits. Thus, studies suggest that adolescents from lower SES families engage in less physical activity

(Kantomaa, Tammelin, Nayha, & Taanila, 2007; Nader et al., 2008) and more screen-based sedentary activity than peers from higher SES families (Brodersen et al., 2005; Gorely et al., 2004; Nelson et al., 2005; Woodard & Gridina, 2000).

Additionally, available data suggest that low SES youth are more likely than other youth to report a following a diet that is low in cost, low in nutrients, and high in fat and calories, as indicated by their frequent fast food consumption and high rate of failing to meet recommended dietary guidelines for vegetable, fruit, and dairy intake (Bauer et al., 2009; Larson, Neumark-Sztainer, Hannan, & Story, 2007; Larson, Story, Wall, & Neumark-Sztainer, 2006; Munoz et al., 1997; Neumark-Sztainer et al., 2002). Taken together, extant findings suggest that adolescents engage in significantly more unhealthy eating and activity behaviors when their families lack the resources for healthy foods and are limited in providing access to safe places to be physically active (e.g., recreation facilities and places to walk; Gordon-Larsen, Nelson, Page & Popkin, 2006; Kligerman, Sallis, Ryan, Frank, & Nader, 2007; Larson et al., 2006; Munoz et al., 1997; Neumark-Sztainer et al., 1996, 2002). Thus, the unique role of SES also was accounted for in this study.

In summary, this section highlighted various indicators thought to independently predict individual differences in obesity and related eating and activity behaviors among adolescents. Empirical evidence suggests that adolescent obesity status, parental obesity status, family SES, ethnicity, gender, and age all serve as significant antecedents dictating trends in obesity-related outcomes. Thus, it was important to account for the unique influence of these

predictors, so as to avoid obscuring the role of friends for the development of obesity and related behaviors.

Summary of Key Study Aims and Hypotheses

The present Study Aimed to extend past research focused on the socialization of obesity and related behaviors within the context of adolescents' same-sex friendships. Study hypotheses were tested with both reciprocal and nonreciprocal same-sex friends because both have the capacity to serve as significant socialization influences on adolescents' eating and activity behaviors. The first major Study Aim assessed longitudinal relations between friends' physical activity, sedentary activity, and eating behaviors. The APIM was used to test this first Study Aim because it can illustrate socialization within reciprocal and nonreciprocal same-sex friend dyads; additionally, interaction frequency and friendship stability were assessed as moderators to explore whether time spent with friends and friendship longevity moderate the strength of relations between friends' behaviors. The second major Study Aim built on the first aim by assessing whether same-sex friendships also serve as a source of risk for obesity. The role of cumulative risk of friends' obesity-promoting behaviors for later obesity status was tested with the APIM to determine if both adolescents' and their friends' unhealthy eating and activity behaviors are additive in their prediction of obesity risk.

To reiterate, the following hypotheses were tested with both reciprocal and nonreciprocal friends: (a) same-sex friends' reported physical activity levels are positively and longitudinally associated, above and beyond individual stability in

physical activity; (b) same-sex friends' reported screen-based sedentary activity levels are positively and longitudinally associated, above and beyond individual stability in screen-based sedentary activity; (c) same-sex friends' reported eating behaviors are positively and longitudinally associated, above and beyond individual stability in eating behaviors; (d) interaction frequency within same-sex friendships was expected to moderate longitudinal links between friends' obesity-related behaviors, such that stronger links would result in dyads characterized by higher interaction frequency; (e) friendship stability also was expected to moderate relations between friends' obesity-related behaviors, such that stronger links would be evident among friends in more stable friendships. Additionally, significant longitudinal relations were expected while also accounting for SES, ethnicity, adolescent obesity status, parental obesity status, age, and gender. (f) Finally, friends' obesity-promoting behaviors (i.e., partner effects) would additively predict future obesity risk, so that a higher number of unhealthy behaviors reported by friends would be associated with higher obesity risk, in addition to the contribution of adolescents' self-reported eating and activity behaviors (i.e., actor effects) and covariates presumed to dictate obesity-prevalence.

Method

Data for this study were collected as part of the National Longitudinal Study of Adolescent Health (Add Health). Add Health is an on-going school-based, panel study that has followed a nationally-representative sample of adolescents in grades 7-12 across four Waves of data collection. Wave 1 data

were collected both through a large-scale in-school survey and through in-home interviews between September 1994 and December 1995 when participants were ages 12-19. Data were only collected in Waves 2, 3, and 4 via in-home surveys. Wave 2 data were collected in 1996 when participants were ages 13-20; Wave 3 data were collected in 2001-2002 when participants were ages 18-26; Wave 4 data were collected in 2007-2008 when participants were ages 24-32. The present study focused on data collected in Waves 1 and 2.

Procedure

A cluster sampling design was employed to recruit participating schools. US high schools listed in the Quality Education Data database provided the sampling frame; high schools needed to have an 11^{th} grade and more than 30 enrolled students to be eligible for selection. Eighty sampled high schools reflecting variation in geographical region, size, type (e.g., private versus public or rural versus urban) and racial make-up across all US high schools were selected for participation. The majority (≈ 70%) of the 80 selected high schools agreed to participate; the 28 schools that declined participation were replaced by schools with similar characteristics. Participating high schools identified feeder schools or middle and junior high schools with a 7^{th} grade that sent students to that particular high school. In total, 145 schools, including both paired feeder and high schools and 20 high schools with grades 7-12 (i.e., no feeder school), were recruited for participation in the Add Health study. Parental consent was required for initial participation in the Wave 1 in-school survey. Most schools used a passive parental consent procedure where parents only signed and returned

consent forms to indicate their child could not participate; otherwise, remaining schools elected for active parental consent procedures where parents had to sign and return the consent form to indicate that their child could participate. In addition, both parental written consent and assent from participating adolescents less than 18 years of age were required for participation in the Wave 1 and Wave 2 in-home surveys.

This investigation used the in-home survey data collected in the first two Waves. The Computer-Assisted Personal Interview (CAPI) was completed on project lap-tops in participants' homes. Interviewers read survey items aloud and entered participants' responses. For more sensitive questions, the Audio Computer-Assisted Self-Interview (ACASI) enabled adolescents to listen to prerecorded questions through headphones and then enter responses themselves. In-home surveys took about 1-2 hours to complete. At each Wave, participants answered questions about family and peer relationships, health behaviors, behavior problems and delinquency, and physical indicators, including weight and height. Maintaining the confidentiality of Add Health participants' personal information was critical so participants were assigned identification numbers to ensure their anonymity.

Add Health Sample

Over 90,000 7^{th}-12^{th} grade adolescents participated in the initial in-school survey administered in Wave 1. Subsequent in-home surveys were administered to a sub-sample of the original in-school survey participants. The Wave 1 in-home survey sub-sample (n = 20,745) was drawn from adolescents that completed the

in-school survey or from adolescents that did not complete the in-school survey, but were listed on a school roster. The in-home sample was comprised of various subgroups, including a randomly-selected core sample (n = 12,105) and special over-samples (i.e., ethnic, disabled adolescents, genetic; n = 8,640). At Wave 1 only, parents of participating adolescents (n = 17, 670) completed an in-home survey.

The sample (n =14,738) for the Wave 2 in-home survey was similar to the Wave 1 in-home sample, with three exceptions. Disabled adolescents and participants who had been in 12th grade at Wave 1 (i.e., with the exception of those who were part of a genetic pair) were excluded from the study sample in Wave 2. Additionally, a small number of adolescents (n = 65) in the genetic sub-sample (i.e., sample including unrelated and related pairs of adolescent siblings living in the same household) that did not complete the Wave 1 survey were added in Wave 2.

Study sample. Multiple sub-samples of Add Health participants were utilized to test the present study's goals. Information is presented separately for the sub-samples of non-reciprocal and reciprocal same-sex friend pairs. It was *not* necessary to restrict the samples to only include adolescents that participated in stable reciprocal or non-reciprocal friendships (i.e., participated in the same-sex friendship at both Wave 1 and Wave 2), as such restrictions would have yielded a small sample that is not representative of adolescent friendships. The number of dyads and the nature of friendships (i.e., reciprocal or non-reciprocal friendship) were the key distinguishing factors between the sub-samples.

Participants needed to be a member of either a reciprocal or non-reciprocal same-sex friendship at Wave 1 to be considered for inclusion in this study. The study's two samples included reciprocal same-sex friend dyads and non-reciprocal same-sex friend dyads identified at Wave 1. Many participants listed peers that could not be identified or matched to another peer's identification (ID) number (i.e., because peers did not attend the same school or due to data collection errors); so, only friend pairs that could be identified by matching participants' ID numbers were retained when selecting each sample. At Wave 1, participants could have been identified as a member of multiple reciprocal or non-reciprocal same-sex friendships. Yet, only one reciprocal or non-reciprocal same-sex friendship was selected for each participant to avoid violating assumptions of independence in the data (Kenny et al., 2006). Separate samples were created for reciprocal same-sex friend pairs and non-reciprocal same-sex friend pairs; in turn, participants could have been used more than once (i.e., as a member of a reciprocal or non-reciprocal same-sex friendship) to assess each study goal.

Multiple steps were taken to identify which same-sex friend dyads would be selected for each sample. Because only same-sex friendships were included in the present study, male and female participants were limited to inclusion in up to 5 reciprocal same-sex friendships. The number of nonreciprocal same-sex friendships adolescents could participate in was not restricted because participants could both nominate 0-5 same-sex peers as friends and be nominated as a friend by an unlimited number of peers. Many adolescents were in fact identified as having multiple reciprocal or nonreciprocal same-sex friendships, thus

necessitating a random sample selection process to select which one friend pair would be included for each participant. In turn, as friend pairs were selected for inclusion in a study sample, all additional friendships identified for participants in a selected friend dyad were excluded.

Prior to dyad selection, both members of each identified reciprocal or nonreciprocal friend pair were organized as consecutive cases in each data set. Friend pairs were assigned a unique ID number to indicate membership in a particular dyad. To establish a systematic sample selection process, it was necessary to further organize dyads into smaller categories based on a pertinent indicator, such as participants' frequency of friendships. Given that both samples were comprised of friend pairs that varied with respect to their respective members' number of friendships, it was useful to categorize dyads based on such information. Participants were first assigned a code indicating their number of reciprocal or nonreciprocal friendships; a two-digit code was then created to represent both members' number of friendships in a friend dyad (e.g., a dyad was coded as 11 if each member only had one friend). Twenty-five friend pairs were identified in the reciprocal friendship samples, and 30 friend pairs were identified in the nonreciprocal friendship samples. The large number of unique pairings required that friend pairs reflecting similar combinations (e.g., all pairs in which each member had between two and five friends) were grouped together and assigned a final code that would be used to guide dyad selection. For example, in the samples of reciprocal friends, dyads were categorized into one of three groups, including dyads where each member had only one reciprocal friend, dyads where

one member had only one reciprocal friend and the other member had more than one reciprocal friend, or dyads where both members had more than one reciprocal friend. Nonreciprocal friend dyads were categorized similarly, with the addition of dyads where one friend nominated one or more peers as nonreciprocal friends, whereas the other friend had not nominated any peers as nonreciprocal friends.

Priority for sampling was based on the proportion of a particular grouping of friend pairs within the overall sample of dyads; larger groups of dyads were given higher priority. Various steps were undertaken to complete the random selection process. First, dyads were assigned a weight reflecting their priority for selection. A random number was then generated for each individual participant. The sum of assigned weights and random numbers was calculated for each participant. Only friend pairs where both dyad members had the lowest sum were retained for inclusion in the final sample. Selected dyad members' additional friend pairings were subsequently removed from the sample. This sample selection process was repeated until all dyads were either selected for or excluded from each final sample. Participants could have been selected as a member of one reciprocal or nonreciprocal same-sex friendship at Wave 1.

Samples of reciprocal and nonreciprocal friend pairs. Of the 20,745 participants that completed the Wave 1 in-home survey, 1,947 participants reported having at least one reciprocal same-sex friend, with a total of 1,279 reciprocal same-sex friend dyads identified at Wave 1. The final sample of reciprocal same-sex friendships included 862 friend pairs (n = 1,724 participants; 393 male-male dyads, 469 female-female dyads). The median annual household

income of participants' families was $44,000 in the reciprocal friend pair sample. Primary caregivers' educational attainment was as follows: 15% did not complete high school, 29% completed high school or earned a GED, 31% received some additional schooling beyond high school, 16% earned a college degree, and 10 % earned an advanced degree. Regarding the race/ethnic composition of the reciprocal friend dyad sample, 62% were non-Hispanic White, 15% were non-Hispanic African American, 13% were Hispanic, and 10% were Asian American. Girls comprised 54% of the reciprocal friend sample and the average age of dyad members was 16 years at Wave 1 and 17 years at Wave 2.

At Wave 1, 4748 participants reported having at least one nonreciprocal same-sex friend; a total of 3,893 nonreciprocal same-sex friend pairs were identified. After random selection, 1,908 friend pairs (n = 3,816 participants; 950 male-male dyads, 958 female-female dyads) were retained for the final sample of nonreciprocal same-sex friendships used to test both study goals.

The median family income for the nonreciprocal friend pair sample was $38,500. Regarding primary caregivers' educational attainment, 16% did not complete high school, 31% completed high school or earned a GED, 30% received some additional schooling beyond high school, 14% earned a college degree, and 9% earned an advanced degree. The race/ethnic composition of the sample was 56% non-Hispanic White, 20% non-Hispanic African American, 16% Hispanic, and 8% Asian American. Girls and boys each comprised 50% of the nonreciprocal friend sample and the average age of participants was 16 years at Wave 1 and 17 years at Wave 2.

Measures

Same-sex friendships. At Wave 1, adolescents were asked to list their five closest male friends and five closest female friends; respondents were told to list their best friend first, then, list their next closest friend second, and so on. Friendships were restricted to same-sex dyads for both theoretical and methodological reasons in this study. Same-sex friendships are both more common and characteristically different in nature than cross-sex friendships, which tend to be romantic relationships during adolescence (Hartup, 1993). Also, because adolescents were allowed to list a boyfriend or girlfriend as their closest cross-sex friend, the cross-sex friend nominations were not fully valid in their representation of non-romantic close friendships.

Close friendships have been conceptualized and measured in different ways in the peer relationship literature (Bukowski & Hoza, 1989; Parker & Asher, 1993). For example, past studies have often conceptualized reciprocal friends as pairs of peers that have mutually nominated one another as a close friend, but have varied with respect to whether peers needed to list one another as their first choice (i.e., very best friends) or only as one of their closest friends (i.e., 1st and 3rd choice or 2nd and 4th choice; e.g., Maxwell, 2002; Vaquera & Kao, 2008). To maximize the number of close reciprocal friendships in the present study, a reciprocal same-sex friendship was defined as any pair of same-sex peers that mutually nominated one another as one of their top five same-sex friends. A non-reciprocal same-sex friendship was defined as any pair of same-sex peers where one adolescent nominated another peer as one of his/her top five same-sex

friends, but the friendship nomination was not reciprocated by the nominated peer. Same-sex peers needed to be linked to one another by a valid identification number to be included as members of reciprocal or non-reciprocal friendships in this study.

Physical activity. At Waves 1 and 2, adolescents completed a 7-day recall questionnaire including items assessing adolescents' weekly engagement in MVPA (e. g., exercise and sport activity with an energy expenditure value of 5-8). The three items used to assess physical activity were similar to items found to be reliable and valid in other large-scale studies (e.g., Sallis, Buono, Roby, Micale, & Nelson, 1993). The following physical activity items were used at both Wave 1 and Wave 2: "During the past week, how many times did you go rollerblading, roller-skating, skate-boarding, or bicycling?", "During the past week, how many times did you play an active sport, such as baseball, softball, basketball, soccer, swimming, or football?", and "During the past week, how many times did you do exercise, such as jogging, walking, karate, jumping rope, gymnastics, or dancing?" Response choices for these items included 0 = *not at all,* 1 = *1 or 2 times,* 2 = *3 or 4 times, or* 3 = *5 or more times*. Similar to other investigations that have utilized these Add Health physical activity items, responses across items were summed to reflect overall physical activity engagement or rather indicate the total number of bouts of physical activity per week (Gordon-Larsen et al., 1999, 2000; 2002; 2004; Nelson et al., 2005; Ornelas, Perreira, & Ayala, 2007). Physical activity scores ranged from 0-15. The Wave 1 physical activity indicator was utilized as a predictor for both Study Aims 1 and 2, whereas the Wave 2

physical activity indicator was only used as an outcome indicator for Study Aim 1.

Sedentary activity. Participating adolescents completed a 7-day recall questionnaire that included three items measuring the number of hours per week engaged in particular screen-based sedentary activities (i.e., low energy expenditure or activities with a MET value of 1.5 or less) at Waves 1 and 2. Respondents were asked "How many hours per week do you watch TV?", "How many hours per week do you watch videos?", and "How many hours per week do you play video or computer games?" Responses indicated the number of hours per week (i.e., between 0 and 99 hours) spent in each activity. Unlike Add Health, the majority of past studies that have measured sedentary activity asked respondents to report the number of hours per day, often assessing TV/video viewing and playing video games together in a single item or via a fixed response scale (e.g., 1 = *1 hour*; e.g., Hume, van der Horst, Brug, Salmon, & Oenema, 2010; Sanchez et al., 2007; Singh et al., 2008; Utter et al., 2003). Given the likelihood that the summed number of hours reported across the three separate sedentary activity items reflects inflated indicator of sedentary activity engagement, responses across the three sedentary activity items were summed and averaged. Limited data is available on the scale's psychometric properties as few studies have examined adolescent sedentary behaviors. As indicated for the physical activity index, the Wave 1 sedentary activity indicator was utilized for both Study Goals 1 and 2; whereas, the Wave 2 sedentary behaviors index was only utilized as an outcome variable for Study Goal 1.

Eating behaviors. Similar to food frequency questionnaires used in other large-scale investigations (e.g., Hanson, Neumark-Sztainer, Eisenberg, Story, & Wall, 2005), participants reported on their meal frequency and intake of various food and beverage items at Waves 1 and 2. Items that measured fruit intake, vegetable intake, dairy intake, and breakfast consumption, at both Waves were used to assess Study Goals 1 and 2. The main difference in the measurement of these eating behaviors across Waves was that consumption was assessed using a single item at Wave 1 and multiple items at Wave 2. The three items measuring dairy, fruit, and vegetable intake at Wave 1 were as follows: 'How often did you drink milk, or eat yogurt, or cheese yesterday?', 'How often did you eat fruit or drink fruit juice?', and 'How often did you eat vegetables yesterday?' The response choices for these three items were 0 = *did not eat*, 1 = *ate once*, and 2 = *ate twice or more*. For breakfast consumption, participants were asked a series of questions about whether they usually consumed a particular type of food or beverage for breakfast during the week. One item directly asked participants whether they ate *nothing* for breakfast; this item was used to represent breakfast consumption on weekdays, with responses coded as 1 for not usually eating breakfast or 0 for usually eat breakfast.

To create an index of healthy eating behaviors using the four Wave 1 items, the dairy, fruit, and vegetable consumption items were dichotomized to reflect adherence to USDA and DGA (2005) guidelines for dietary intake. Similar to a prior study using the same fruit, vegetable, and dairy items (Videon & Manning, 2003), responses were re-coded as 0 if participants did not report

consuming the recommended servings or 1 if participants did report consuming the recommended serving. The breakfast item also was reverse-coded to reflect healthy eating, in that a response of 1 indicated regularly eating breakfast, whereas a response of 0 indicated regularly skipping breakfast. These four dichotomous indicators were then summed to create the Wave 1 healthy eating behaviors index, with scores ranging from 0-4; the Wave 1 healthy eating behaviors variable was included as a predictor when testing Study Goal 1. Additionally, the individual Wave 1 breakfast consumption and fruit, vegetable, and dairy consumption (i.e., in their original continuous format) indicators were included as part of the cumulative risk index for Study Goal 2.

The Wave 2 eating behaviors assessment was more extensive than in Wave 1, including multiple items measuring consumption in each of the different categories of dietary intake (e.g., dairy or vegetable consumption). Three questions were included to assess dairy consumption (e.g., "Did you drink milk, including milk poured on cereal or dessert?"), nine questions were included to assess fruit/fruit juice consumption (e.g., "Did you drink 100% orange, grapefruit, or tomato juice?" and "Did you eat peaches, plums, nectarines, or apricots?"), and 12 questions were included to assess vegetable consumption (e.g., "Did you eat broccoli?"). Participants indicated whether or not each item was consumed on the prior day (0 = *no* or 1 = *yes*). Responses to multiple items in each category of dietary intake were summed to create three continuous indicators of dairy, vegetable, fruit/fruit juice intake. Each summed composite variable was then dichotomized to indicate whether reported total intake adhered to DGA (2005)

nutrition recommendations; scores were dummy-coded 1 for consuming the recommended servings or 0 for not consuming the recommended servings. At Wave 2, breakfast consumption was assessed with the following item, "In the last seven days, on how many days did you eat breakfast?" Response choices included 0 = *0 days* to 7 = *7 days*. To maintain consistency with the Wave 1 item that assessed breakfast consumption on weekdays and the other three Wave 2 eating behavior items, responses were dichotomized and re-coded as 1 = *ate breakfast 5 or more days per week* or 0 = *ate breakfast 4 or less days per week*. The four dichotomous eating behavior items were summed to create the Wave 2 healthy eating index included as part of the first Study Aim.

Cumulative risk index. As part of the second major Study Aim, a cumulative index of unhealthy obesity-related behaviors reported at Wave 1 was created to serve as a predictor of change in BMIz between Waves 1 and 2. National recommendations for both activity engagement and nutritional intake guided the conceptualization of eating and activity behaviors as risk factors for obesity (AAP, 2001; DGA, 2005). For example, it is recommended that youth engage in 5 or more sessions of physical activity a week and 14 or less hours of screen-based sedentary activity a week; in turn, a lack of adherence to these guidelines would indicate that adolescents' activity behaviors are obesity-promoting or indicative of heightened obesity risk (Gorin & Crane, 2008). Along the same line, obesity-promoting eating behaviors would be conceptualized as not consuming the recommended two servings of dairy, two servings of fruit, and

three servings of vegetables, and skipping breakfast five or more days per week (DGA, 2005).

Each of the six Wave 1 indicators of healthy eating and activity behaviors (i.e., dairy, fruit, vegetable, and breakfast consumption, physical activity, and sedentary behaviors) were dichotomized and reverse-coded as 0 = *not obesity-promoting* and 1 = *obesity-promoting* to reflect behaviors that increase obesity risk. Similar to past studies focused on obesity-promoting activity behaviors, the Wave 1 continuous indicators of physical activity and sedentary behaviors were dummy-coded as 0 = *14 or less hours of screen-based sedentary behaviors per week* or 1 = *more than 14 hours of screen-based sedentary behaviors per week* and 0 = *5 or more bouts of physical activity per week* or 1 = *less than 5 bouts of physical activity per week* (e.g., Gordon-Larsen et al., 2000; 2004). The dummy-codes for the obesity-promoting eating behaviors were as follows: 1 = *consumed less than two servings of dairy* or 0 = *consumed 2 or more servings of dairy*, 1 = *consumed less than 2 servings of fruit* or 0 = *consumed 2 or more servings of fruit*, 1 = *consumed two or less servings of vegetables* or 0 = *consumed three or more servings of vegetables*, and 1 = *eating breakfast less than 5 days per week* or 0 = *eating breakfast 5 or more days per week* (Videon & Manning, 2003). Because the four eating behavior items comprised 75% of the cumulative risk index, it was necessary to weight these items so that they would be similar to the physical and sedentary activity items in their contribution to the overall scale; the four eating behavior items were re-coded as .25 or 0 to indicate meeting or not meeting the respective dietary guideline. The six binary variables were summed to

create a cumulative index of obesity-promoting eating and activity behaviors, with scores ranging 0-3; higher scores would indicate that participants engaged in a higher number of or obesity-promoting behaviors.

Interaction frequency. In line with social learning theory, interaction frequency was conceptualized as the extent to which same-sex friends hang out together or are physically in the presence of one another (Bandura, 1977). At Wave 1, three in-home survey items measured adolescents' perceptions of interaction frequency with each of the peers they nominated as a close friend. The three interaction frequency items were as follows: "Did you go to [Name's] house in the past week?"; "Did you meet [Name] after school to hang out or go somewhere in the past week?"; "Did you spend time with [Name] in the past week?" Response choices included 1= *yes* and 0 = *no.* Participants' responses were summed across the three items yielding composite scores ranging between 0 and 3; higher scores indicated higher perceived interaction frequency with friends. The level of interaction frequency among reciprocal friend pairs was determined by coding both members' responses as high or low. Both dyad members' summed scores needed to be 2 or 3 to be categorized as high interaction frequency, whereas both members of low interaction frequency dyads needed summed scores of 0-1. In nonreciprocal friend pairs, categorization of dyads as high or low was based only responses from the adolescent who nominated their peer as a friend; for example, if participants with unreciprocated friend nominations had an interaction frequency score of 2-3, that dyad was coded as having high interaction frequency and coded 1. For the moderator analyses, dummy-codes were used to

indicate that a dyad was high (a) or low (0) in interaction frequency. The three-item scale had strong internal consistency with respect to both male and female participants' perceived interaction frequency with each of their close friends (1st through 5th same-sex friend nominations; α = .98-.99). Similar items have been used in other investigations to assess interaction frequency between friends (e.g., get together on weekends or after school, go places together, or go over each other's house; α = .78), thus supporting the use of the scale in the present study (Barry & Wentzel, 2006; Jaccard et al., 2005).

Friendship stability. The reciprocal and nonreciprocal friend pairs included in the present study were identified by matching same-sex friend nominations reported at Wave 1. All same-sex friend pairs identified at Wave 2 were utilized to examine whether participants' Wave 1 reciprocal or nonreciprocal friendships persisted into Wave 2. Wave 1 reciprocal or nonreciprocal friend pairs were conceptualized as stable if the key defining feature of each type of friendship (i.e., two peers nominating one another as friends in reciprocal friend pairs or one adolescent nominating a particular peer as a friend in nonreciprocal friend pairs) was maintained across Waves (see Appendix A). Stable reciprocal friend dyads included pairs of participants that nominated one another as friends at Waves 1 and 2. In unstable reciprocal friend dyads, only one or neither of the dyad members that mutually nominated one another as friends at Wave 1, nominated their peer as a friend at Wave 2. Nonreciprocal friend dyads were categorized as stable if an adolescent nominated the same peer as a friend at Waves 1 and 2. In line with empirical data indicating that emergent friendships

are significant sources of socialization during adolescence, it was appropriate to categorize Wave 1 nonreciprocal friend dyads that were identified as reciprocal friend dyads at Wave 2 as stable (e.g., Kandel, 1978; Popp et al., 2008). Nonreciprocal friendships were considered to be unstable in cases where adolescents did not nominate the same friend at Wave 1 again at Wave 2 who did not reciprocate their friend nomination Friendships were coded 1 if stable and 0 if unstable.

Body Mass Index. BMI was used to measure adiposity at Waves one and two. BMI is defined as individuals' weight adjusted for height; strong correlations with other tools that directly measure body fat, such as underwater weighing and skinfold measurements, reflect BMI's validity as a measure of body fatness in youth (Dietz & Bellizzi, 1999). In children and adolescents, BMI *z*-scores, or BMI standard deviation scores, are utilized to account for age- and gender-related variation in body fat composition (Must & Anderson, 2006). CDC BMI-for-age growth charts are used to determine where youth stand in comparison to same-age and same-sex peers on BMI, to in turn, determine obesity status (CDC, 2010). BMI percentiles, which reflect children's and adolescents' level of BMI relative to peers, serve as the basis for classifying children and adolescents as underweight (i.e., less than the 5^{th} percentile), normal weight (i.e., between the 5^{th} and 85^{th} percentile, overweight (i.e., between the 85^{th} and 95^{th} percentile), or obese (i.e., at or above the 95^{th} percentile; Barlow, 2007; CDC, 2010). Participants' self-reported weight and height at Wave 1 and measured weight and height at Wave 2 were used to calculate participants' BMI *z*-scores; weight was recorded in pounds

and height was recorded in feet and inches. For Study Goal 2, change in BMIz was calculated by subtracting Wave 1 BMIz scores from Wave 2 BMIz scores (Niemeier et al., 2006).

Gender. Participants' gender was dummy-coded. Males were coded as 0, and females were coded as 1.

Age. Adolescents reported their birth date in years and months. At each Wave, birth date information was used to calculate participants' age in years on the day they completed in-home survey.

Socioeconomic status. Family income and parent education were included as indicators of SES. In the Wave 1 in-home survey, the primary caregiver reported on the total annual family income (i.e., before taxes) in 1994. Income was recorded in increments of $10,000. The primary caregiver also reported how far he/she went in school (0 = *8th grade or less*, 9 = *professional training beyond a four-year college or university*). Both parent education and family income have been identified as valid indicators of family SES (McLaren, 2007).

Parent obesity status. Data on parents' height and weight were not collected as part of ADD Health; thus, parents' obesity status was not based on BMI scores. At Wave 1, the primary caregiver that completed the Wave 1 in-home survey reported whether the participating adolescents' biological mother and biological father were currently obese or not (1 = *obese* or 0 = *not obese*). Responses were summed across items and coded as 0 = *neither parent was obese*, 1 = *one obese parent*, or 2 = *two obese parents*. The validity of the primary

caregiver's self-reported and other-report of obesity status is compromised because the indicator is not based on height, weight, and in turn, BMI scores. Yet, accounting for parents' obesity status is pertinent, given the heightened obesity risk among adolescents with at least one obese parent (Serdula et al., 1993; Whitaker et al., 1997).

Ethnicity. Five items in the Wave 1 in-home survey were used to describe participants' racial and ethnic background. Participants were asked to indicate whether or not they identified as White, African-American, Asian or Pacific Islander, or whether they were of Hispanic or Latino origin; response choices were 1 = *yes* or 0 = *no* for each item. In cases where participants both identified their race and indicated that they were Hispanic/Latino, were categorized as Hispanic/Latino. In line with extant data indicating that membership in a minority group is associated with higher obesity risk, when compared to non-Hispanic White peers, participants' responses were re-coded to reflect membership in a high-risk or low-risk ethnic group (e.g., Ogden at al., 2010; Wang & Beydoun, 2007). Participants were categorized as a member of a higher obesity risk group and dummy-coded as 1 if they identified as non-Hispanic African American, Latino, or Asian, whereas adolescents that described themselves as non-Hispanic White were categorized as a member of a lower-risk obesity risk group and dummy-coded as 0.

Analysis Plan

Both SPSS (PASW 18.0) and SAS 9.2 were used to test this study's hypotheses. First, descriptive statistics and bivariate correlations were run on all

variables. Descriptive statistics and correlations were calculated together for the full sample of reciprocal or exchangeable friend dyads, but separately for members of the nonreciprocal or distinguishable friend dyads. The hierarchical structure of the dyadic data necessitates using tools such as multi-level modeling to adjust for any shared variance tied to friendship membership (Hox, 2010; Kenny et al., 2006; Little, Schnabel, & Baumert, 2000). Proc Mixed in SAS was used to estimate the APIM for both Study Aims 1 and 2; the two-intercept model was used for estimation of the APIM with the nonreciprocal friend dyads. Restricted maximum likelihood (REML) estimation adjusted for missing data on all key indicators (Campbell & Kashy, 2002; Cook & Kenny, 2005; Kenny et al., 2006). For Study Goal 1, interaction terms for interaction frequency and friendship stability were created and included in all APIM model to assess whether these indicators moderate relations between friends' obesity-related behaviors.

Results

Missing Data

Given the large number of participants interviewed in the annual Add Health in-home survey, it was highly probable that some participants would be missing data on study indicators at Waves one or two. To examine the effects of missing data, differences between participants that had complete data (reciprocal dyad members: n = 1,380 participants; nonreciprocal dyad members: n = 2,808) and participants that were missing some data (reciprocal dyad members: n = 348; nonreciprocal dyad members: n = 1,008) were assessed through t-tests and chi-

squared analyses. Twenty-four comparisons were run (i.e., one for each study variable) separately for each sample of friend pairs. The following four comparisons were statistically significant for both reciprocal and nonreciprocal friend samples. Youth with complete data were more likely to report stable friendships (reciprocal: $\chi^2 = 64.81$, $p < .001$; nonreciprocal: $\chi^2 = 14.62$, $p < .001$), more likely to identify themselves as white (reciprocal: $\chi^2 = 25.69$, $p < .001$; nonreciprocal: $\chi^2 = 52.1$, $p < .001$), more likely to report higher dairy consumption (reciprocal: $d = .16$, t (1726) = 2.85, $p < .01$; nonreciprocal: $d = .08$, t (3813) = 2.47, $p < .05$), and more likely to be younger than youth with incomplete data (reciprocal: $d = .24$, t (1726) = -3.75, $p < .001$; nonreciprocal: $d = .34$, t (3813) = -9.51, $p < .001$). The following comparison also was significant, but only for the reciprocal friendship sample; youth with complete data reported healthier eating behaviors at Wave 1 ($d = .14$, t (1726) = 2.26, $p < .05$) than participants with missing data. Further, with respect to only the nonreciprocal friend sample, participants with complete data had more educated parents ($d = .12$, t (3274) = 2.47, $p < .05$) and reported higher sedentary behaviors at Wave 1 ($d = .08$, t (3795) = 2.15, $p < .05$). Effect sizes were typically small for statistically significant comparisons in both samples.

Sample Validity

Additional comparisons were conducted to examine whether friend pairs included in the present study's samples were similar on key study indicators to the friend pairs that were not selected through the random selection process. To reiterate, friend dyads were randomly selected from the larger sample of friend

pairs identified in Wave 1 of the Add Health Study; friend pairs were not retained for inclusion in this investigation when one dyad member had been previously selected as a member of another friend dyad. Akin to the missing data analyses, twenty comparisons were conducted using t-tests and chi-squared tests for the samples of reciprocal (included: n = 1,724; excluded: n = 612) and nonreciprocal friend pairs (included: n = 3,816; excluded: n = 2,258). Two comparisons were statistically significant for both samples; excluded friend pairs were older (reciprocal: d = .20, t (2339) = 4.24, p < .001; nonreciprocal: d = .18, t (6072) = 6.44, p < .001) and reported lower sedentary activity (reciprocal: d = .11, t (2336) = -2.24, p < .05; nonreciprocal: d = .07, t (6049) = -2.51, p < .05) at Wave 1. The following comparisons also were found to be significant only for the reciprocal friend pairs: excluded reciprocal friend pairs reported higher dairy consumption (d = .01, t (2339) = 2.04, p < .05) and lower sedentary activity at Wave 2 (d = .14, t (2336) = -2.77, p < .01) than selected reciprocal friend pairs. Despite the significant differences reported between those selected and not selected for inclusion in this study's samples, effect sizes were small.

An additional check was performed to illustrate that the final study samples were representative of all friend pairs identified at Wave 1. Given this study's focus on obesity- promoting behaviors and obesity risk, frequencies were run to assess whether the distribution of Wave 1 obesity status was similar among selected reciprocal and nonreciprocal friend pairs and the larger respective samples from which they were selected. Wave 1 BMI z-scores were first calculated in participants in the samples of (a) all identified same-sex reciprocal

friend pairs, (b) all identified same-sex nonreciprocal friend pairs, (c) selected samples of reciprocal same-sex friend pairs, and (d) selected samples of nonreciprocal same-sex friend pairs and secondly used to categorize participants' obesity status as underweight, normal weight, overweight, or obese. Both selected samples were found to be representative of their respective, larger samples, as they were similar (i.e., within 1 percentage point) in their percentage of underweight, normal weight, overweight, and obese participants. All four samples had obesity status distributions that fell into the following ranges: 3-4% underweight, 71-76% normal weight, 12-13% overweight, and 7-11% obese.

Descriptive Statistics and Bivariate Correlations

Prior to conducting descriptive analyses, normality tests were run to examine the distribution of scores for key study variables in each sample. Both the Wave 1 and Wave 2 sedentary activity variables in the reciprocal and nonreciprocal samples were positively skewed (i.e. 2.72, 2.35, 2.88, and 2.17, respectively) and in violation of the assumption of normality (Cohen, Cohen, West, & Aiken, 2003). In line with recommendations for transforming count data and increasing linearity between variables, square root transformations were performed on both predictor and outcome variables (i.e., Wave 1 and 2 sedentary activity) reported by each sample. The Wave 1 and 2 sedentary behavior variables had a skewness of .92-1.05 after performing transformations, indicating an acceptable and more normal distribution of scores. The transformed variables were utilized to assess longitudinal relations between friends' sedentary activities as part of Study Goal 1.

Taking into account the differential nature of reciprocal and nonreciprocal friend pairs (i.e., indistinguishable versus distinguishable), means and standard deviations were calculated separately for nonreciprocal dyad members and together for reciprocal dyad members; descriptive statistics for all study indicators are displayed in Tables 1 and 2. Participants in reciprocal friendships, on average, met the requirements for less than 14 hours per week of sedentary activities and 5 or more bouts of physical activity a week, met two of four healthy eating guidelines, and were normal weight status. Among reciprocal friend pairs, friends spent a moderate amount of time together, but tended to have unstable friendships.

In nonreciprocal friend pairs, members were differentiated by which member nominated his/her peer as a friend (nominator) and which member was nominated but did not reciprocate the friend nominations (nominee); however, results across indicators were similar for nominators and nominees, with the exception of interaction frequency, for which only nominators' data were included. Similar to participants in reciprocal friendships, nonreciprocal friend dyad members, on average, met two of four healthy eating guidelines, met the requirement for engaging in less than 14 hours per week of sedentary activity and 5 or more bouts of physical activity, were normal weight status, and tended to have unstable friendships. Nominators reported spending a moderate amount of time with their nonreciprocal friends.

Bivariate correlations are displayed in Table 3 for reciprocal friend dyads and in Tables 4 and 5 for nonreciprocal friend dyads. Results suggest that physical

activity, sedentary activity, healthy eating, and BMIz are stable over time among adolescents in both reciprocal and nonreciprocal friendships. For reciprocal friends and the nominees within the nonreciprocal friend pairs, scores on the cumulative risk index were positively associated with Wave 1 BMIz scores. These findings indicate that heavier adolescents were more likely than their peers to report engaging in a higher number of obesity-promoting behaviors at Wave 1; similar links between cumulative risk and BMIz scores for the nominators were positive, but not significant. Contrary to expectations, Wave 1 cumulative risk was not significantly associated with BMIz one year later in either sample.

Actor-Partner Interdependence Models Testing Relations between Friends' Obesity-Related Behaviors

In line with procedures outlined by Campbell and Kashy (2002) and Kenny and colleagues (2006), the APIM for both indistinguishable and distinguishable dyads was estimated to examine longitudinal links between friends' obesity-related behaviors. Three separate APIM models were estimated for physical activity, sedentary activity, and healthy eating for each sample of friend dyads; a total of six main effects models were estimated. For the reciprocal friend dyads, each main effects model included each friend's Wave 1 and Wave 2 self-reported behaviors to test for both actor and partner effects. The following covariates were included in each model to control for their independent contribution to individual differences in Wave 2 physical activity, sedentary activity, and eating behaviors: gender, ethnicity, parent income, parent education, parent obesity status, Wave 1 age, and Wave 1 BMI *z*-scores. All continuous

predictors were grand-mean centered before creating interaction terms and conducting analyses for Study Aim 1; effects coding (i.e., variable levels re-coded as 1 and -1) was used with the categorical variables so that their intercepts would be zero (Cohen et al., 2003).

A key distinction between reciprocal and nonreciprocal friends is that the former cannot be differentiated with respect to each member's unique role within the dyad, whereas the latter can be differentiated with respect to friendship nominations. In the present study, nonreciprocal dyad members were distinguished in accordance with whether a member was the friendship nominator or friendship nominee. Because nonreciprocal friends can be distinguished by their role in the friendship, the assessment of the APIM is modified to account for the effects of the distinguishing variable (Campbell & Kashy, 2002; Kenny et al., 2006). The two-intercept model approach is recommended for conducting dyadic data analyses with distinguishable dyads and thus was used in the present study to assess all APIM models with the nonreciprocal friend pairs (Kenny et al., 2006). A key modification of the two-intercept model is that two separate intercepts are included for each dyad member. Two dummy-code variables, nominator and nominee, were created and included in all models to represent these separate intercepts. The nominator variable was coded 1 for nonreciprocal friend dyad members who nominated their peer as a friend and 0 for the nominated peer who did not reciprocate the nomination; the nominee variable was coded in the opposite manner, with the nonreciprocal dyad members who nominated their peers as 0 and the nominated peers who did not reciprocate the nomination as 1.

Each APIM model for the nonreciprocal friend pairs included the nominator and nominee dummy variables, as well as, interaction terms between each dummy-code variable and each predictor variable that yielded separate estimates for nominators and nominees.

Physical activity. Results for the main effects models assessing longitudinal links between reciprocal and nonreciprocal friends' physical activity are displayed in Tables 6 and 7, respectively. Participants' self-reported physical activity at Wave 1 was expected to be positively linked to their own and their friends' self-reported physical activity at Wave 2. As hypothesized, significant actor (b = .38, t (1094) = 14.33, p <.001) and partner effects (b = .07, t (1094) = 2.81, p <.01) were found for physical activity within reciprocal friend dyads (see Figure 3). These findings indicate that above and beyond individual stability in physical activity, adolescents' self-reported physical activity scores predict increases in their friends' physical activity over time. Separate estimates were reported for each dyad member (i.e., nominators and nominees) within nonreciprocal friend dyads. Similar to reciprocal friends, self-reported physical activity scores were significantly and positively associated over time for both nominators (b = .34, t (1304) = 12.37, p <.001) and nominees (b = .41, t (1385) = 15.16, p <.001). Significant partner effects were only evident for nominators (b = .07, t (1384) = 2.39, p <.05), indicating that the nominators were more likely to engage in higher levels of physical activity when the nominees reported higher physical activity engagement; partner-reported physical activity was only a

marginally significant predictor of nominees' physical activity over time (b = .05, t (1317) = 1.75, p <.10; see Figure 4).

Sedentary activity. Longitudinal relations between friends' levels of sedentary activity also were assessed in the context of the Actor Partner Interdependence Model. Significant, positive actor and partner effects were expected. For both reciprocal and nonreciprocal friend pairs, only significant actor effects were found (see Tables 8 and 9). Findings suggest that engagement in sedentary activity is stable over time for reciprocal friend dyad members (b = .47, t (1076) = 17.74, p < .001) and both nominators (b = .43, t (1364) = 16.44, p < .001) and nominees (b = .40, t (1297) = 15.26, p < .001) within nonreciprocal friend dyads. Contrary to expectations, no significant partner effects resulted within reciprocal or nonreciprocal friend dyads. As illustrated in Figures 5 and 6, these results suggest that adolescents' self-reported level of sedentary activity does not serve as a significant predictor of changes in their friends' sedentary activity engagement over time.

Healthy eating. The APIM was also utilized to assess whether adolescents' Wave 1 self-reported healthy eating was a significant and positive predictor of their own and their friends' Wave 2 self-reported healthy eating (see Tables 10 and 11). In line with study expectations, adolescents' self-reported healthy eating was significantly and positively associated over time for members of reciprocal (b = .36, t (1101) = 11.40, p <.001) and nonreciprocal friend pairs (nominators: b = .38, t (1377) = 11.65, p <.001; nominees: b = .43, t (1333) = 1359, p <.001). Findings also indicated significant partner effects, suggesting that

above and beyond individual stability in healthy eating habits, adolescents are more likely to report healthy eating when their friends report engaging in healthy eating habits (reciprocal friends: $b = .08$, $t\ (1100) = 2.53$, $p < .05$; nominators: $b = .10$, $t\ (1377) = 3.01$, $p < .01$; nominees: $b = .09$, $t\ (1410) = 2.79$, $p < .01$; see Figures 7 and 8). Of the three key study predictors, the strongest support for hypothesized actor and partner effects resulted for healthy eating.

In summary, findings indicate that there is stability in adolescents' physical activity, sedentary activity, and healthy eating behaviors over time. In the main effects APIM models, mixed support was found for the hypothesized partner effects on adolescents' obesity-related behaviors within same-sex friendships. Results suggest that partner-reported physical activity and healthy eating, but not sedentary activity, significantly predict changes in adolescents' engagement in the same behaviors over time, particularly for adolescents that acknowledged the relationship through friendship nominations (i.e., reciprocal friend dyad members and nominators within nonreciprocal friend dyads).

Possible Moderators

To assess whether the strength of relations between friends' eating and activity behaviors varies with friendship stability and interaction frequency, additional models were estimated to assess moderator effects. The three main effects models for physical activity, sedentary activity, and healthy eating behaviors were re-run with interaction terms representing each respective moderator. For the indistinguishable dyads, or reciprocal friend pairs, interaction terms were created by computing the cross-product of friendship stability or

interaction frequency with friends' self-reported physical activity, sedentary activity, and healthy eating at Wave 1 (i.e., partner effects). As customary when testing interactions, friendship stability and interaction frequency were also included as independent predictors in each model to account for the main effects of the moderating variables on adolescents' outcomes (Aiken & West, 1991; Cohen et al., 2003). For the distinguishable dyads, or nonreciprocal friend pairs, separate interactions terms representing the cross-product between each moderator and the partner effect indicators (i.e., Wave 1 partner-reported physical activity, sedentary activity, or healthy eating) were included for the nominators and nominees.

Friendship stability and interaction frequency were tested as moderators in separate interaction effects models; a total of 12 interaction effect models were estimated for each sample of friend pairs. Results for the moderator analyses are presented along with the results of the main effects models in Tables 6 through 11. Stronger partner effects were expected among friend pairs with more stable friendships and higher interaction frequency. Contrary to expectations, none of the interaction terms assessing friendship stability and interaction frequency as moderators of the links between friends' physical activity, friends' sedentary activity, or friends' healthy eating were significant for either reciprocal or nonreciprocal friend dyads. The lack of support for moderation indicates that the strength of relations between friends' obesity-related behaviors does not vary with the amount of time friends spend together or with friendship stability.

Actor-Partner Interdependence Models Testing Relations between Friends' Obesity-Promoting Behaviors and Obesity Status

Two models were estimated to assess a cumulative risk model of friends' obesity-promoting behaviors for adolescents' BMIz within reciprocal and nonreciprocal friend dyads. Included in the model for reciprocal friends were both dyad members' Wave 1 cumulative risk index variable, an indicator of change in BMIz from Wave 1 to Wave 2, and six covariates (i.e., gender, ethnicity, parent income, parent education, parent obesity status, and Wave 1 age). The model for the nonreciprocal friend pairs included the two dummy-code variables (i.e., nominee and nominator) and interaction terms representing the cross-product between each dummy variable and the Wave 1 cumulative risk index indicator and study covariates; in turn, this model yielded separate estimates for the nominees and nominators.

The present study expected to find that the number of obesity-promoting behaviors reported by adolescents at Wave 1 would be positively associated with their own and their friends' obesity status at Wave 2. Results are displayed in Tables 12 and 13. Surprisingly, actor effects were not indicated for either sample of friend pairs; thus, the number of obesity-promoting behaviors self-reported by adolescents at Wave 1 did not predict heightened risk for obesity at Wave 2. Support was found for hypothesized partner effects, but only for the reciprocal friend dyads; significant, positive links were found between adolescents' cumulative obesity-promoting behaviors and their reciprocal friend's change in BMIz from Wave 1 to Wave 2 ($b = .06$, $t\,(1068) = 2.14$, $p < .05$). Findings

suggest that adolescents with reciprocal friends that engaging in a higher number unhealthy eating and activity behaviors dyad members are more likely report an increase in BMIz over time (see Figures 9 and 10). Although significant partner effects only resulted for reciprocal friend pairs, these results align with findings from Study Goal 1 that highlight the role of partner-reported behaviors for adolescents' obesity-related outcomes.

Discussion

The present study advanced current knowledge about the role of same-sex friends in adolescents' obesity-related outcomes by modeling dyadic relations within both reciprocal and nonreciprocal friend dyads. Adolescents have received considerable attention as a group at heightened risk for obesity because they tend to engage in obesity-promoting eating and activity behaviors and tend to experience more intractable weight problems than their younger counterparts (Adair, 2008; Gordon-Larsen, Nelson, & Popkin, 2004; Sanchez et al., 2007; Wright, Pepe, Seidel, & Dietz, 1997). Given the presumed significance of the peer context as a source of risk and socialization during adolescence (Berndt & Murphy, 2002; Brown et al., 2008; Sullivan, 1953) and extensive data suggesting that friendship participation is tied to changes in adolescents' behavior habits and adjustment (e.g., Barry & Wentzyl, 2006; Kandel, 1978; Parker & Asher, 1993; Mercken et al., 2010; Popp et al., 2008), this investigation assessed longitudinal links between close same-sex friends' physical activity, sedentary activity, and eating behaviors and explored whether friends' obesity-related behaviors are risk factors that predict weight change among adolescents. Noteworthy contributions

to extant literature include being the first to study to (a) empirically address socialization of adolescents' physical activity, sedentary behaviors, and eating behaviors within the context of both reciprocal and nonreciprocal same-sex friendships, (b) conceptualize and assess friends' obesity-promoting behaviors as part of a cumulative risk model, and (c) assess relations between friends' obesity-related outcomes using the Actor-Partner Interdependence Model. This discussion serves to synthesize study findings with extant literature, highlight study limitations and implications, and offer recommendations for future research exploring links between peers and obesity-related outcomes.

Longitudinal Relations between Same-Sex Friends' Eating and Activity Behaviors

As part of first major study aim, several hypotheses were tested to see whether adolescents' engagement in eating and activity behaviors would be stable over time (i.e., actor effects) and whether adolescents in reciprocal and nonreciprocal same-sex friendships would be more likely to engage in physical activity, sedentary activity, and healthy eating behaviors when their close friends reported engaging the same behaviors (i.e., partner effects). In line with the expected findings for this first goal, significant actor effects resulted for all three obesity-related behaviors. That is, eating and activity behaviors were significantly correlated over a one-year period for youth during adolescence. This evidence of stability in adolescents' eating and activity behaviors aligns with findings indicating that weight problems become increasingly stable as youth move through childhood and adolescence (Adair, 2008; Dietz, 1994; Gordon-Larsen et

al., 2004; Serdula, 1993) and suggests that such patterns will likely persist into adulthood (Janz et al., 2000; Lien et al., 2001).

Beyond individual stability in eating and activity behaviors, a central focus of the first study goal was to examine partner effects, or the extent to which friends' self-reported eating and activity behaviors become increasingly concordant over time. Theories of social influence suggest that same-sex friendships represent significant sources of socialization that are purportedly characterized by repeated reciprocal interactions between friends and afford adolescents opportunities for socialization; notably, friends' behaviors become more similar through processes of modeling and reinforcement (Bandura, 1977; Berndt & Murphy, 2002; Bronfenbrenner, 1989; Brown et al., 2008). Study findings provide support for the contention that friends are significant sources of socialization for two of the three obesity-related behaviors examined in this study. Partner effects emerged for both physical activity and healthy eating behaviors among reciprocal friend pairs and for the nominators within nonreciprocal friend pairs. These results suggest that adolescents are more likely to report higher levels of physical activity and healthy eating over time when their friends reported higher levels of engagement in these behaviors.

First, evidence of significant, positive links between friends' self-reported physical activity is consistent with past research. Cross-sectional and longitudinal studies indicate both homophily (Ali et al., 2011; de lay Haye et al., 2010, 2011b; Luszczynska et al., 2004) and increased concordance in friends' physical activity habits over time (de lay Haye et al., 2011b; Duncan et al., 2007; Lau et al. 1990).

Using the Actor-Partner Interdependence Model strengthens this body of literature as this study provides evidence of socialization between friends in physical activity behavior after controlling for initial similarity in friends' physical activity habits and taking into account nonindependence in friends' behaviors (Kenny & Cook, 1999; Kenny et al., 2006). Moreover, finding evidence of peer influence within both reciprocal and nonreciprocal friendships in this investigation further challenges the contention that mutual recognition of a friendship is required for socialization (Bukowski & Hoza, 1989; Parker & Asher, 1993). Notably, the pattern of partner effects that emerged for physical activity (i.e., significant partner effects among only reciprocal friends and the nominators with nonreciprocal friend dyads) aligns with the contention that adolescents' perception of a peer as a friend is what underlies their susceptibility for socialization (Brown, 2008). These results contribute to a growing literature that suggests that nonreciprocal friends represent another significant source of peer influence (Adams et al., 2005; Bot et al., 2005; Kandel, 1978; Mercken et al., 2010; Popp et al., 2008). In summary, close same-sex friendships appear to play a significant role in shaping adolescents' physical activity habits, as long as peers are perceived to be friends and salient social models (Berndt, 1996; Brown et al., 2008).

As noted for physical activity, significant partner effects for healthy eating suggest that same-sex friends engage in increasingly similar levels of healthy eating behaviors over time (Bandura, 1977; Berndt & Murphy, 2002). Given considerable research findings indicating that both adults and children adjust their

food intake in the presence of peers and close friends, it was not surprising that partner effects for healthy eating were the strongest of the three obesity-related behaviors (e.g., Herman et al., 2003; Salvy et al., 2007, 2009). These results contribute to a more balanced understanding of peers as social referents for eating behaviors because past research tends to suggest that friends' intake of unhealthy (i.e., consumption of high-calorie foods, including fast food, savory snacks, sweets, and sugary soft drinks), rather than healthy, foods are related (Ali et al., 2011; de la Haye et al., 2010; Feunekes et al., 1998; Woodard et al., 2006). Within the context of available literature, the present study holds particular value for two reasons. First, because longitudinal data have rarely been used to investigate socialization of eating behaviors, this study can better illustrate that friendship participation, rather than friendship selection, is tied to increased similarity between same-sex friends (Bauman & Ennett, 1996; Lau et al., 1990). More importantly, study findings highlight the peer group as another significant developmental context wherein adolescents can form healthy eating habits, such as eating breakfast, that are believed to be primarily shaped at home with their families (Bronfenbrenner, 1986, 1989; Videon & Manning, 2003). In summary, the significant partner effects for healthy eating imply that adolescents are taking note of their close friends' overall diet or lifestyle habits, which is not surprising given the emphasis on maintaining weight and being perceived as physical attractive during adolescence (Mackey & La Greca, 2007; Wang, Houshyar, & Prinstein, 2006).

It was interesting that significant partner effects for healthy eating resulted for reciprocal friends and both members of the nonreciprocal friend dyads (Brown et al., 2008). With respect to the nonreciprocal friend dyads, it is reasonable to believe that as the nominators' eating behaviors became more concordant with the nominee's eating behaviors over time, nonreciprocal dyad members likely started mutually shaping one another's eating behaviors (Berndt & Murphy, 2002). In particular, the increased concordance in eating behaviors between nonreciprocal friends may be associated with a change in the nominees' perception of the nominators as friends and salient socialization agents (Berndt, 1996; Brown et al., 2008). Such a contention aligns with findings from past research indicating that mutual influence is evident among peers in nonreciprocal friendships that later develop into reciprocal friendships (e.g., Popp et al., 2008). Thus, it would be useful to explore whether the significant partner effects on healthy eating for nominees reflect socialization patterns within emergent friendships.

Unlike physical activity and healthy eating, significant partner effects did not emerge for sedentary activity in this study. Given that sedentary activities are leisure in nature and highly normative among adolescents (Marshall et al., 2006; Olson, 2010), it is surprising that same-sex friendships do not appear to serve as significant socialization contexts for shaping sedentary activity (Bandura, 1977; Bronfenbrenner, 1986, 1989; de la Haye et al., 2010). There are a few possible explanations for the non-significant partner effects for sedentary behaviors. First, studies have found that youth are more likely to watch higher levels of TV when they report a lack of friends and are less likely to watch TV when they report

having friends to spend time with (Krosnick, Anand, & Hartl, 2003; Vandewater et al., 2004). It is reasonable to posit that spending increased time engaged in screen-based sedentary activities may occur in response to poor peer relationships rather than peer influence. Second, peer socialization may only be tied to adolescents' engagement in sedentary activities that are perceived to be socially-oriented. Given advances in technology, video games have become more interactive and competitive, and in turn, playing video games is increasingly viewed as a social activity that youth enjoy sharing with friends; many adolescents have even been labeled 'gamers' to signify that their identity among peers is tied to their frequent video game playing (Olson, 2010). Along the same line, spending time on the computer, particularly in internet-based social networking activities, now plays a critical role in socializing with peers; adolescents may be more highly motivated to emulate their friends' engagement in such activities (de la Haye et al., 2010; Schneider et al., 2007). Finally, the lack of evidence for socialization of sedentary activities can be better understood by considering the implications of engaging in these behaviors for adolescents' standing among peers (Brechwald & Prinstein, 2011). In contrast to physical activity and healthy eating habits, which enable adolescents to maintain their weight and increase the likelihood that they will be perceived by their peers as attractive, sedentary activities do *not* appear to be revered within the peer group and are not perceived to have a positive impact on adolescents' social standing (Adler, Kless, & Adler, 1992; Allen et al., 2005; Clossen, 2008; Dijkstra, Cillessen, Lindenberg, & Veenstra, 2010; Rose, Glick, & Smith, 2011; Wang et

al., 2008). Adolescents may be less motivated to emulate their friends' sedentary behaviors and in turn be less susceptible to socialization of sedentary activities. Additional research, utilizing longitudinal data and assessing engagement in a variety of sedentary activities, is necessary to further examine whether or not same-sex friends shape engagement in sedentary activities during adolescence.

In summary, this section summarized evidence of peer socialization with respect to adolescents' self-reported physical activity, sedentary activity, and healthy eating habits. Significant positive links between same-sex friends resulted for two out of the three indicators of obesity-related behaviors; thus, adolescents were more likely to report increased physical activity and healthy eating over time if their friends' reported high levels of physical activity and healthy eating. Study results reinforce the value of examining both reciprocal and nonreciprocal friendships as sources of socialization of obesity-related behaviors during adolescence.

Role of Interaction Frequency and Friendship Stability as Moderators

Drawing on theories of social influence, interaction frequency and friendship stability were assessed as moderators as part of the first study goal. Although friendship longevity and the extent of time friends spend together would be expected to dictate variation in the socialization of eating and activity behaviors within same-sex friendships, significant interaction effects did not emerge for any of the obesity-related behaviors or for either type of friend dyad (Bandura, 1977; Bronfenbrenner, 1986, 1989). It is counterintuitive that socialization patterns were not tied to these social learning theory indicators,

particularly because friendships that persist over time or are characterized by more frequent interaction would purportedly be higher in friendship quality and intimacy, and in turn, include peers that more highly value one another as social referents (Hartup, 1993, 1996; Poulin & Chan, 2010). Yet, the null findings should not discount the role of interaction frequency and friendship stability, but rather, be taken to imply that these indicators were too broad to capture variation in socialization of obesity-related behaviors between friends (Bandura, 1977). Past research can attest to the validity of this premise for interaction frequency. For example, the frequency of time spent exercising or playing sports with friends has been shown to predict adolescents' overall engagement in physical activities (Voorhees et al., 2005). Likewise, Tucker et al. (2008) found that the extent of time spent in constructive, rather than unconstructive, activities with siblings was tied to positive adjustment among adolescents. Collectively, these findings point to the value of assessing the extent of coactivity in specific and pertinent activities, such as sharing meals or working out, as opposed to overall interaction frequency with friends, for delineating differential patterns of socialization of obesity-related behaviors across friend pairs.

Regarding friendship stability, the overall degree of socialization on obesity-related behaviors was expected to be contingent upon friendship length because adolescents are presumably afforded more opportunities for socialization within longer-lasting friendships (Bandura, 1977). The lack of support for this premise suggests that the extent to which same-sex friends can shape one another's obesity-related behaviors is tied to their significance as social referents,

rather than whether their friendships persist over a longer period of time (Berndt, 1996; Brown et al., 2008). Studies that have examined whether the significance of friendships for socialization and adjustment varies across the course of friendships (e.g., friendship formation and dissolution) can shed light on the null findings in this investigation (Bowker, Rubin, Burgess, Booth-LaForce, & Rose-Krasnor, 2006; Parker & Seal, 1996; Popp et al., 2008). Notably, strong levels of peer socialization within close friendships are evident both in the period directly following friendship formation and as friendships persist over time (e.g., Popp et al., 2008). The similar levels of socialization that emerged among stable and unstable friend dyads in this investigation imply that same-sex friends can play a significant role in shaping adolescents' eating and activity behaviors both early on and throughout the course of a friendship. Because adolescents are conceivably very motivated to emulate their friends' behaviors and strengthen their friendship tie at the beginning of a friendship, it is conceivable that increased concordance in obesity-related behaviors resulted from a high degree of influence after friendship formation, rather than through cumulative socialization over time (Berndt & Murphy, 2002). In turn, future research should aim to further assess whether friendship stability has any bearing on the extent to which friends shape obesity-related behaviors during adolescence. Given that adolescent friendships are often short-lived, it may make more sense to assess stability with more frequent assessments and across shorter intervals of time (Hartup, 1993; Poulin & Chan, 2010).

Alternatively, measurement issues may have contributed to the null findings in this investigation. As is the case for this investigation, the assessment of friendship stability is often flawed because studies only allow participants to nominate a fixed number of same-sex peers as friends; limited friend nominations can result in friendship ties being incorrectly categorized as unstable because adolescents are unable to nominate all of their closest friends (Berndt, 1996; Bukowski & Hoza, 1989; Hartup, 1993). Thus, the role of stable friendships for obesity-related eating and activity behaviors was possibly underestimated in the present study because participants were only able to nominate 5 same-sex friends at each Wave (Poulin & Chan, 2010). Additionally, the lack of support for interaction frequency as a moderator likely reflects that the indicator of interaction frequency utilized in this study was not sensitive enough to differentiate socialization patterns across friend dyads (Bandura, 1977). Very few studies to date have examined the role of shared time with friends; yet, the two studies that found varying socialization patterns across high and low interaction dyads included more fine-grained measures of interaction frequency that reflected the number of interactions or hours spent together per week (e.g., Barry & Wentzyl, 2006; Tucker et al., 2008). Additional research is warranted to confirm whether friendship stability and interaction frequency can explicate differential levels of socialization of eating and activity behaviors across friend dyads.

Friends' Obesity-Promoting Eating and Activity Behaviors and Cumulative Risk for Increased BMI

The second major study goal was to expand on the assessment of longitudinal links between friends' obesity related eating and activity behaviors by exploring whether friend's obesity-promoting behaviors also serve as risk factors that can predict changes in adolescents' BMI. An extensive number of studies have substantiated the hypothesized links between eating and activity (i.e., energy intake and energy expenditure) and weight (Burniat et al., 2002; Fields & Higgins, 2008). Notably, various indicators of food and beverage consumption, sedentary activities, and physical activities have been found to be concurrently, longitudinally, and additively linked to weight-related outcomes, such as obesity status or BMI (e.g., Berkey et al., 2003; Eisenmann et al., 2008; Forshee et al., 2004; Harrington, 2008; Kimm et al., 2005; Newby, 2007; Sanchez et al., 2007; Schneider et al., 2007; Vandewater et al., 2004). Thus, drawing on a cumulative risk model, the present study expected to find a positive link between the number of self-reported obesity-promoting behaviors and weight gain over time (Deater-Deckard et al., 1998; Rutter, 1979). Using the Actor-Partner Interdependence Model, adolescents' self-reported obesity-promoting behaviors were assessed as cumulative predictors of both their own change in BMI (i.e., actor effects) and their same-sex friends' change in BMI (Kenny et al., 2006).

First, contrary to expectations, significant actor effects did not emerge. The null findings suggest that adolescents that reported a higher number of obesity-promoting eating and activity behaviors were not at higher risk for weight

gain. The lack of support for a cumulative risk pattern in this investigation is surprising because adolescents are more likely to be overweight or at risk for obesity when they report multiple obesity-promoting behavioral risk factors (Kosti et al., 2009; Sanchez et al., 2007; Wong & Leatherdale, 2009). It is plausible that the cumulative risk indicator was not sensitive enough to pick up change in adolescents' BMI. Although extant research indicates that obesity-related behaviors are significantly associated with adolescents' weight-related outcomes, findings across studies do vary with the type of eating or activity indicator assessed (Newby, 2007; Schneider et al., 2007). While overall eating and activity habits directly affect weight, particular eating or activity behaviors may differ in their specific role for weight regulation. For example, despite being low-calorie, nutrient-dense and purportedly associated with weight regulation, there is limited empirical support showing that higher fruit, vegetable, and low-fat dairy intake are linked to lower obesity risk among adolescents (Berkey et al., 2005; Cullins et al., 2001; Newby, 2007). Alternatively, intake of high-calorie and energy-dense foods and beverages, particularly fast food and sugary soft drinks, have been more consistently indicated as significant risk factors for obesity (Harrington, 2008; Newby, 2007; Niemeier et al., 2006). Collectively, these findings suggest that the healthy eating behaviors assessed in this study may only be associated with maintaining weight, while unhealthy eating behaviors that were not assessed in this study appear to contribute to excess energy or weight gain (Epstein et al., 2001; Fields & Higgins, 2008). Therefore, the cumulative risk for obesity indicator utilized for Study Goal 2 does not appear to have adequately

represented the constellation of obesity-promoting eating and activity behaviors that underlie heightened risk for weight gain. Future investigations may yield different findings about the cumulative role of obesity-promoting behaviors by including only indicators of eating and activity that have been strongly and consistently linked to obesity risk.

The primary purpose of Study Aim 2 was to explore whether adolescents' obesity-promoting behaviors were positively associated with their same-sex friends' heightened risk for weight gain (i.e., partner effects), while controlling for possible actor effects. Theories of risk postulate that key social environments, such as the peer context, represent significant sources of risk for developing risky health behavior patterns and experiencing adverse health outcomes during adolescence (Jessor, 1991; 1992). In line with expectations about the role of friends for obesity risk, reciprocal friends' obesity-promoting behaviors were found to be significantly and additively related to an increase in one another's BMI over time. Evidence of significant partner effects in this investigation aligns with a growing literature that highlights the role of obesigenic social influences as risk factors for obesity (Gorin & Crane, 2008). Most importantly, study findings suggest that like the family, the peer context also serves as a source of risk for the development of obesity-promoting behaviors (Davison et al., 2005; Davison & Birch, 2002; Francis et al., 2007). Thus, this investigation underscores the significance of examining multiple key developmental contexts for delineating obesity risk among adolescents (Bronfenbrenner, 1986, 1989).

Yet, given collective findings indicating significant links between friends' obesity-related behaviors, friends' changes in weight status, and links between obesity-promoting behaviors and obesity risk, it is reasonable to speculate that friends' obesity-promoting behaviors may play a more indirect role in predicting friends' obesity risk (e.g., Ali et al., 2011; Christakis & Fowler, 2007; Sanchez et al., 2007; Trogdon et al., 2008). In fact, these results suggest that adolescents with reciprocal friends that engage in many unhealthy eating and activity behaviors may experience a shift toward a less healthy lifestyle that, in turn, may elevate their obesity risk. Thus, it is plausible to expect that socialization of eating and activity behaviors within reciprocal same-sex friendships precipitated significant changes in adolescents' BMI (Fields & Higgins 2008). Future research should aim to assess links between friends' obesity-related behaviors and BMI within the context of a mediational model to more accurately capture the process through which close friends increase one another's risk obesity (Jessor, 1991; 1992).

Contrary to expectations, significant links between friends' obesity-promoting behaviors and change in BMI were not found for nonreciprocal friend dyads. Similar patterns were expected for both reciprocal friends and the nominators within nonreciprocal friend pairs because these adolescents acknowledged the existence of their friendship with particular peers and conceivably are more susceptible to negative influence from such peers (Brown et al., 2008). A possible explanation for the null findings is that nonreciprocal friends are reluctant to adopt their obesigenic friends' unhealthy behaviors for fear of the negative social implications of being overweight (Puhl & Latner,

2007). Despite evidence suggesting that nonreciprocal friends shape adolescents' engagement in both eating and activity behaviors, it is reasonable to conceive that adolescents would be less motivated to increase similarity and maintain their friendships with their obesigenic nonreciprocal friends, given their concerns about weight and social standing; in particular, because obesigenic, nonreciprocal friends are likely to be overweight and less preferred among peers, adolescents may not come to highly value their obesigenic nonreciprocal friends as social referents, which in turn, reduces their significance as sources of obesity risk (Dijkstra et al., 2010; Strauss & Pollack, 2003; Valente et al., 2009). It would be interesting to see whether friendships with obesigenic nonreciprocal friends persist over time, as that assessment could illustrate whether adolescents are less invested in sustaining friendships with obesigenic peers. Additional research is needed to further investigate whether friends' obesity-related behaviors and BMI are significantly associated over time among reciprocal and nonreciprocal same-sex reciprocal friend pairs.

In summary, the present study found limited evidence to support the contention that same-sex friends represent obesity-related risk factors; failing to find significant partner effects within both reciprocal and nonreciprocal friend dyads undermines drawing conclusions about the role of same-sex friends for obesity risk in Study Goal 2. It is important to note that the results from the Actor-Partner Interdependence Model for Study Goal 2 should be interpreted with caution, particularly because partner effect-only models, as evidenced for Study Goal 2, are relatively rare in their occurrence (Kenny & Ledermann, 2010). In line

with theoretical propositions of the APIM, actor effects are typically expected in conjunction with significant partner effects; thus, the cumulative risk indicator would be expected to operate in the same manner when predicting adolescents and their friends' BMI (Kenny & Cook, 1999; Kenny & Ledermann, 2010). Yet, the cumulative risk indicator appears to have been more sensitive in predicting change in reciprocal friends', rather than adolescents', own BMI. The unique pattern of partner-only findings in this investigation underscores the role of additional research for clarifying whether obesity-promoting behaviors additively predict obesity risk for both adolescents and their friends (Kenny & Cook, 1999).

Limitations and Future Directions

Despite its significant contribution to literature focused on close friends and obesity risk, the present investigation is not without limitations. Measurement issues for both eating and activity behaviors, as well as, this study's limited ability to account for peer socialization are noteworthy limitations that are discussed next. First, the fact that the data for this study were collected as part of the larger Add Health study over fifteen years ago undermines their relevance for current populations of adolescents. In particular, the prevalence of obesity and adolescents' unhealthy eating and activity habits have changed (Bauer et al., 2009; Hills et al., 2007; Newby, 2007; Ogden & Carroll, 2010) and particular types of eating and activity behaviors have become more commonplace over time (e.g., Schneider et al., 2007; Vandewater et al., 2004). Notably, the validity of the sedentary activity scale may be questionable because only watching TV/videos and playing video games were assessed. As a result of extensive advancements in

technology over the last two decades, adolescents now spend considerable amounts of time on the computer and engaged in leisure sedentary activities such as surfing the internet (Schneider et al., 2007). In turn, the measurement of sedentary activities within Add Health may not adequately capture adolescents' engagement in media-related sedentary behaviors that result in minimal energy expenditure (Ainsworth et al., 2000). Notably, spending time using the computer and engaged in internet-based activities are now highly normative among adolescents (Marshall et al., 2006). In fact, empirical findings point to the significance of close friends for computer and internet use, given positive links between friends' engagement in those activities and adolescents' preference for socially-oriented sedentary activities that involve peers (de la Haye et al., 2010; Olson, 2010). Thus, future research could further clarify whether friends are involved in the socialization of sedentary activities, by including a set of sedentary activity items that are more representative of adolescents' engagement in these activities.

Measurement error associated with over-reporting among participants also likely undermined the assessment of sedentary activities in the present study. Studies reportedly vary widely in their assessment of sedentary activities, and similar to the Add Health study, use sedentary activity items or scales that have not been evaluated to confirm whether they are psychometrically-sound (Bryant, Lucove, Evenson, & Marshall, 2006). In particular, the reliability of this study's sedentary activity scale is questionable for two reasons: three separate items were used to assess time spent watching TV, watching videos, and playing computer or

video games and respondents were able to report spending up to 95 hours per week for each specific sedentary activity item. Thus, sedentary activity engagement was likely overestimated for the majority of participants because they were not provided reasonable parameters for reporting engagement and likely did not account for logical overlap in their responses (e.g., watching TV and videos) (Marshall et al., 2006). Alternatively, utilizing measures with reasonable timeframes (i.e., hours per day) for recalling time spent in sedentary activities would yield more representative data and limit inaccurate self-reporting among adolescents (e.g., Hume et al., 2010; Utter et al., 2003; Vandewater et al., 2004; Zabinski et al., 2007).

In addition, measurement of adolescents' eating behaviors was restricted in the present study due to the limited assessment of both healthy and unhealthy food consumption in the Add Health study. As previously noted, consumption of fast food and sugary drinks represent two significant risk factors for obesity because they are both high in calories and reportedly tied to increased obesity risk (Harrington, 2008; Niemeier et al., 2006). Yet, these particular eating indicators were not available at both Waves 1 and 2 , and in turn, could not be included as part of a more comprehensive assessment of eating behaviors. Another limitation relates to inconsistency in the measurement of eating behaviors across Waves. Although the healthy eating scales were comprised of indicators of fruit, vegetable, dairy, and breakfast consumption at each Wave, fruit, vegetable, and dairy intake were measured by three single items at Wave 1 and each by multiple items that assessed different types of intake within same food category at Wave 2;

the estimation of stability and intake of healthy eating were compromised in this investigation. Future research should assess a broad range of indicators of food intake collected through either detailed diet diaries or food frequency questionnaires to replicate this study's findings about the socialization of eating behaviors between same-sex friends (e.g., Hanson et al., 2005; Harrington, 2008).

Beyond measurement issues, the present study was limited in its assessment of the role of peers for shaping obesity-related eating and activity behaviors and increasing obesity risk. Same-sex friendships have long been believed to be a significant source of influence on adolescents' behaviors and overall adjustment, particularly because they fulfill adolescents' social needs and are characterized by high level of interaction frequency (Hartup, 1993, 1996; Sullivan, 1953). Yet, friendships represent only one type of peer influence within adolescents' peer network, as evidenced by many studies that indicate links between adolescents' behaviors and the level of engagement reported by fellow members of adolescents' friendship groups and peer crowds (Ali et al., 2011; Brown & Klute, 2003; Hussong, 2002; Mackey & La Greca, 2007; Urberg et al., 1997). Given that the magnitude of influence on close friends' obesity-related outcomes in the present investigation was rather weak, the focus on friend dyads only provided a glimpse into the development of obesity-related within the peer context. Therefore, it would be of value for future studies to assess multiple dimensions of the peer context to explore whether socialization patterns and the degree of obesity risk differ across adolescents with varying sources of peer influence on obesity-promoting behaviors. As an example, Hussong (2002)

examined substance use among adolescents' best friends, peer cliques, and social crowds as predictors of adolescents' own substance use and found that all three sources of influence independently and cumulatively predicted the level of substance use among adolescents. It is reasonable to believe that similar patterns could result for adolescents' obesity-promoting eating and activity behaviors, as separate studies have shown that adolescents' eating and activity behaviors reflect engagement in both peer crowds and among multiple friends (Ali et al., 2011; Mackey & La Greca, 2007). In summary, same-sex friends do appear to be significant sources of socialization for shaping adolescents' eating and activity habits. Yet, the examination of additional sources of influence at different levels of the peer context would yield a more complete picture of the role of peers for obesity-related outcomes and clarify whether adolescents must make sense of competing sources of influence (e.g., best friends' healthy eating versus peer crowd' unhealthy eating).

Building on the need to examine multiple sources of peer influence for obesity-promoting behaviors, alternative processes of socialization should also be considered (Brechwald & Prinstein, 2011; Brown et al., 2008). When assessing the role of more distal peers or peers with whom adolescents have little or no direct contact (e.g., popular peers or friends of friends), it is conceivable that processes of social learning do not represent the only means through which adolescents learn about or are influenced by peers' behaviors. For example, adolescents' propensity to engage in particular behaviors may be tied to perceptions they have formed about which behaviors are valued by peers or

whether idealized peers exhibit these behaviors. Although argued as reflecting homophily or adolescents' tendency to project their behaviors onto peers, adolescents' behaviors tend to be more strongly related to perceived reports of peers' behaviors rather than peers' own self-reported behaviors (Bauman & Ennett, 1996; Kobus. 2003). In turn, perceived peer norms may play a role in adolescents' adoption of more healthy or unhealthy obesity-related behaviors, particularly when adolescents do not possess accurate knowledge of what salient, distal peers are actually doing (Brechwald & Prinstein, 2011). In line with theoretical propositions about the role of perceived norms, studies suggest that adolescents' perceptions of expected norms for significant role models' eating and activity habits predicted their own obesity-related behavior habits (Baker, Little, & Brownell, 2003; Cullen et al., 2001; Kremers et al., 2007). Therefore, it is of value for future studies to expand their conceptualization of peer socialization to include more indirect or even adolescent-driven processes to better capture how peers can shape obesity-related eating and activity during adolescence (Brechwald & Prinstein, 2011).

Conclusions

The present study was the first to date to assess the associations between friends' obesity-related outcomes in the context of both reciprocal and nonreciprocal friendships. Same-sex friends were found to play a significant role in the socialization of obesity-related behaviors, as indicated by significant links between friends' physical activity and friends' healthy eating behaviors and friends' obesity-promoting behaviors and change in BMI. Parallel study findings

across reciprocal friends and the nominators within nonreciprocal friend dyads further support the assertion that perceived friendship ties with salient and valued peers are sufficient for socialization during adolescence. By utilizing longitudinal data, friends' matched self-reports, and the Actor-Partner Interdependence Model, this study was able to address methodological problems associated with analyzing dyadic data, in turn, yielding valid information about the degree to which same-sex friends shape one another's eating and activity habits. Study results reinforce the value of close friends for transmitting healthy social norms and supporting the development of eating and activity behaviors that reduce obesity risk among adolescents. In conclusion, this investigation can inform future school-based obesity prevention programs by highlighting the role of peers for encouraging youth to eat healthy and exercise.

References

Adair, L. S. (2008). Child and adolescent obesity: Epidemiology and developmental perspectives. *Physiology & Behavior, 94,* 8-16.

Adler, P. A., Kless, S. J., & Adler, P. (1992). Socialization to gender roles: Popularity among elementary school boys and girls. *Sociology of Education, 65,* 169-187.

Adams, R. E., Bukowski, W. M., & Bagwell, C. (2005). Stability of aggression during early adolescence as moderated by reciprocated friendship status and friend's aggression. *International Journal of Behavioral Development, 29,* 139-145.

Affenito, S. G., Thompson, D. R., Barton, B. A., Franko, D. L., Daniels, S. R., Obarzanek, E., et al. (2005). Breakfast consumption by African-American and white adolescent girls correlates positively with calcium and fiber intake and negatively with body mass index. *Journal of the American Dietetic Association, 105,* 938-945.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions.* Thousand Oaks, CA: Sage.

Ainsworth, B. E, Haskell, W. L., Whitt, M. C., Irwin, M. L., Swartz, A. M., Strath, S. J., et al. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Medicine, Sciences, & Sports Exercise, 32,* S498-S504.

Albertson, A., Anderson, G. H., Crockett, S. & Goebel, M. T. (2003). Ready-to-eat cereal consumption: Its relationship with BMI and nutrient intake of children aged 4 to 12 years. *Journal of the American Dietetic Association, 103,* 1613-1619.

Ali, M. M., Amialchuk, A., & Heiland, F. W. (2011). Weight-related behavior among adolescents: The role of peer effects. *PLoS One, 6,* e21179.

Allen, J. P., Porter, M. R., McFarland, F. C., Marsh, P., McElhaney, K. B. (2005). The two faces of adolescents' success with peers: Adolescent popularity, social adaptation, and deviant behaviors. *Child Development, 76,* 747-760.

American Academy of Pediatrics (2001). Children, adolescents, and television. *Pediatrics, 107,* 423-426.

Appleyard, K., Egeland, B., Van Dulmen, M. H. M., & Sroufe, L. A. (2005). When more is not better: The role of cumulative risk in child behavior outcomes. *Journal of Child Psychology and Psychiatry, 46,* 235-245.

Bahr, D. B., Browning, R. C., Wyatt, H. R., & Hill, J. O. (2009). Exploiting social networks to mitigate the obesity epidemic. *Obesity, 17,* 723-728.

Baker, C. W., Little, T. D., & Brownell, K. D. (2003). Predicting adolescent eating and activity behaviors: the role of social norms and personal agency. *Health Psychology, 22,* 189-198.

Bandini, L. G., Must A, Spadano, J. L., & Dietz, W. H. (2002). Relation of body composition, parental overweight, pubertal stage, and race-ethnicity to energy expenditure among premenarcheal girls. *American Journal of Clinical Nutrition*, *76,* 1040-1047.

Bandura, A. (1977). *Social learning theory.* Englewood Cliffs, NJ: Prentice Hall.

Barlow, S. E. (2007). Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report. *Pediatrics, 120*, S164-S192.

Barry, C. M., & Wentzel, K. R. (2006). Friend influence on prosocial behavior: The role of motivational factors and friendship characteristics. *Developmental Psychology, 42*, 153-163.

Bauer, K. W., Larson, N. I., Nelson, M. C., Story, M., & Neumark-Sztainer, D. (2009). Fast food intake among adolescents: secular and longitudinal trends from 1999 to 2004. *Preventive Medicine, 48,* 284-287.

Bauman, K. E., & Ennett, S. T. (1996). On the importance of peer influence for adolescent drug use: Commonly neglected considerations. *Addiction, 91,* 185-198.

Belue, R., Francis, L. A., Rollins, B., & Colaco, B. (2009). One size does not fit all: Identifying risk profiles for overweight in adolescent population subsets. *Journal of Adolescent Health, 45,* 517-524.

Bere, E., Glomnes, E. S., te Velde, S. J., & Klepp, K. I. (2007). Determinants of adolescents' soft drink consumption. *Public Health Nutrition, 11,* 49-56.

Berkey, C. S., Rockett, H. R., Field, A. E., Gillman, M. W., Frazier, A. L., Camargo, C. A., et al. (2000). Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. *Pediatrics, 105*, E56.

Berkey, C. S., Rockett, H. R. H., Gillman, M. W., Field, A. E., & Colditz, G. A. (2003). Longitudinal study of skipping breakfast and weight change in adolescents. *International Journal of Obesity, 27,* 1258-1266.

Berkey, C. S., Helain, R. S., Willett, W. C., & Colditz, G. A. (2005). Milk, dairy fat, dietary calcium and weight gain; A longitudinal study of adolescents. *Archives of Pediatrics and Adolescent Medicine, 159,* 543-550.

Berndt, T. J. (1992). Friendship and friends' influence in adolescence. *Current Directions in Psychological Science, 1,* 156-159.

Berndt, T. J. (1996). Transitions in friendship and friends' influence. In J. A. Graver, J. Brooks-Gunn, & A. C. Peterson (Eds.), *Transitions through adolescence: Interpersonal domains and context* (pp. 57-84). Mahwah, NJ: Lawrence Erlbaum Associates.

Berndt, T. J., Hawkins, J. A., & Jiao, Z. (1999). Influences of friends and friendships on adjustment to junior high. *Merrill-Palmer Quarterly, 45,* 13-41.

Berndt, T. J., & Keefe, K. (1995). Friend's influence on adolescents' adjustment to school. *Child Development, 66,* 1312-1329.

Berndt T. J., & Murphy, L. M. (2002). Influences of friends and friendships: Myths, truths, and research recommendations. *Advances in Child Development, 30,* 275-310.

Bibbins-Domingo, K., Coxson, P., Pletcher, M. J., Lightwood, J., & Goldman, L. (2007). Adolescent overweight and future adult coronary heart disease. *New England Journal of Medicine, 357,* 2371-2379.

Boone, J. E., Gordon-Larsen, P., Adair, L. S., & Popkin, B. M. (2007). Screen time and physical activity during adolescence: Longitudinal effects on obesity in young adulthood. *International Journal of Behavioral Nutrition and Physical Activity, 4,* 26-36.

Bot, S. M., Engles, R., Knibbe, R. A., & Meeus, W. (2005). Friend's drinking behaviour and adolescent consumption: The moderating role of friendship characteristics. *Addictive Behaviors, 30,* 929-949.

Bowker, J. C. W., Rubin, K. H., Burgess, K. B., Booth-LaForce, C., & Rose-Krasnor, L. (2006). Behavioral characteristics with stable ad fluid best friendship patterns in middle childhood. *Merrill-Palmer Quarterly, 52,* 671-693.

Brechwald, W. A., & Prinstein, M. J. (2011). Beyond homophily: A decade of advances in understanding peer influence processes. *Journal of Research on Adolescence, 21,* 166-179.

Brodersen, N. H., Steptoe, A., & Williamson, S. (2005). Sociodemographic, developmental, environmental, and psychosocial correlates of physical activity and sedentary behavior at age 11 and 12. *Annals of Behavioral Medicine, 29,* 2-11.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology,* 22, 723-742.

Bronfenbrenner U. (1989). Ecological systems theory. In P. Vasta (Ed.), *Annals of child development, Vol. 6. Six theories of child development: Revised formulations and current issues* (pp. 187-249). London: Jai Press.

Bronfenbrenner, U., & Crouter, A. C. (1983). The evolution of environmental models in developmental research. In W. Kessen (Ed), *Handbook of child psychology, Vol. 1: History, theory, and methods* (pp. 357–414). New York: Wiley.

Brown, B. B., Bakken, J. P., Ameringer, S. W., & Mahon, S. D. (2008). A comprehensive conceptualization of the peer influence process in adolescence. In M. J. Prinstein & Dodge, K. A. (Eds.), *Understanding peer influence in children and adolescents* (pp. 17-44). New York: The Guilford Press.

Brown, B. B., & Klute, C. (2003). Friendships, cliques, and crowds. In G. R. Adams & M. D. Berzonsky (Eds.), *Blackwell handbook of adolescence volume 4* (pp. 330-348). Malden, MA: Wiley-Blackwell.

Bryant, M. J., Lucove, J. C., Evenson, K. R. & Marshall, S. (2006). Measurement of television viewing in children and adolescents: A systematic review. *Obesity Reviews, 8,* 197-209.

Bukowski, W. M., & Hoza, B. (1989). Popularity and friendship: Issues in theory, measurement, and outcome. In T. J. Berndt & G. W. Ladd (Eds.), *Peer relationships in child development* (pp. 15-45). New York: John Wiley & Sons.

Burke, V., Beilin, L. J., Durkin, K., Stritzke, W. G., Houghton, S., & Cameron C. A. (2006). Television, computer use, physical activity, diet and fatness in Australian adolescents. *International Journal of Pediatric Obesity, 1,* 248-255.

Burniat, W., Cole, T., Lissau, I., & Poskitt, E. (2002). *Child and adolescent obesity.* Cambridge: Cambridge University Press.

Caballero, B., Himes, J. H., Lohman, T., Davis, S. M., Stevens, J., Evans, M., et al. (2003). Body composition and overweight prevalence in 1704 school children from 7 American Indian communities. *American Journal of Clinical Nutrition, 78,* 308-312.

Campbell, L., & Kashy, D. A. (2002). Estimating actor, partner, and interaction effects for dyadic data using PROC MIXED and HLM: A user-friendly guide. *Personal Relationships, 9,* 327-342.

Card, N. A., Selig, J. P., & Little, T. D. (2008). *Modeling dyadic and interdependent data in developmental research*. Mahwah, NJ: LEA.

Centers for Disease Control and Prevention. (2012). *Overweight and obesity*. Retrieved April 12, 2010, from http://www.cdc.gov/nccdphp/dnpa/obesity/index.htm

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *The New England Journal Medicine, 357,* 370-379.

Cillessen, A. H. N., Jiang, X. L., West, T. V. & Laszkowski, D. K. (2005). Predictors of dyadic friendship quality in adolescence. *International Journal of Behavioral Development, 29,* 165-172.

Closson, L. M. (2008). Status and gender differences in early adolescents' description of popularity. *Social Development, 18,* 412-426.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the Behavioral Sciences* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Collins, W. A. (1997). Relationships and development during adolescence: Interpersonal adaptation to individual change. *Personal Relationships, 4,* 1-14.

Cook, W. L., & Kenny, D. A. (2005). The Actor-Partner Interdependence Model: A model of bidirectional effects in developmental studies. *International Journal of Behavioral Development*, 29, 101-109.

Crawford, P., Story, M., Wang, M., Ritchie, L., & Sabry, Z. (2001). Ethnic issues in the epidemiology of childhood obesity. *Pediatric Clinics of North America*, *48,* 855-878.

Crosnoe, R., Cavanagh, S., & Elder, G. H. (2003). Adolescent friendships as academic resources: The intersection of friendship, race, and school disadvantage. *Sociological Perspectives, 46,* 331-352.

Crossman, A., Sullivan, D. A. & Benin, M. (2006). The family environment and American adolescents' risk of obesity as young adults. *Social Science & Medicine, 63,* 2255-2267.

Davison, K. K., & Birch, L. L. (2001). Childhood overweight: A contextual model and recommendations for future research. *Obesity Reviews, 2,*159-171.

Davison, K. K., & Birch, L. L. (2002).Obesigenic families: parents' physical activity and dietary intake patterns predict girls' risk of overweight. *International Journal of Obesity and Related Metabolic Disorders, 26,* 1186-1193.

Davison, K. K., Francis, L. A., & Birch, L. L. (2005). Reexamining obesigenic families: Parents' obesity-related behaviors predict girls' change in BMI. *Obesity Research, 13,* 1980-1990.

Deater-Deckard, K., Dodge, K. A., Bates, J. E., & Pettit, G. S. (1998). Multiple risk factors in the development of externalizing behavior problems: Group and individuals differences. *Developmental Psychopathology, 10,* 469-493.

de la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2010). Obesity-related behaviors in adolescent friendship networks. *Social Networks*, *32,* 161-167.

de la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2011a). How physical activity shapes, and is shaped by adolescent friendships. *Social Science & Medicine, 73,* 719-728.

de la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2011a). Homophily and contagion as explanations for weight similarities among adolescent friends. *Journal of Adolescent Health, 49,* 421-427.

Değirmencioğlu, S. M., Urberg, K. A., Tolson, J. M. & Richard, P. (1998). Adolescent friendship networks: Continuity and change over the school year. *Merrill-Palmer Quarterly, 44,* 313-337.

DeJong, C. S., van Lenthe, F. J., vander Horst, K. & Oenema, A. (2009). Environmental and cognitive correlates of adolescent breakfast consumption. *Preventive Medicine*, *48,* 4, 372-377.

Delva, J., O'Malley, P. M., & Johnston, L. D. (2006). Racial/ethnic and socioeconomic status differences in overweight and health-related behaviors among American students: National trends 1986-2003. *Journal of Adolescent Health, 39*, 536-545.

Dietz, W. H. (1994). Critical periods in childhood for the development of obesity. *American Journal of Clinical Nutrition, 59,* 955-959.

Dietz, W. H. (1998). Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics, 101,* 515-525.

Dietz. W. H., & Bellizzi, M. C. (1999). Introduction: The use of body mass index to assess obesity in children. *American Journal of Clinical Nutrition, 70*, 1235-1255.

Dijkstra, j. K., Cillessen, A. H. N., Lindenberg, S., & Veenstra, R. (2010). Basking in reflected glory and its limits: Why adolescents hang with popular peers. *Journal of Research on Adolescence, 20,* 942-958.

Driskell, M. M., Dyment, S., Mauriello, L., Castle, P., & Sherman, K. (2008). Relationships among multiple behaviors for childhood and adolescent obesity prevention. *Preventive Medicine, 46,* 209-215.

Duncan, S. C, Duncan, T. E., Strycker L. A., & Chaumeton N. R. (2007). A cohort-sequential latent growth model of physical activity from ages 12 to 17 years. *Annals of Behavioral Medicine, 33*, 80-89.

Dunton, G. F., Whalen, C. K., Jamner, L. D. & Floro, J. N. (2007). Mapping the social and physical contexts of physical activity across adolescence using ecological momentary assessment. *Annals of Behavioral Medicine, 34,* 144-153.

Ebbeling, C. B., Feldman, H. A., Osganian, S. K., Chomitz, V. R., Ellenbogen, S. J., & Ludwig D. S. (2006). Effects of decreasing sugar-sweetened beverage consumption on body weight in adolescents: A randomized, controlled pilot study. *Pediatrics, 117,* 673-680.

Eccles, J. S. (1993). School and family effects on the ontogeny of children's interests, self-perceptions, and activity choices. In R. Dienstbier (Series Ed.) & J. E. Jacobs (Vol. Ed.), *Nebraska symposium on motivation: 1992. Developmental perspectives on motivation* (pp. 145-208). Lincoln, NE: University of Nebraska Press.

Eisenmann, J. C., Bartee, R. T., Smith, D. T., Welk, G. J. & Fu, Q. (2008). Combined influence of physical activity and television viewing on the risk of overweight in U.S. youth. *International Journal of Obesity, 32,* 613-618.

Epstein, L. H., Gordy, C. C., Raynor, H. A., Beddome, M., Kilanowski, C. K., & Paluch, R. (2001). Increasing fruit and vegetable intake and decreasing fat and sugar intake in families at risk for childhood obesity. *Obesity Research, 9,* 171-178.

Epstein, L. H., Valoski, A. M., & Vara, L. S. (1995). Effects of decreasing sedentary behavior and increasing activity on weight change in obese children. *Health Psychology, 14,* 109-115.

Feldman, D. E., Barnett, T., Shrier, I., Rossignol, M., & Abenhaim, L. (2003). Is physical activity differentially associated with different types of sedentary pursuits? *Archives of Pediatrics and Adolescent Medicine, 157,* 797-802.

Feunekes, G. I. J., de Graaf, C., Meyboom, S., & van Staveren, W. A. (1998). Food choice and fat intake of adolescents and adults: Associations of intakes within social networks. *Preventive Medicine, 27,* 645-656.

Field, A. E., Austin, S. B., Gillman, M. W., Rosner, B., Rockett, H. R., & Colditz, G. A. (2004). Snack food intake does not predict weight change among children and adolescents. *International Journal of Obesity, 28,* 1210-1216.

Fields, D., & Higgins, P. (2008). Physiological mechanisms impacting weight regulation. In E. Jelalian & R. G. Steele (Eds.), *Handbook of childhood and adolescent obesity* (pp. 109-126). New York: Springer.

Fisher, J. O., & Kral, T. V. E. (2008). Super-size me: Portion size effects on young children's eating. *Physiology & Behavior, 94,* 39-47.

Fletcher, J. (2006). Social interactions in adolescent television viewing. *Archives of Pediatrics and Adolescent Medicine, 160,* 383-386.

Forshee, R. A., Anderson, P. A., & Storey, M. L. (2004). The role of beverage consumption, physical activity, sedentary, and demographics on body mass index of adolescents. *International Journal of Food Sciences and Nutrition, 55,* 463-478.

Forshee, R. A., & Storey, M. L. (2003). Total beverage consumption and beverage choices among children and adolescents. *International Journal of Food Sciences and Nutrition, 54,* 297-307.

Francis, L. A., Ventura, A. K., Marini, M., & Birch, L. L. (2007). Parent overweight predicts daughters' increase in BMI and disinhibited overeating from 5 to 13 years. *Obesity, 15,* 1544-1553.

Frelut, M. L., & Flodmark, C. E. (2002). The obese adolescent. In W. Burniat, T. Cole, I. Lissau, & E. Poskitt, (Eds.), *Child and adolescent obesity* (pp. 154-170). Cambridge, UK: Cambridge University Press.

Furman, W., & Buhrmester, D. (1992). Age and sex differences in perceptions of networks of personal relationships. *Child Development, 63,* 103-115.

Gerard, J. M., & Buehler, C. (2004a). Cumulative environmental risk and youth problem behavior. *Journal of Marriage and Family, 66,* 702-720.

Gerard, J. M., & Buehler, C. (2004b). Cumulative environmental risk and youth maladjustment: The role of youth attributes. *Child Development, 75,* 1832-1849.

Gidding, S. S., Dennison, B. A., Birch, L. L., Daniels, S. R., Gilman, M. W., Lichtenstein, A. H., et al. (2005). Dietary recommendations for children and adolescents: A guide for practitioners. *Circulation, 11,* 2061-2075.

Giletta, M., Scholte, R. H. J., Burk, W. J., Engels, C. M. E., Larsen, J. K., Prinsteinm, M. J., et al. (2011). Similarity in depression symptoms in adolescents' friendship dyads: Selection or socialization. *Developmental Psychology, 34,* 1-11.

Gonzalez, R., & Griffin, D. (1999). The correlation analysis of dyad-level data in the distinguishable case. *Personal Relationships, 6,* 449-469.

Gordon-Larsen P., Adair L. S., & Popkin B. M. (2002). Ethnic differences in physical activity and inactivity patterns and overweight status. *Obesity Research, 10,* 141-149.

Gordon-Larsen, P., Adair, L. S., & Popkin, B. M. (2003). The relationships of ethnicity, socioeconomic factors, and overweight in U.S. adolescents. *Obesity Research, 11,* 121-129.

Gordon-Larsen, P., McMurray, R. G., & Popkin, B. M. (1999). Adolescent physical activity and inactivity vary by ethnicity: The National Longitudinal Study of Adolescent Health. *Journal of Pediatrics, 135,* 301-306.

Gordon-Larsen, P., McMurray, R. G., & Popkin, B. M. (2000). Determinants of adolescent physical activity and inactivity patterns. *Pediatrics. 105*, E83.

Gordon-Larsen, P., Nelson, M. C., Page, P., & Popkin, B. M. (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics, 117,* 417-424.

Gordon-Larsen, P., Nelson, M. C., & Popkin, B. M. (2004). Longitudinal physical activity and sedentary trends: Adolescence to adulthood. *American Journal of Preventive Medicine, 27,* 277-283.

Gorely, T., Marshall, S. J., & Biddle, S. J. H. (2004). Couch kids: Correlates of television viewing among youth. *International Journal of Behavioral Medicine, 11*, 152-163.

Gorin, A. A., & Crane, M. M. (2008). The obesigenic environment. In E. Jelalian and R. G. Steele (Eds.), *Handbook of childhood and adolescent obesity* (pp. 145-162). New York: Springer.

Haines J., Neumark-Sztainer, D., Perry, C. L., Hannan, P. J., & Levine, M. P. (2008). A school-based program designed to reduce teasing and unhealthy weight-control behaviors. *Health Education Research. 21,* 884-895.

Halliday, T., & Kwak, S. (2009). Weight gain in adolescents and their peers. *Economics and Human Biology, 7,* 181-190.

Hancox, R. J., Milne, B. J., & Poulton, R. (2004). Association between child and adolescent television viewing and adult health: a longitudinal birth cohort study. *Lancet, 364,* 257-262.

Hand, L. S., & Furman, W. (2009). Rewards and costs in adolescent other-sex friendships: Comparisons to same-sex friendships and romantic relationships. *Social Development, 18,* 270-287.

Hanson, N. I., Neumark-Sztainer, D., Eisenberg, M. E., Story, M., & Wall, M. (2005). Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables, and dairy foods. *Public Health Nutrition, 8,* 77-85.

Hardy, L. L., Bass, S. L., & Booth, M. L. (2007). Changes in sedentary behavior among adolescents girls: A 2.5 year prospective cohort study. *Journal of Adolescent Health, 40,* 158-165.

Harrington, S. (2008). The role of sugar-sweetened beverage consumption in adolescent obesity: A review of the literature. *Journal of School Nursing, 24*, 3-12.

Hartup, W. W. (1993). Adolescents and their friends. In B. Laursen (Ed.), *Close friendships in adolescence* (pp. 3-22). San Francisco, CA: Jossey-Bass.

Hartup, W. W. (1996). The company they keep: Friendships and their developmental significance. *Child Development*, 67, 1-13.

health.gov. (2005). *Dietary guidelines for Americans*. Retrieved July 16, 2008, from www.healthierus.gov/dietaryguidelines

Herman, C. P., Roth, D. A., & Polivy, J. (2003). Effects of the presence of others on food intake: A normative interpretation. *Psychological Bulletin, 129,* 873-886.

Hill, J. O., & Peters, J. C. (1998). Environmental contribution to the obesity epidemic. *Science, 280,* 1371-1374.

Hills, A. P., King, N. A. & Armstrong, T. P. (2007). The contribution of physical activity and sedentary behaviours to the growth and development of children and adolescents. *Sports Medicine, 37,* 533-545.

Holland, A., & Andre, T. (1994). Athletic participation and the social status of adolescent males and females. *Youth & Society, 25,* 388-407.

Holmbeck, G. N. (2002). Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *Journal of Pediatric Psychology, 27,* 87-96.

Hox, J. J. (2010). *Multilevel analysis techniques and applications* (2nd ed.). New York: Routledge.

Hume, C., van der Horst, K., Brug, J., Salmon, J., & Oenema, A. (2010). Understanding the correlates of adolescents' TV viewing: A social ecological approach. *International Journal of Pediatric Obesity, 5,* 161-168.

Hundley, R. J., & Cohen, R. (1999) Children's relationships with classmates: A comprehensive analysis of friendship nominations and liking. *Child Study Journal, 29,* 233-246.

Hunter, F. T., & Youniss, J. (1982). Changes in functions of three relations during adolescence. *Developmental Psychology, 18,* 806-811.

Hussong, A. M. (2002). Differentiating peer contexts and risk for adolescent substance use. *Journal of Youth & Adolescence, 31,* 207-220.

Jaccard, J., Blanton, H. & Dodge, T. (2005). Peer influences on risk behavior: An analysis of the effects of a close friend. *Developmental Psychology, 41,* 135-147.

James, J., Thomas, P., Cavan, D., & Kerr, D. (2004). Preventing childhood obesity by reducing consumption of carbonated drinks: Cluster randomised controlled trial. *British Medical Journal 328,* 1237.

Janz, K. F., Dawson, J. D., & Mahoney, L. T. (2000). Tracking physical fitness and physical activity from childhood to adolescence: The Muscatine Study. *Medicine, Science & Sports Exercise, 32,* 1250-1257.

Jessor, R. (1991). Risk behavior in adolescence: A psychosocial framework for understanding and action. *Journal of Adolescent Health, 12,* 597-605.

Jessor, R. (1992). Risk behavior in adolescence: A psychosocial framework for understanding and action. In D. E. Rogers & E. Ginzberg (Ed.), *Adolescents at risk: Medical social perspectives* (pp. 19-34). Boulder, CO: Westview.

Jessor, R., & Jessor, S. L. (1977). *Problem behavior and psychosocial: A longitudinal study*. New York: Academic Press.

Jessor, R., Turbin, M. S., & Costa, F. M. (1998). Protective factors in adolescent health behavior. *Journal of Personality and Social Psychology, 75,* 788-800.

Jimenez-Pavon, D., Ruiz, J. R., Ortega, F. B., Artero, E. G., Espana-Romero, V., Castro-Pinero, J., et al. (2011). Physical activity, fitness, and fatness in children and adolescents. In L. A. Moreno, L. Pigeot, & W. Ahrens (Eds.), *Epidemiology of obesity in children and adolescents* (pp. 347-366). New York: Springer.

Johnson, H. D. (2004). Gender, grade, and relationship differences in emotional closeness within adolescent friendships. *Adolescence, 39*, 243-255.

Jones, D. C., Vigfusdottir, T. H., & Lee, Y. (2004). Body image and the appearance culture among adolescent girls and boys: An examination of friend conversations, peer criticism, appearance magazines, and the internalization of appearance ideals. *Journal of Adolescent Research, 19,* 323-339.

Kahn, J. A., Huang, B., Gillman, M. W., Field A. E., Austin, S. B. Colditz, G. A., et al. (2008). Patterns and determinants of physical activity. *Journal of Adolescent Health, 42,* 369-377.

Kandel, D. B. (1978). Homophily, selection, and socialization in adolescent friendships. *American Journal of Sociology, 84,* 427-436.

Kantomaa, M. T., Tammelin, T. H., Nayh, S., & Taanila, A. N. (2007). Adolescents' physical activity in relation to family income and parents' education. *Preventive Medicine, 44,* 410-415.

Kassem, N. O., Lee, J. W., Modeste, N. N., & Johnston, P. K. (2003). Understanding soft drink consumptions among female adolescents using the Theory of Planned Behavior. *Health Education Research, 18,* 278-291.

Kenny, D. A. (1996). Models of nonindependence in dyadic research. *Journal of Social & Personal Relationships, 13,* 279-294.

Kenny, D. A., & Cook, W. (1999). Partner effects in relationship research: Conceptual issues, analytic difficulties, and illustrations. *Personal Relationships, 6,* 433-448.

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis.* New York: Cambridge University Press.

Kenny, D. A., & Ledermann, T. (2010). Detecting measuring and testing dyadic patterns in the actor-partner interdependence model. *Journal of Family Psychology, 24,* 359-366.

Keresztes, N., Piko B. F., Pluhar Z. F., & Page R. M. (2008). Social influences in sports activity among adolescents. *The Journal of the Royal Society for the Promotion of Health, 128*, 21–25.

Kimm, S. Y. S., Glynn, N. W., Obarzanek, E., Kriska, A. M., Daniels, S. R., Barton, B., et al. (2005). Relation between the changes in physical activity and body-mass index during adolescence: A multicentre longitudinal study. *Lancet, 366,* 301-307.

King, K. A., Tergerson, J. L., & Wilson, B. R. (2008). Effect of social support on adolescents' perceptions of and engagement in physical activity. *Journal of Physical Activity & Health*, *5,* 374-384.

Kligerman, M., Sallis, J. F., Ryan, S., Frank, L. D., & Nader, P. R. (2007). Association of neighborhood design and recreation environment variables with physical activity and body mass index in adolescents. *American Journal of Health Promotion, 21,* 274-277.

Kline, S. (2005). Countering children's sedentary lifestyles: an evaluation study of a media risk education approach. *Childhood, 12,* 239-258.

Kobus, K. (2003). Peers and adolescent smoking. *Addictions, 98,* 37-55.

Kosti, R. I., Panagiotakos, A., Mariolis, A., Zampelas, A., Anthanasopoulous, P, & Tountas, Y. (2009). The diet-lifestyle index evaluating the quality of eating and lifestyle behaviours in relation to the prevalence of overweight/obesity in adolescents. *International Journal Food Sciences and Nutrition, 60,* 34-47.

Kremers, S., Horst, K., & Brug, J. (2007). Adolescent screen-viewing behaviour is associated with consumption of sugar-sweetened beverages: The role of habit strength and perceived parental norms. *Appetite*, *48,* 345-350.

Krosnick, J. A., Anand, S. N., & Hartl, S. P. (2003). Psychosocial predictors of heavy television viewing among preadolescents and adolescents. *Basic and Applied Social Psychology, 25,* 87-110.

Larson, N. I., Neumark-Sztainer, D. R., Story, M. T., Wall, M. M., Harnack, L. J., & Eisenberg, M. E. (2008). Fast food intake: longitudinal trends during the transition to young adulthood and correlates of intake. *Journal of Adolescent Health, 43*, 79-86.

Larson, R. W., Richards, M. H., Moneta, G., Holmbeck, G., & Duckett, T. (1996). Changes in adolescents' daily interactions with their families from ages 10 to 18: Disengagement and transformation. *Developmental Psychology, 32,* 744-754.

Larson, N. I., Story, M., Wall, M., & Neumark-Sztainer, D. (2006). Calcium and dairy intakes of adolescents are associated with their home environment, taste preferences, personal health beliefs, and meal patterns. *Journal of the American Dietetic Association, 106,* 1816-1824.

Larson, N., Neumark-Sztainer, D., Hannan, P. & Story, M. (2007). Trends in adolescent fruit and vegetable consumption, 1999-2004 Project EAT. *American Journal of Preventive Medicine, 32,* 147-150.

Lau, R., Quadrel, M. J., & Hartman, K. A. (1990). Development and change of young adults' preventive health beliefs and behavior: influence from parents and peers. *Journal of Health and Social Behavior, 31,* 240-259.

Laursen, B., Popp, D., Burke, W. J., Kerr, M., & Stattin, H. (2008) Incorporating interdependence into developmental research: Examples from the study of homophily and homogeneity. In N. A. Card, T. D. Little, & J. P. Selig (Eds.), *Modeling dyadic and interdependent data in developmental research* (pp. 11-37). New York: Routledge/Taylor & Francis Group.

Lempers, J. D., & Clark-Lempers, D. S. (1993). A functional comparison of same-sex and opposite-sex friendships during adolescence. *Journal of Adolescent Research, 8,* 89-108.

Lerner, R. M., & Steinberg, L. (2009). *Handbook of adolescent psychology* (3rd ed.). Hoboken, NJ: John Wiley & Sons Inc.

Lien, N., Lytle, L. A., & Klepp, K. I. (2001). Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. *Preventive Medicine, 33,* 217-226.

Lin, B. & Morrison, R. M. (2004). Higher fruit consumption link with lower body mass index. *Food Review, 25,* 27-32.

Lindstrom, W., & Lease, A. (2005). The role of athlete as contributor to peer status in school-age and adolescent females in the United States: From pre-title IX to 2000 and beyond. *Social Psychology, 8,* 223-244.

Little, T. D., & Card, N. A. (2005). On the use of the Social Relations and Actor-Partner Interdependence Models in developmental research. *International Journal of Behavioral Development, 29,* 173-179.

Little, T. D., Schnabel, K. U., & Baumert, J. (2000). *Modeling longitudinal and multilevel data: Practice issues, applied approaches, and specific examples.* Mahwah, NJ: Lawrence Erlbaum Associates.

Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: A crisis in public health. *Obesity Reviews, 5,* 4-85.

Ludwig, D. S., Peterson, K. E., & Gortmaker, S. L. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: A prospective, observational analysis. *Lancet, 357,* 505-508.

Luszczynska, A., Gibbons, F. X., Piko, B. F., & Tekozel, M. (2004). Self-regulatory cognitions, social comparison, and perceived peers' behaviors as predictors of nutrition and physical activity: A comparison among adolescents in Hungary, Poland, Turkey, and USA. *Psychology and Health, 19,* 577-593.

Lytle, L. A., Seifert, S., Greenstein, J., & McGovern, P. (2000). How do children's eating patterns and food choices change over time? Results from a cohort study. *American Journal of Health Promotion, 14,* 222-228.

Marshall, S. J., Gorely, T. & Biddle, S. J. (2006). A descriptive epidemiology of screen-based media use in youth: a review and critique. *Journal of Adolescence*, 29, 333-349.

Maxwell, K. A. (2002). Friends: The role of peer influence across adolescent risk behaviors. *Journal of Youth and Adolescence, 31,* 267-277.

Mayeux, L., Sandstrom, M. J., & Cillessen, A. N. H. (2008). Is being popular a risky proposition? *Journal of Research on Adolescence, 18,* 49-74.

McGuire, M. T., Neumark-Sztainer, D. R., & Story, M. (2002). Correlates of time spent in physical activity and television viewing in a multi-racial sample of adolescents. *Pediatric Exercise Science, 14,* 75-86.

McLaren, L. (2007). Socioeconomic status and obesity. *Epidemiological Reviews, 29,* 29-48.

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Reviews of Sociology, 27,* 415-444.

Menschik, D., Ahmed, S., Alexander, M. H., & Blum, R. W. (2008). Adolescent physical activities as predictors of young adult weight. *Archives of Pediatrics & Adolescent Medicine, 162,* 29-33.

Mercken, L., Candel, M., Williams, P., & de Vries, H. (2007). Disentangling social selection and social influence effects on adolescent smoking: The importance of reciprocity in friendships. *Addiction, 102,* 1483-1492.

Mercken, l., Snijders, T. A. B., Steglich, C., Vartianinen, E., & de Vries, H., (2010). Dynamics of adolescent friendship networks and smoking behavior. *Social Networks, 32,* 72-81.

Miech, R. A., Kumanyika, S. K., Stettler, N., Link, B. G., Phelan, J. C. & Chang, V. W. (2006). Trends in the association of poverty with overweight among US adolescents. *Journal of the American Medical Association, 295,* 2385-2393.

Moreno, L. A., Pigeot, L. & Ahrens, W. (2011). *Epidemiology of obesity in children and adolescents.* New York: Springer.

Mota, J., Fidalgo, F., Silva, R., Ribeiro, J. C., Santos, R., Carvalho, J., et al. (2008) Relationships between physical activity, obesity, and meal frequency in adolescents. *Annals of Human Biology, 35,* 1-10.

Munoz, K. A., Krebs-Smith, S. M., Ballard-Barbash, R., & Cleveland, L. E. (1997). Food intakes of US children and adolescents compared with recommendations. *Pediatrics, 100,* 323-329.

Must, A. (2003). Does overweight in childhood have an impact on adult health? *Nutrition Reviews*, *61,* 139-142.

Must, A. & Anderson, S. E. (2006). Body mass index in children and adolescents: Considerations for population-based applications. *International Journal of Obesity, 30*, 590-594.

Must, A., & Tybor, D. J. (2005). Physical activity and sedentary behavior: A review of longitudinal studies of weight and adiposity in youth. *International Journal of Obesity, 29,* s84-s96.

Nader, P. R., Bradley, R. H., Houts, R. M., McRitchie, S. L., & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *Journal of the American Medical Association*, *300***,** 295-395.

Nelson, M. C., Gordon-Larsen, P., Adair, L. S., & Popkin, B. M. (2005). Adolescent physical activity and sedentary behavior: Patterning and long-term maintenance. *American Journal of Preventive Medicine, 28,* 259-266.

Neumark-Sztainer, D. (1999). The social environments of adolescents: Associations between socioenvironmental factors and health behaviors during adolescence. *Adolescent Medicine, 10,* 41-55.

Neumark-Sztainer, D., Story, M., Hannan, P. J., & Croll, J. (2002). Overweight status and eating patterns among adolescents: Where do youths stand in comparison with the Healthy People 2010 objectives. *American Journal of Public Health, 92,* 844-851.

Neumark-Sztainer, D., Story, M., Hannan, P. J., Tharp, T., & Rex, J. (2003). Factors associated with changes in physical activity: A cohort study of inactive adolescent girls. *Archives of Pediatrics and Adolescent Medicine, 157,* 803-810.

Neumark-Sztainer, D., Story, M., Resnick, M. D., & Blum, R. W. (1996). Correlates of inadequate fruit and vegetable consumption among adolescents. *Preventive Medicine, 25,* 497-505.

Newby, P. K. (2007). Are dietary intakes and eating behaviors related to childhood obesity? A comprehensive review of the evidence? *Journal of Law, Medicine, & Ethics, 35,* 35-60.

Newcomb, A., & Bagwell, C. (1995). Children's friendship relations: a meta-analytic review. *Psychological Bulletin, 117,* 306-347.

Niemeier,, H., Raynor,, H., Lloyd-Richardson, E., Rogers, M., & Wing, R (2006). Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample. *Journal of Adolescent Health, 39,* 842-849.

Nofziger, S., & Lee, H. R. (2006). Differential associations and daily smoking of adolescents: The importance of same-sex models. *Youth & Society. 37,* 453-478.

Norman, G. J., Schmid, B. A., Sallis, J. F., Calfas, K. J., & Patrick, K. (2005). Psychosocial and environmental correlates of adolescent sedentary behaviors. *Pediatrics, 116,* 908-916.

Ogden, C. L., & Carroll, M. D. (2010). *NCHS Health E-stat: Prevalence of obesity among children and adolescents: Unites States, Trends 1963-1965 through 2007-2008*. Retrieved May 21, 2011 from http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm

Ogden, C. L., Carroll, M. D., Curtin, L.R., Lamb, M. M. (2010). Prevalence of high body mass index in US children and adolescents 2007-2008. *Journal of the American Medical Association, 303*, 242-249.

Ogden, C. L., Carroll, M. D., Curtin, L.R., McDowell, M.A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *Journal of the American Medical Association, 295,* 1549-1555.

Ogden, C. L., Carroll, M. D., & Flegal, K. M. (2008). High body mass index for age among US children and adolescents, 2003-2006. *Journal of the American Medical Association, 299,* 2401-2405.

Ogden, C. L., Flegal, K. M., Carroll, M. D., & Johnson, C. L. (2002). Prevalence and trends in overweight among US children and adolescents, 1999-2000. *Journal of the American Medical Association, 288,* 1728-1732.

Olson, C. K. (2010). Children's motivations for video game play in the context of normal development. *Review of General Psychology, 14,* 180-187.

Ornelas, I. J., Perreira, K. M., & Ayala, G. X. (2007). Parental influences on adolescent physical activity: A longitudinal study. *International Journal of Behavioral Nutrition and Physical Activity, 4,* 3.

Parker, J. G., & Asher, S. R. (1993). Friendship and friendship quality in middle childhood: Links with peer group acceptance and feelings of loneliness and social dissatisfaction. *Developmental Psychology*, *29,* 611-621.

Parker, J. G., & Seal, J. (1996). Forming, losing, renewing, and replacing friendships: Applying temporal parameters to the assessment of children's friendships experiences. *Child Development, 67,* 2248-2268.

Patrick, K., Norman, G. J., Calfas, K. J., Sallis, J. F., Zabinski, M. F., Rupp, J., et al. (2004). Diet, physical activity, and sedentary behaviors as risk factors for overweight in adolescence. *Archives of Pediatrics and Adolescent Medicine, 158,* 385-390.

Peters, E., Cillessen, A. H. N., Riksen-Walraven, J. M., & Hasselager, G. J. T. (2010). Best friends' preference and popularity: Associations with aggression and prosocial behavior. *International Journal of Behavioral Development, 34*, 398-405.

Phillips, S. M., Bandini, L. G., Cyr, H., Colclough-Douglas, S., Naumova, E., & Must, A. (2003). Dairy food consumption and body weight and fatness studied longitudinally over the adolescent period. *International Journal of Obesity and Related Metabolic Disorders, 27,* 1106-1113.

Phillips, S. M., Bandini, L. G., Naumova, E. N., Cyr, H., Colclough, S., Dietz, W. H., et al. (2004). Energy-dense snack food intake in adolescence: Longitudinal relationship to weight and fatness. *Obesity Research, 12,* 461-472.

Plotnikoff, R. C., Bercovitz, K., Rhodes, R. E., Loucaides, C. A. & Karunamuni, N. (2007). Testing a conceptual model related to weight perceptions, physical activity and smoking in adolescents. *Health & Education Research*, *22*, 192-202.

Popp, D., Laursen, B., Kerr, M., Stattin, H. & Burk, W. K. (2008). Modeling homophily over time with an actor-partner interdependence model. *Developmental Psychology, 44,* 1028-1039.

Poulin, F., & Chan, A. (2010). Friendship stability and change in childhood and adolescence. *Developmental Review, 30,* 257-272.

Price, M. N., & Hyde, J. S. (2009). When two isn't better than one: Predictors of early sexual activity in adolescence using a cumulative risk model. *Journal of Youth and Adolescence, 38,* 1059-1071.

Prinstein, M. J., Boergers, J., & Spirito, A. (2001). Adolescents' and their friends' health-risk behavior: Factors that alter or add to peer influence. *Journal of Pediatric Psychology, 26,* 287-298.

Puhl, R., & Latner, J. (2007). Obesity, stigma, and the health of the nation's children. *Psychological Bulletin*, *133,* 557-580.

Rancourt, D., & Prinstein, M. J. (2010). Peer status and victimization as possible reinforcements of adolescent girls' and boys' weight-related behaviors and cognitions. *Journal of Pediatric Psychology, 35,* 354-367.

Reichert, F. F., Baptista, A. M., Menezes, J. C., Wells, S., Carvalho, D., & Hallal, P. C. (2009). Physical activity as a predictor of adolescent body fatness: A systematic review, *Sports Medicine, 39,* 279-294.

Rex, L. (2005). *Adolescent health: A multidisciplinary approach, research and intervention.* Thousand Oaks, CA: Sage Publications.

Richmond, T., Hayward, R., Gahagan, S., Field, A., & Heisler, M. (2006). Can school income and racial/ethnic composition explain the racial/ethnic disparity in adolescent physical activity participation? *Pediatrics, 117,* 2158-2166.

Roberts, R., Roberts, C. R., & Xing, Y. (2010). One-year incidence of suicide attempts and associated risk and protective factors among. *Archives of Suicide Research, 14,* 66-78.

Robinson, T. N. (1999). Reducing children's television viewing to prevent obesity: A randomized controlled trial. *Journal of the American Medical Association, 282,* 1561-1567.

Rodriguez, G., Sjoberg, A., Lissner, L., & Moreno, L. A. (2010). Food patterns and nutrient intake in relation to childhood obesity. In L. A. Moreno, L. Pigeot, & W. Ahrens (Eds.), *Epidemiology of obesity in children and adolescents* (pp. 329-346). New York: Springer.

Romero, N., Epstein, l., & Salvy, S. (2009). Peer modeling influences girls' snack intake, *Journal of the American Dietetic Association, 109,* 133-136.

Rose, A., J., Glick, G. C., & Smith R. L. (2011). Popularity and gender: The two cultures of boys and girls. In A. H. N. Cillessen, D. Schwartz, and L. Mayeux (Eds). *Popularity in the peer system* (pp. 103-122). Guilford Press: New York.

Rosenberg, D. E., Norman, G. J., Sallis, J. F., Calfas, K. J., & Patrick, K. (2007). Covariation of adolescent physical activity and dietary behaviors over 12 months. *Journal of Adolescent Health, 41,* 472-478.

Rutter, M. (1979). Protective factors in children's responses to stress and disadvantage. In M. W. Kent & J. E. Rolf (Eds.), *Primary prevention of psychopathology, Vol. 3: Social competence in children* (pp. 49-74). Hanover, NH: University of New England Press.

Sabiston, C. M., & Crocker, P. R. E. (2008). Exploring self-perceptions and social influences as correlates of adolescent leisure-time physical activity. *Journal of Sport & Exercise Psychology, 30,* 3-22.

Sallis, J. F., Buono, M. J., Roby, J. J., Micale, F. G., & Nelson, J. A. (1993). Seven-day recall and other physical activity self-reports in children and adolescents. *Medicine & Science in Sports & Exercise, 25*, 99-108.

Salvy, S. J., Howard, M., Read, M., & Mele, E. (2009). The presence of friends increases food intake in youth. *American Journal of Clinical Nutrition, 90*, 282-287.

Salvy, S. J., Romero, N., Paluch, R., & Epstein, L. H. (2007). Peer influence on preadolescent girls' snack intake: Effects of weight status. *Appetite, 49,* 177-182.

Salvy, S. J., Bowker, J. W., Roemmich, J. N., Romero, N., Kieffer, E. & Paluch, R. (2008). Peer influence on children's physical activity: an experience sampling study. *Journal of Pediatric Psychology, 33,* 39-49.

Samdal, O., Tynjala, J., Roberts, C., Sallis, J. F., Villberg, J., & Wold B. (2007). Trends in vigorous physical activity and TV watching of adolescents from 1986 to 2002 in seven European Countries. *European Journal of Public Health, 17,* 242-248.

Sanchez, A., Norman, G. J., Sallis, J. F., Calfas, K., J., Cella, J., & Patrick, K. (2007). Patterns and correlates of physical activity and nutrition behaviors in adolescents. *American Journal of Preventive Medicine, 32,* 124-130.

Schneider, M., Dunton, G. F. & Cooper, D. M. (2007). Media use and obesity in adolescent females. *Obesity, 15,* 2328-2335.

Schutz, Y., & Maffeis, C. (2002). Physical activity. In W. Burniat, T. Cole, I. Lissau, & E. Poskitt, (Eds.), *Child and adolescent obesity* (pp. 93-109). Cambridge, UK: Cambridge University Press.

Selfhout, M. H. W., Branje, S. J. T., & Meeus, W. H. J. (2008). The development of delinquency and perceived friendship quality in adolescent best friendship dyads. *Journal of Abnormal Child Psychology, 36,* 471-485.

Serdula, M. K., Ivery, D., Coates, R. J., Freedman, D. S., Williamson, D. F., & Byers, T. (1993). Do obese children become obese adults? A review of the literature. *Preventive Medicine, 22,* 167-177.

Shanahan, M. J., & Flaherty, B. P. (2001). Dynamic patterns of time use in adolescence. *Child Development, 72,* 385-401.

Sherwood, N. E. (2008). Diet assessment in children and adolescents. In E. Jelalian and R. G. Steele (Eds.), *Handbook of childhood and adolescent obesity* (pp. 73-89). New York: Springer.

Shrewsbury, V., & Wardle, J. (2008). Socioeconomic status and adiposity in childhood: A systematic review of cross-sectional studies 1990-2005. *Obesity, 16,* 275-284.

Sieving, R., Perry, C., & Williams, C. (2000). Do friendships change behaviours, or do behaviours change friendships? Examining paths of influence in young adolescents' alcohol use. *Journal of Adolescent Health, 26*, 27-35.

Singh, G. K., Kogan, M. D., Van Dyck, P. C., & Siahpush, M. (2008). Racial/ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: Analyzing independent and joint associations. *Annals of Epidemiology, 18,* 682-695.

Skelton, J. A., Cook, S. R., Auinger, P., Klein, J. D., & Barlow, S. E. (2009). Prevalence and trends of severe obesity among US children and adolescents. *Academic Pediatrics, 9,* 322-329.

Snoek, H. M., van Strien, T., Janssens, J. M. A. M., & Engels, R. C. M. E. (2006). The effect of television viewing on adolescents ' snacking: Individual differences explained by external, restrained and emotional eating. *Journal of Adolescent Health, 39,* 448-451.

Springer, A. E., Kelder, S. H., & Hoelscher, D. M. (2006). Social support, physical activity and sedentary behavior among 6th grade girls: A cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity, 3,* 1-10.

Stice, E., Presnell, K., Shaw, H. & Rohde, P. (2005). Psychological and behavioral risk factors for onset of obesity in adolescent girls: A prospective study. *Journal of Consulting and Clinical Psychology, 73,* 195-202.

Strauss, R. S. (2000). Childhood obesity and self-esteem. *Pediatrics, 105,* e15.

Strauss, R. S., & Pollack, H. A. (2003). Social marginalization of overweight children. *Archives of Pediatrics and Adolescent Medicine, 157,* 746-752.

Sullivan, H. S. (1953). The interpersonal theory of psychiatry. New York: W. W. Norton, & Company.

Suls, J., Martin, R. & Wheeler, L. (2002). Social comparison: Why, with whom, and with what effect. *Current Directions in Psychological Science, 11,* 159-163.

Sweeting, H. N. (2008). Gendered dimensions of obesity in childhood and adolescence. *Nutrition Journal, 7,* 1-14.

Thompson, O. M., Ballew, C., Resnicow, K., Must, A., Bandini, G., Cyr, H., et al. (2004). Food purchased away from home as a predictor of change in BMI *z*-score among girls. *International Journal of Obesity, 28,* 282-289.

Timlin, M. T., Pereira, M. A., Story, M., & Neumark-Sztainer, D. 2008). Breakfast eating and weight change in a 5-year prospective analysis of adolescents: Project EAT (Eating Among Teens). *Pediatrics, 121*, e638-e645.

Trogdon J. G., Nonnemaker, J., & Pais, J. (2008). Peer effects in adolescent overweight. *Journal of Health Economics, 27,* 1388-1399.

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilbert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports & Exercise, 40,* 181-188.

Troiano, R. P., Briefel, R. R., Carroll, M. D., & Bialostosky, K. (2000). Energy and fat intakes of children and adolescents in the United States: Data from the National Health and Nutrition Examination Surveys. *American Journal Clinical Nutrition, 72,* 1343S-1353S.

Tucker, C. J., McHale, S. M., & Crouter, A. C. (2008). Links between older and younger adolescent siblings' adjustment: The moderating role of shared activities. *International Journal of Behavioral Development, 32,* 152-160.

Tyler, C., & Fullerton. G. (2008). The definition and assessment of child overweight: A development perspective. In E. Jelalian & R. G. Steele (Eds.), *Handbook of childhood and adolescent obesity* (pp. 63-89). New York: Springer.

Urberg, K. A. (1992). Locus of peer influence: Social crowd and best friend. *Journal of Youth & Adolescence*, *21,* 439-450.

Urberg, K. A., Degirmencioglu, S. M., & Pilgrim, C. (1997). Close friend and group influence on adolescent cigarette smoking and alcohol use. *Developmental Psychology*, *33,* 834-844.

Urberg, K. A., Degirmencioglu, S. M., Tolson, J. M., & Halliday-Scher, K. (2000). Adolescent social crowds: Measurement and relationship to friendships. *Journal of Adolescent Research, 15,* 427-445.

U.S. Department of Health and Human Services (2000). *Healthy people 2010. With understanding and improving health and objectives for improving health*, 2nd ed., 2 vols. Washington, DC: U.S. Government Printing Office.

Utter, J., Neumark-Sztainer, D., Jeffrey, R., & Story, M. (2003). Couch potatoes or French fries: Are sedentary behaviors associated with body mass index, physical activity, and dietary behaviors among adolescents? *Journal of the American Dietetic Association, 103,* 1298-1305.

Valente, T. W., Fujimoto, K., Chou, C. P., Spruijt-Metz, D. (2009). Adolescent affiliations and adiposity: A social network analysis of friendships and obesity. *Journal of Adolescent Health, 45,* 202-204.

Vandewater, E. A., Shim, M. S., & Caplovitz, A. G. (2004). Linking obesity and activity level with children's television and video game use. *Journal of Adolescence, 27,* 71-85.

Vaquera, E., & Kao, G. (2008). Do you like me as much as I like you? Friendship reciprocity among adolescents. *Social Science Research, 37,* 55-72.

Videon, T. M., & Manning, C. K. (2003). Influences on adolescent eating patterns: The importance of family meals. *Journal of Adolescent Health, 32,* 365-373.

Vilhjalmsson, R., & Thorlindsson, T. (1998). Factors related to physical activity: A study of adolescents. *Social Science & Medicine, 47,* 665-675.

Vitaro, F., Boivin, M., & Bukowski, W. M. (2009). The role of friendship in child and adolescent psychosocial development. In K. H. Rubin, W. M. Bukowski, and B. Laursen (Eds.), *Handbook of peer interactions, relationships, and groups* (pp. 568-585). New York: The Guildford Press.

Vivier, P., & Tompkins, C. (2008). Health consequences of obesity in children and adolescents. In E. Jelalian & R. G. Steele (Eds.), *Handbook of childhood and adolescent obesity* (pp. 11-24). New York: Springer.

Voorhees, C. C., Murray, D., Welk, G., Burnbaum, A., Ribisl, K. M., Johnson, C. C., et al. (2005). The role of peer social network factors and physical activity in adolescent girls. *American Journal of Health Behavior, 29,* 183-190.

Wang, Y., & Beydoun, M. A. (2007). The obesity epidemic in the United States-Gender, age, socioeconomic, racial/ethnic, and geographic characteristics: A systematic review and meta-regression analysis. *Epidemiological Reviews, 29,* 1-23.

Wang, Y., Beydoun, M. A., Liang, L., Caballero, B., & Kumanyika, S. K. (2008). Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. *Obesity, 16,* 2323-2330.

Wang, G., & Dietz, W. H. (2002). Economic burden of obesity in youths aged 6 to 17 years: 1979-1999. *Pediatrics, 109,* E81.

Wang, M. Q., Fitzhugh, E. C., Westerfield, R. C., & Eddy, J. M. (1995). Family and peer influences on smoking behavior among American adolescents: An age trend. *Journal of Adolescent Health, 16*, 200-203.

Wang, S. S., Houshyar, S., & Prinstein, M. (2006). Adolescent girls' and boys' weight-related health behaviors and cognitional: Associations with reputation and preference-based peer status. *Health Psychology, 25,* 658-663.

Weiss, R. S. (1974). The provisions of social relationships. In Z. Rubin (Ed.), *Doing unto others* (pp. 17-26). Englewood Cliffs, NJ: Preston-Hall.

Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D. & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *The New England Journal of Medicine, 337,* 869-873.

Wickrama, K. A. T., Wickrama, K. A. S., & Bryant, C. M. (2006). Community influence on adolescent obesity: Race/ethnic differences. *Journal of Youth and Adolescence, 35,* 647-657.

Wills, T. A., & Cleary, S. D. (1999). Peer and adolescent substance use among 6th-9th graders: Latent growth analyses of influence versus selection mechanisms. *Health Psychology, 18*, 453-463.

Wong. S. L., & Leatherdale, S. T. (2009). Association between sedentary behaviour, physical activity, and obesity: Inactivity among active kids. *Preventive Chronic Disease, 6,* 1-13.

Woodard, E. H., & Gridina, N. (2000). *Media in the home: The fifth annual survey of parents and children.* The Annenberg Public Policy Center. University of Pennsylvania, Pennsylvania.

Woodard, D. R., Boon, J. A., Cumming, F. J., Ball, P. J., Williams, H. M., & Hornsby, H. (1996). Adolescents' reported usage of selected foods in relation to their perceptions and social norms for those foods. *Appetite, 27,* 109-117.

Young, E. M. & Fors, S. W. (2001). Factors related to the eating habits of students in grades 9-12. *Journal of School Health, 71,* 483-488.

Zabinski, M. F., Norman, G. J., Sallis, J. F., Calfas, K. J., & Patrick, K. (2007). Patterns of sedentary behaviors among adolescents. *Health Psychology, 26,* 113-120.

Zick, C. D. (2010). The shifting balance of adolescent time use. *Youth & Society, 41,* 569-596.

Zimmer-Gembeck, M. J., & Collins, W. A. (2003). Autonomy development during adolescence. In Adams, G. R., & Berzonsky, M. D. (Eds.), *Blackwell handbook of adolescence: Blackwell handbooks of developmental psychology* (pp. 175-204). Malden, MA: Blackwell Publishing.

Table 1

Descriptive Statistics for Continuous Study Variables

	Reciprocal Friends				Nonreciprocal Friends: Nominators				Nonreciprocal Friends: Nominees			
Variables	*M*	*SD*	Minimum	Maximum	*M*	*SD*	Minimum	Maximum	*M*	*SD*	Minimum	Maximum
W1 Age	15.83	1.40	13.00	19.00	15.86	1.56	12.00	20.00	15.84	1.54	13.00	20.00
Family income[a]	$44,000	$55,000	$0	$999,000	$38,000	$61,000	$0	$999,000	$39,000	$58,000	$0	$999,000
Parent obesity	.28	.55	.00	2.00	.28	.57	.00	2.00	.29	.56	.00	2.00
W1 Vegetables	.98	.79	.00	2.00	.95	.78	.00	2.00	.94	.77	.00	2.00
W1 Fruit	1.27	.77	.00	2.00	1.28	.77	.00	2.00	1.26	.78	.00	2.00
W1 Dairy	1.37	.73	.00	2.00	1.36	.75	.00	2.00	1.34	.75	.00	2.00
W1 Physical activity	3.89	2.08	.00	9.00	3.83	2.08	.00	9.00	3.93	2.12	.00	9.00
W2 Physical activity	3.65	2.03	.00	9.00	3.66	2.05	.00	9.00	3.59	2.00	.00	9.00
W1 Sedentary activity[b]	6.97	6.34	.00	75.67	7.49	6.81	.00	76.00	7.43	6.85	.00	75.67
W2 Sedentary activity[b]	7.00	6.41	.00	56.00	7.21	6.73	.00	56.00	6.78	6.08	.00	49.33
W1 Healthy eating	2.09	1.06	.00	4.00	2.09	1.06	.00	4.00	2.05	1.07	.00	4.00
W2 Healthy eating	1.91	1.20	.00	4.00	1.86	1.20	.00	4.00	1.85	1.21	.00	4.00
W1 Cumulative risk	1.18	.66	.00	3.00	1.23	.68	.00	3.00	1.20	.66	.00	3.00
W1 BMIz	.27	.94	-5.00	3.00	.39	1.01	-4.00	3.00	.37	1.00	-6.00	3.00
W2 BMIz	.23	1.03	-4.00	3.00	.36	1.12	-5.00	3.00	.34	1.08	-4.00	3.00
Interaction frequency	1.88	1.14	.00	3.00	1.44	1.18	.00	3.00				

Note. W = Wave; [a] = Median [b] = Mean.

Table 2

Frequencies for All Categorical Study Variables

Variable	Reciprocal Friends	Nonreciprocal Friends: Nominators	Nonreciprocal Friends: Nominees
Gender	54% Girls	50% Girls	50% Girls
Ethnicity	62% White	56% White	56% White
Parent education	15% Some high school	17% Some high school	16% Some high school
	29% High school/GED	30% High school/GED	31% High school/GED
	31% Some college	31% Some college	30% Some college
	16% College graduate	13% College graduate	14% College graduate
	10% Professional degree	9% Professional degree	9% Professional degree
W1 Breakfast	81% Eat breakfast	80% Eat breakfast	81% Eat breakfast
Friendship stability	33% Stable	25% Stable	25% Stable

Note. W = Wave.

Table 3

Bivariate Relations between All Indicators: Reciprocal Friend Pairs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Gender	—																			
2 W1 Age	-.08**	—																		
3 Ethnicity	-.03	-.16**	—																	
4 P educ	-.04†	-.08**	.17**	—																
5 Fam inc	.00	-.03	.16**	.29**	—															
6 P obesity	.02	.03	.09**	.00	-.04	—														
7 W1 Br	-.09**	-.11**	.03	.03	.03	-.04	—													
8 W1 Veg	.01	-.04†	.08**	.10**	.04	.01	.09**	—												
9 W1 Fruit	-.03	-.02	-.09**	.11**	.07**	-.02	.15**	.20**	—											
10 W1 Da	-.10**	-.08**	.19**	.04	.06*	.01	.15**	.15**	.10**	—										
11 W1 PA	-.23**	-.18**	.06**	.08**	.06*	-.07**	.12**	.11**	.17**	.20**	—									
12 W2 PA	-.22**	-.26**	.09**	.04	.09**	-.06*	.09**	.12**	.15**	.13**	.46**	—								
13 W1 SA	-.09**	-.13**	-.11**	-.50†	-.11**	.00	-.03	-.06*	-.07**	-.06*	.01	.03	—							
14 W2 SA	-.12**	-.11**	-.14**	-.03	-.12**	.00	-.02	-.08**	-.03	-.01	.07*	.06*	.47**	—						
15 W1 HE	-.08**	-.08**	.08**	.11**	.07**	-.01	.50**	.56**	.58**	.56**	.23**	.19**	-.08**	-.04†	—					
16 W2 HE	-.09**	-.11**	.10**	.12**	.11**	-.04	.24**	.24**	.24**	.17**	.18**	.24**	-.10**	-.06*	.34**	—				
17 W1 CR	.16**	.10**	-.13**	-.09**	-.09**	.05*	-.26**	-.30**	-.34**	-.35**	-.71**	-.35**	.34**	.13**	-.55**	-.27**	—			
18 W1 BMIz	-.06	-.01	-.09**	-.07**	-.06*	.20**	-.11**	-.06*	.01	-.04†	.00	.05†	.09**	.06*	-.07**	-.06*	.06*	—		
19 W2 BMIz	-.03	-.07**	-.04	-.07**	-.05†	.08**	-.09**	-.03	.04	-.04	.02	.05*	.07*	.06*	-.06*	-.04†	.03	.84**	—	
20 Fr stab	.02	.01	.04†	-.01	-.03	-.06*	.02	.03	.04†	.06**	-.01	-.04†	.01	.00	.05*	.03	.00	-.05*	-.02	—
21 Int freq	-.05*	.10**	.06*	.01	.05†	-.07**	.01	-.01	.02	.04†	.09**	.09**	-.08**	-.02	.01	.06*	-.08**	-.08**	-.09**	.06*

Note. Break = Breakfast; CR = Cumulative risk; Da = Dairy; Fam inc = Family income; Fr stab = Friendship stability; HE = Healthy eating; Int freq = Interaction frequency; PA = Physical activity; P Educ = Parent education; P obesity = Parent obesity; SA = Sedentary activity; Veg = Vegetables; W = Wave. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$.

Table 4

Bivariate Relations between All Indicators for the Nominators within the Nonreciprocal Friend Pairs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Gender	—																			
2 W1 Age	-.07**	—																		
3 Ethnicity	.03	-.12**	—																	
4 P educ	.00	-.06*	.14**	—																
5 Fam inc	.03	.00	.11**	.25**	—															
6 P obesity	-.01	.01	.07**	.05†	-.03	—														
7 W1 Br	-.11**	-.11**	-.02	.06*	.06*	-.09**	—													
8 W1 Veg	-.01	-.03	.12**	.13**	.08**	.04	.08**	—												
9 W1 Fruit	.00	-.03	-.05*	.06*	.08**	-.01	.14**	.21**	—											
10 W1 Da	-.15**	-.08**	.17**	.05†	.08**	.03	.16**	.16**	.14**	—										
11 W1 PA	-.19**	-.20**	.04	.06*	.07**	.00	.15**	.12**	.13**	.16**	—									
12 W2 PA	-.21**	-.25**	.08**	.02	.05	-.01	.15**	.13**	.12**	.13**	.43**	—								
13 W1 SA	-.16**	-.10**	-.16**	-.05†	-.10**	.04†	.01	-.08**	-.03	-.02	.00	.02	—							
14 W2 SA	-.14**	-.02	-.16**	-.04	-.12**	.04	-.03	-.05*	-.02	-.06*	-.06*	-.02	.40**	—						
15 W1 HE	-.11**	-.10**	.09**	.10**	.11**	-.01	.50**	.56**	.60**	.57**	.21**	.21**	-.04†	-.06**	—					
16 W2 HE	-.06*	-.09**	.09**	.07**	.13**	-.03	.25**	.27**	.25**	.23**	.16**	.28**	-.10**	-.11**	.37**	—				
17 W1 CR	.11*	.11**	-.14**	-.11**	-.13**	-.01	-.27**	-.33**	-.32**	-.33**	-.67**	-.33**	.39**	.21**	-.54**	-.27**	—			
18 W1 BMIz	-.06**	-.04†	-.04†	-.04†	-.04	.24**	-.11**	.00	-.01	-.03	.01	.05†	.10**	.08**	-.05†	-.03*	.03	—		
19 W2 BMIz	.00	-.10**	-.04	-.04	-.04	.23**	-.10**	.01	.00	-.04	.01	.06*	.09**	.07**	-.05	.04	.03	.84**	—	
20 Fr stab	.01	-.06*	.04†	.00	-.02	.02	-.03	.01	-.01	.02	.05†	-.02	.04†	-.02	.00	-.02	.03	-.03	-.04	—
21 Int freq	-.07**	.09**	-.04†	-.02	.02	-.06*	.00	-.01	.07**	-.01	.09**	.03	-.03	-.03	.01	.04	-.06**	-.03**	-.01	.02

Note. Break = Breakfast; CR = Cumulative risk; Da = Dairy; Fam inc = Family income; Fr stab = Friendship stability; HE = Healthy eating; Int freq = Interaction frequency; PA = Physical activity; P Educ = Parent education; P obesity = Parent obesity; SA = Sedentary activity; Veg = Vegetables; W = Wave. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$.

Table 5

Bivariate Relations between All Indicators for the Nominees within the Nonreciprocal Friend Pairs

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Gender	—																		
2 W1 Age	-.10**	—																	
3 Ethnicity	.02	-.16**	—																
4 P education	.00	-.06*	.16**	—															
5 Family income	.01	-.03	.12**	.24**	—														
6 P obesity	.03	.02	.09**	.05+	-.01	—													
7 W1 Breakfast	-.11**	-.12**	-.03	.02	.04	-.04	—												
8 W1 Vegetables	.04+	-.06**	.12**	.13**	.07*	.01	.08**	—											
9 W1 Fruit	.01	-.07**	-.03	.11**	.07**	.02	.15**	.26**	—										
10 W1 Dairy	-.13**	-.06**	.18**	.04	.04	-.02	.15**	.15**	.11**	—									
11 W1 PA	-.20**	-.20**	.06*	.05+	.09**	-.06*	.11**	.15**	.22**	.16**	—								
12 W2 PA	-.18**	-.22**	.11**	.08**	.09**	-.04	.13**	.12**	.16**	.15**	.49**	—							
13 W1 SA	-.10**	-.11**	-.14**	-.06*	-.08**	-.05+	.02	-.06**	-.02	-.02	.03	.03	—						
14 W2 SA	-.12**	-.06*	-.16**	-.04	-.09**	-.03	.01	-.07**	-.06*	.00	.03	.06*	.42**	—					
15 W1 HE	-.07**	-.13**	.09**	.11**	.09**	-.01	.50**	.55**	.61**	.56**	.24**	.23**	-.02	-.04	—				
16 W2 HE	-.06*	-.05*	.08**	.09**	.12**	.02	.25**	.28**	.26**	.24**	.20**	.26**	-.08**	-.06*	.39**	—			
17 W1 CR	.13**	.11**	-.13**	-.09**	-.13**	.02	-.26**	-.33**	-.35**	-.31**	-.69**	-.37**	.34**	.13**	-.53**	-.30**	—		
18 W1 BMIz	-.10**	-.05*	-.10**	-.05*	-.03	.19**	-.04+	-.04	.01	-.02	-.01	.04+	.04+	.06**	-.02	-.04*	.05*	—	
19 W2 BMIz	-.08**	-.08**	-.07**	-.08**	-.08**	.21**	-.06*	-.04+	-.01	-.03	.02	.05+	.03	.05*	.05+	-.03	.03	.84**	—
20 Friend stab	.01	-.04	.03	-.01	-.06*	.06*	.05+	-.01	-.01	.01	.03	.02	-.01	.00	.01	.01	-.02	-.01	-.01

Note. CR = Cumulative risk; Friend stab = Friendship stability; HE = Healthy eating; Interact freq = Interaction frequency; P = Parent; PA = Physical activity; SA = Sedentary activity; W = Wave. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$.

Table 6

Multilevel Models Predicting Wave 2 Physical Activity in Reciprocal Friend Dyads

Predictors	Model 1		Model 2		Model 3	
	b	SE	*b*	SE	*b*	SE
Intercept	3.63***	.06	3.59***	.08	3.62***	.06
Gender	-0.24***	.06	-0.23**	.07	-0.24***	.06
Ethnicity	0.13*	.06	0.13†	.07	0.13*	.06
Age	-0.25***	.04	-0.24***	.05	-0.24***	.04
Family income	0.002†	.001	0.002†	.001	0.002†	.001
Parent education	-0.03	.02	-0.04	.03	-0.03	.02
Parent obesity	0.17†	.10	-0.18	.16	-0.19†	.02
W1 BMIz	0.09	.06	0.10	.07	0.09	.06
Actor W1 Physical activity (PA)	0.38***	.03	0.39***	.03	0.38***	.03
Partner W1 Physical activity (PA)	0.07**	.03	0.06	.04	0.07*	.03
Interaction frequency			0.15†	.08		
Friendship stability					-0.06	.06
Partner W1 PA x Interaction frequency			0.02	.03		
Partner W1 PA x Friendship stability					-0.02	.03

Note. Reported estimates are unstandardized regression coefficients. Model 1 = Main effects model; Model 2 = Friendship stability interaction model; Model 3 = Interaction frequency interaction model. W1 = Wave 1. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

Table 7

Multilevel Models Predicting Wave 2 Physical Activity in Nonreciprocal Friend Dyads

Predictors	Model 1				Model 2				Model 3			
	Nominators		Nominees		Nominators		Nominees		Nominators		Nominees	
	b	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Intercept	3.62***	.06	3.60***	.06	3.62***	.06	3.61***	.06	3.60***	.06	3.62***	.06
Gender	-0.28***	.06	-0.21***	.06	-0.28***	.06	-0.22***	.06	-0.28***	.06	-0.22***	.06
Ethnicity	0.07	.06	0.11†	.06	0.07	.06	0.11†	.06	0.06	.06	0.11†	.06
Age	0.26***	.04	-0.16***	.04	-0.25***	.04	-0.15***	.04	-0.26***	.04	-0.16***	.04
Family income	0.00	.00	0.00	.00	0.00	.00	0.002†	.001	0.00	.00	0.002†	.001
Parent education	-0.02	.02	0.00	.02	0.02	.02	0.00	.02	-0.02	.02	0.00	.02
Parent obesity	-0.05	.10	-0.07	.10	-0.05	.10	-0.08	.10	-0.05	.10	-0.08	.10
W1 BMIz	0.04	.06	0.06	.06	0.04	.06	0.06	.06	0.04	.06	0.07	.06
Actor W1 Physical activity (PA)	0.34***	.03	0.41***	.03	0.36***	.03	0.41***	.03	0.34***	.03	0.41***	.03
Partner W1 Physical activity (PA)	0.07*	.03	0.05†	.03	0.07*	.03	0.05†	.03	0.08**	.03	0.03**	.03
Interaction frequency					-0.01*	.06	-0.14*	.05				
Friendship stability									-0.04	.06	-0.04	.06
Partner W1 PA x Interaction frequency					-0.02	.03	-0.03	.03				
Partner W1 PA x Friendship stability									0.04	.03	-0.03	.03

Note. Reported estimates are unstandardized regression coefficients. Model 1 = Main effects model; Model 2 = Friendship stability interaction model; Model 3 = Interaction frequency interaction model. W1 = Wave 1. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

Table 8

Multilevel Models Predicting Wave 2 Sedentary Activity in Reciprocal Friend Dyads

Predictors	Model 1		Model 2		Model 3	
	b	SE	*b*	SE	*b*	SE
Intercept	1.28***	.10	1.25***	.13	2.05***	.17
Gender	-0.10***	.02	-0.10**	.03	-0.18***	.04
Ethnicity	-0.11***	.03	-0.09**	.03	-0.19**	.05
Age	-0.04*	.02	-0.04†	.02	-0.07*	.03
Family income	0.00	.00	0.00	.00	0.00	.00
Parent education	-0.01	.01	-0.01	.01	-0.01	.02
Parent obesity	-0.03	.04	-0.03	.06	-0.06	.08
W1 BMIz	0.01	.03	0.05	.03	0.01	.05
Actor W1 Sedentary activity (SA)	0.47***	.03	0.49***	.03	0.48***	.03
Partner W1 Sedentary activity (SA)	0.03	.03	0.03	.04	0.04	.03
Interaction frequency			0.11	.10		
Friendship stability					-0.05	.12
Partner W1 SA x Interaction frequency			-0.02	.03		
Partner W1 SA x Friendship stability					0.01	.03

Note. Reported estimates are unstandardized regression coefficients. Transformed square root sedentary activity scores used in analyses. Model 1 = Main effects model; Model 2 = Friendship stability interaction model; Model 3 = Interaction frequency interaction model. W1 = Wave 1. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 9

Multilevel Models Predicting Wave 2 Sedentary Activity in Nonreciprocal Friend Dyads

Predictors	Model 1				Model 2				Model 3			
	Nominators		Nominees		Nominators		Nominees		Nominators		Nominees	
	b	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Intercept	1.44***	.10	1.43***	.10	1.43***	.10	1.43***	.10	1.44***	.11	1.39***	.11
Gender	-0.10***	.05	-0.09***	.05	-0.10***	.03	-0.09***	.03	-0.10***	.03	-0.09**	.03
Ethnicity	-0.06*	.05	-0.08**	.05	-0.06*	.03	-0.08**	.03	-0.06*	.03	-0.08**	.03
Age	0.00	.02	-0.02	.02	0.00	.02	-0.02	.02	0.00	.02	-0.02	.02
Family income	0.00	.00	0.00	.00	0.00	.00	-0.001*	.00	-0.001†	.00	-0.001*	.00
Parent education	-0.01	.01	0.01	.01	-0.01	.01	0.01	.01	-0.01	.01	0.01	.01
Parent obesity	0.01	.04	-0.04	.05	0.01	.04	-0.04	.05	0.01	.05	-0.05	.05
W1 BMIz	0.03	.03	-0.01	.03	0.02	.03	-0.01	.03	0.02	.03	-0.01	.03
Actor W1 Sedentary activity (SA)	0.43***	.03	0.40***	.03	0.43***	.03	0.40***	.03	0.43***	.03	0.40***	.03
Partner W1 Sedentary activity (SA)	0.02	.03	0.04	.03	0.02	.03	0.04	.03	0.01	.03	0.05†	.03
Interaction frequency					-0.06	.07	-0.09	.07				
Friendship stability									0.01	.09	-0.11	.08
Partner W1 SA x Interaction frequency					0.02	.03	0.03	.02				
Partner W1 SA x Friendship stability									-0.02	.03	0.04	.03

Note. Reported estimates are unstandardized regression coefficients. Transformed square root sedentary activity scores used in analyses. Model 1 = Main effects model; Model 2 = Friendship stability interaction model; Model 3 = Interaction frequency interaction model. W1 = Wave 1. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 10

Multilevel Models Predicting Wave 2 Healthy Eating in Reciprocal Friend Dyads

Predictors	Model 1		Model 2		Model 3	
	b	SE	*b*	SE	*b*	SE
Intercept	1.92***	.04	1.91***	.05	1.92***	.04
Gender	-0.06†	.03	-0.05	.04	-0.06†	.03
Ethnicity	0.04	.03	0.05	.04	0.04	.04
Age	-0.04†	.02	-0.03	.03	0.04†	.04
Family income	0.001*	.01	0.00	.00	0.001*	.01
Parent education	0.03*	.02	0.04*	.02	0.03*	.02
Parent obesity	-0.05	.06	-0.02	.07	-0.05	.06
W1 BMIz	-0.05	.04	-0.03	.04	-0.05	.04
Actor W1 Healthy eating (HE)	0.36***	.03	0.39***	.04	0.36***	.03
Partner W1 Healthy eating (HE)	0.08*	.03	0.08†	.04	0.08*	.03
Interaction frequency			0.05	.05		
Friendship stability					0.00	.04
Partner W1 HE x Interaction frequency			0.03	.04		
Partner W1 HE x Friendship stability					0.01	.03

Note. Reported estimates are unstandardized regression coefficients. Model 1 = Main effects model; Model 2 = Friendship stability interaction model; Model 3 = Interaction frequency interaction model. W1 = Wave 1. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

Table 11

Multilevel Models Predicting Wave 2 Healthy Eating in Nonreciprocal Friend Dyads

Predictors	Model 1				Model 2				Model 3			
	Nominators		Nominees		Nominators		Nominees		Nominators		Nominees	
	b	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Intercept	1.84***	.03	1.89***	.03	1.84***	.04	1.88***	.03	1.83***	.04	1.88***	.04
Gender	-0.06	.03	-0.04	.03	-0.05	.03	-0.04	.03	-0.06	.03	-0.04	.03
Ethnicity	0.08*	.04	-0.02	.04	0.08*	.04	-0.02	.04	0.08*	.04	-0.02	.04
Age	-0.04†	.02	0.01	.02	-0.04†	.02	0.01	.02	-0.04†	.02	0.01	.02
Family income	0.002**	.001	0.002*	.001	0.002**	.001	0.002*	.001	0.002**	.00	0.002*	.001
Parent education	0.01	.02	0.01	.02	0.01	.02	0.01	.02	0.01	.02	0.01	.02
Parent obesity	-0.06	.06	0.13*	.06	-0.06	.06	0.13*	.06	-0.06	.06	0.13*	.06
W1 BMIz	-0.02	.04	-0.02	.03	-0.02	.04	-0.03	.04	-0.02	.04	-0.02	.04
Actor W1 Healthy eating (HE)	0.38***	.03	0.43***	.03	0.38***	.03	0.43***	.03	0.38***	.03	0.43***	.03
Partner W1 Healthy eating (HE)	0.10**	.03	0.09**	.03	0.10**	.03	0.09**	.03	0.11**	.03	0.12***	.04
Interaction frequency					0.04	.03	-0.02	.03				
Friendship stability									-0.01	.04	0.01	.04
Partner W1 HE x Interaction frequency					0.03	.03	0.01	.03				
Partner W1 HE x Friendship stability									0.03	.03	0.06†	.04

Note. Reported estimates are unstandardized regression coefficients. Model 1 = Main effects model; Model 2 = Friendship stability interaction model; Model 3 = Interaction frequency interaction model. W1 = Wave 1. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

Table 12

Multilevel Model Predicting Change in BMIz from Wave 1 to Wave 2 among Reciprocal Friends

Predictors	*b*	SE
Intercept	0.05**	.02
Gender	-0.03†	.02
Ethnicity	-0.01	.02
Age	0.04**	.01
Family income	0.00	.00
Parent education	0.00	.01
Parent obesity	0.00	.03
Actor W1 Cumulative risk index	0.03	.03
Partner W1 Cumulative risk index	0.06*	.03

Note. Reported estimates are unstandardized regression coefficients. W1 = Wave 1. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

Table 13

Multilevel Model Predicting Change in BMIz from Wave 1 to Wave 2 among Nonreciprocal Friends

Predictors	Nominators		Nominees	
	b	SE	*b*	SE
Intercept	0.07***	.02	0.06**	.02
Gender	-0.03	.02	-0.02	.02
Ethnicity	0.01	.02	-0.03†	.02
Age	0.03*	.01	0.03*	.01
Family income	0.00	.00	0.00	.00
Parent education	0.00	.01	0.00	.01
Parent obesity	-0.02	.03	-0.10**	.03
Actor W1 Cumulative risk index	0.02	.03	0.03	.03
Partner W1 Cumulative risk index	-0.02	.03	-0.02	.03

Note. Reported estimates are unstandardized regression coefficients. W1 = Wave 1. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

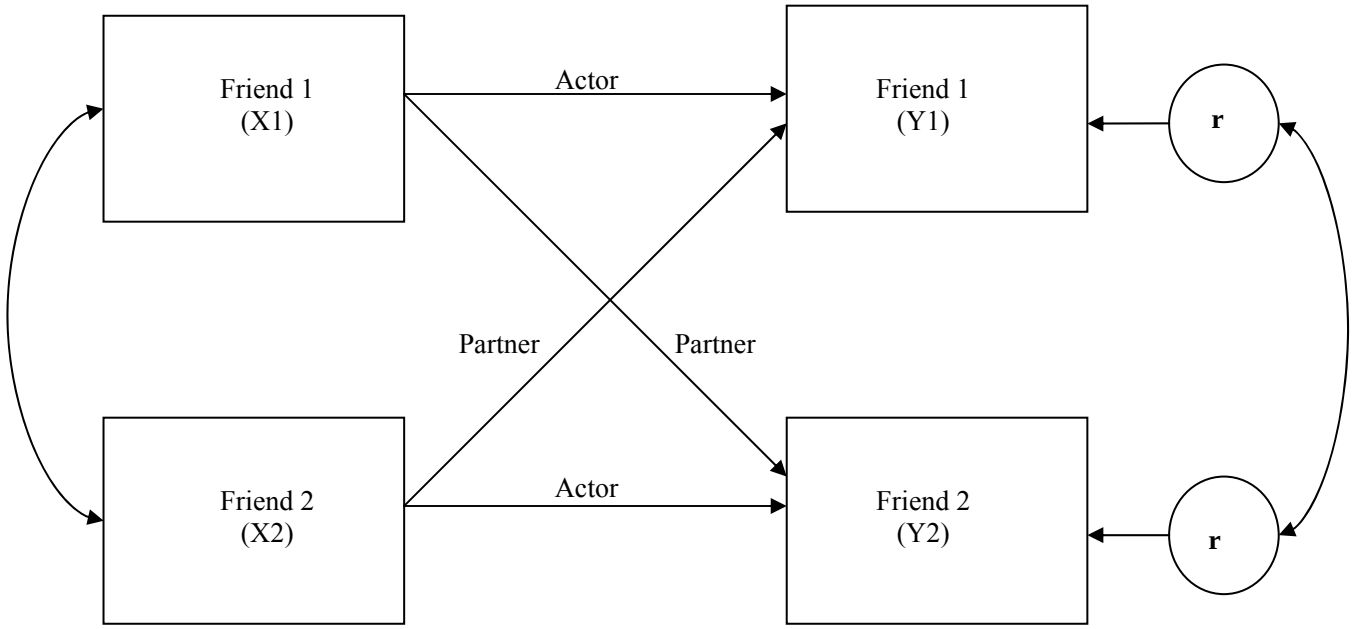

Figure 1. Hypothesized Actor-Partner Interdependence Model. X1 and X2 represent participants' W1 data, whereas Y1 and Y2 represent participants' T2 data; r represents the residual for participants' T2 scores.

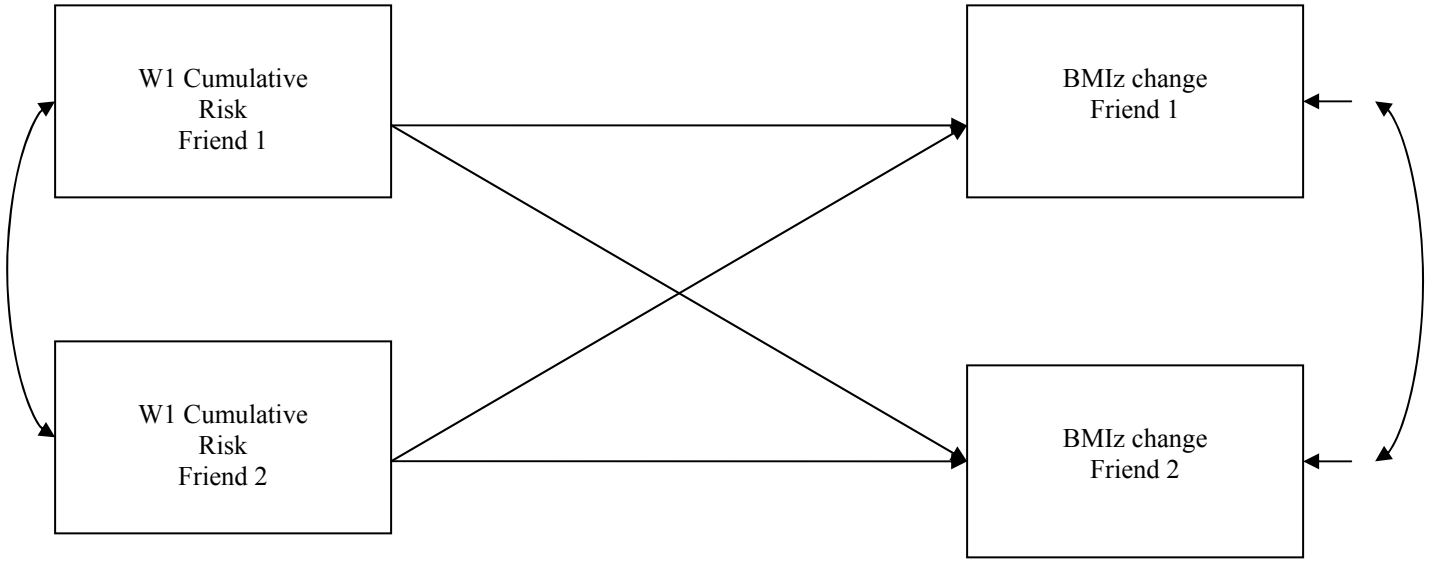

Figure 2. Hypothesized cumulative risk model for obesity.

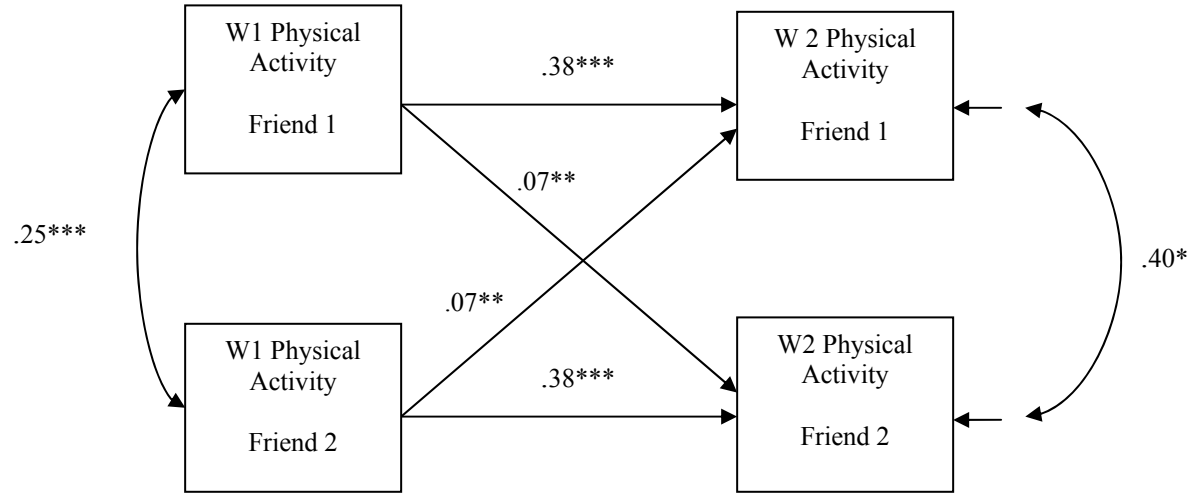

Figure 3. Longitudinal relations between reciprocal friends' self-reported physical activity. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

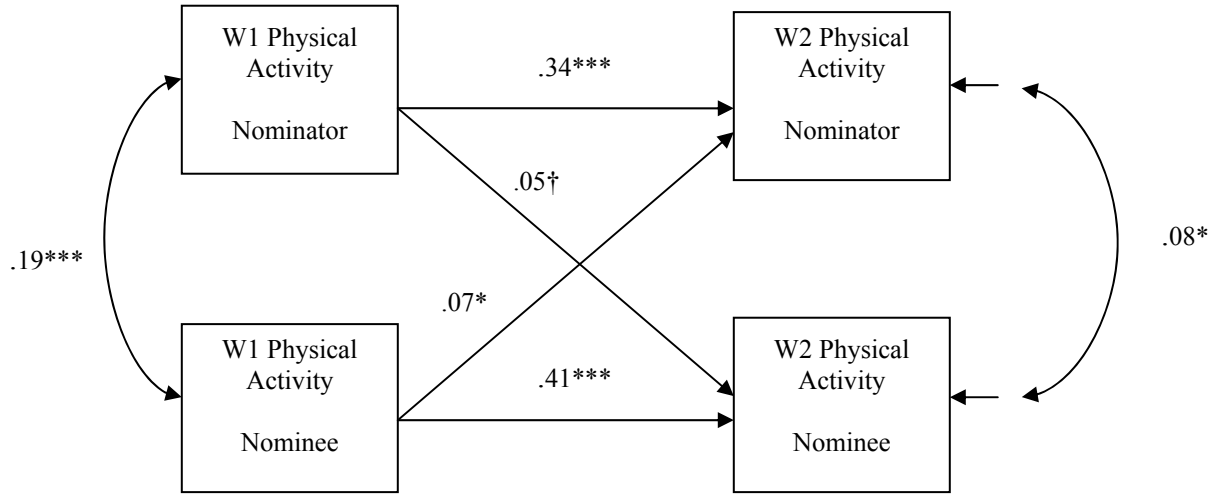

Figure 4. Longitudinal relations between nonreciprocal friends' self-reported physical activity. $^{\dagger}p < .10$; $^{*}p < .05$; $^{***}p < .001$.

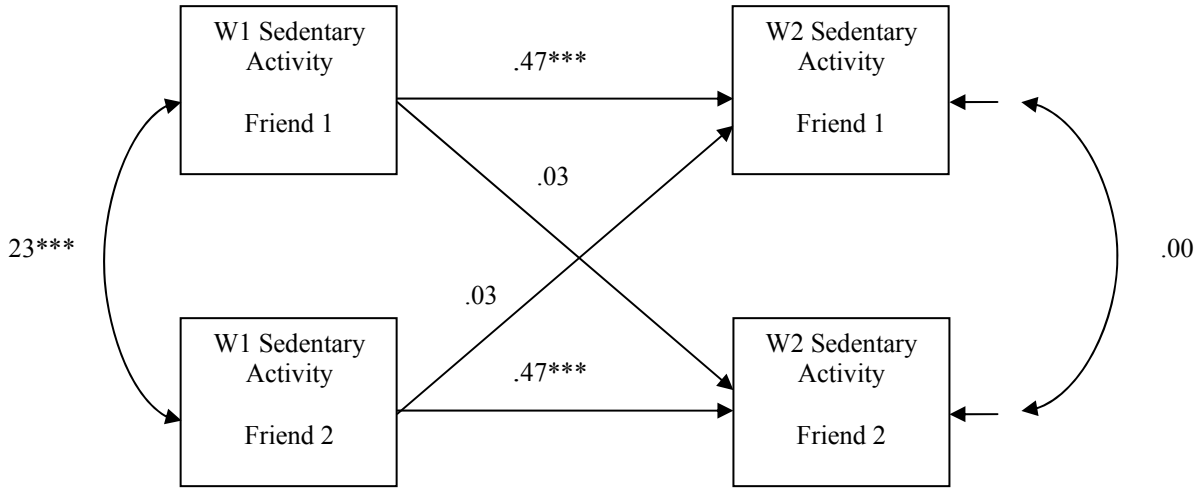

Figure 5. Longitudinal relations between reciprocal friends' self-reported sedentary activity. $^{***}p < .001$.

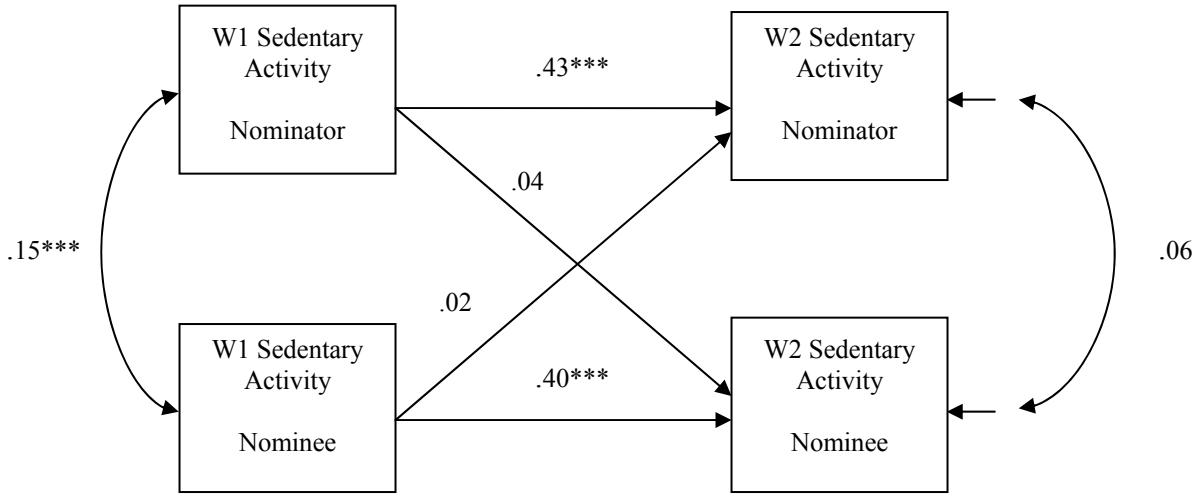

Figure 6. Longitudinal relations between nonreciprocal friends' self-reported sedentary activity. $^{***}p < .001$.

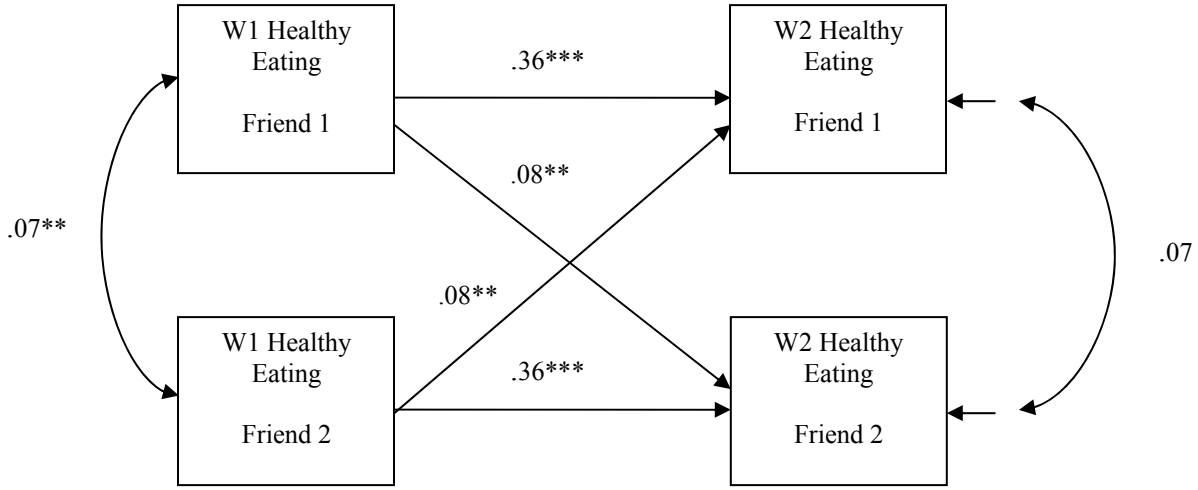

Figure 7. Longitudinal relations between reciprocal friends' self-reported healthy eating. $^{**}p < .01$; $^{***}p < .001$.

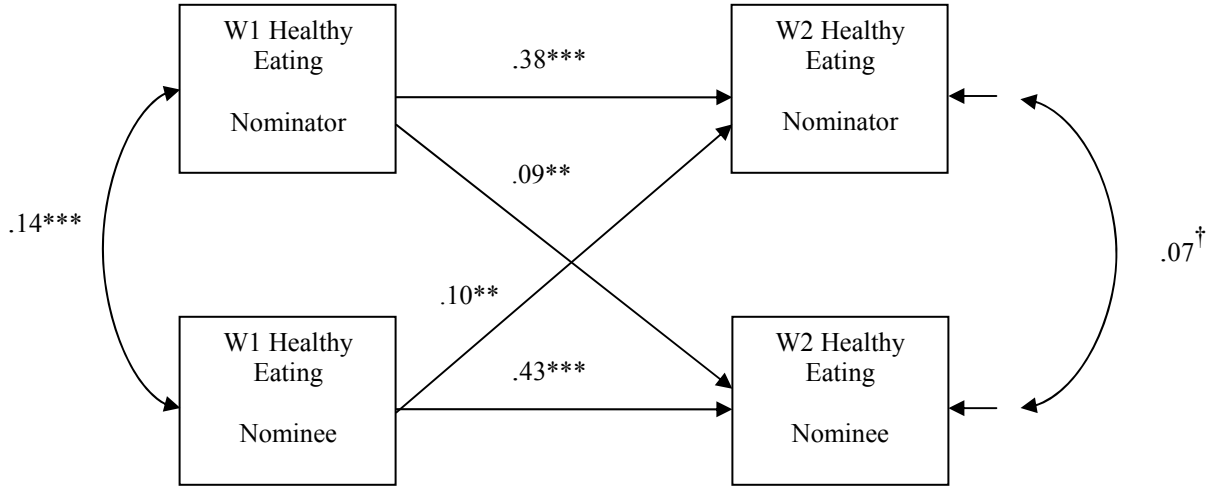

Figure 8. Longitudinal relations between nonreciprocal friends' self-reported healthy eating. $^{\dagger}p < .10$; $^{**}p < .01$; $^{***}p < .001$.

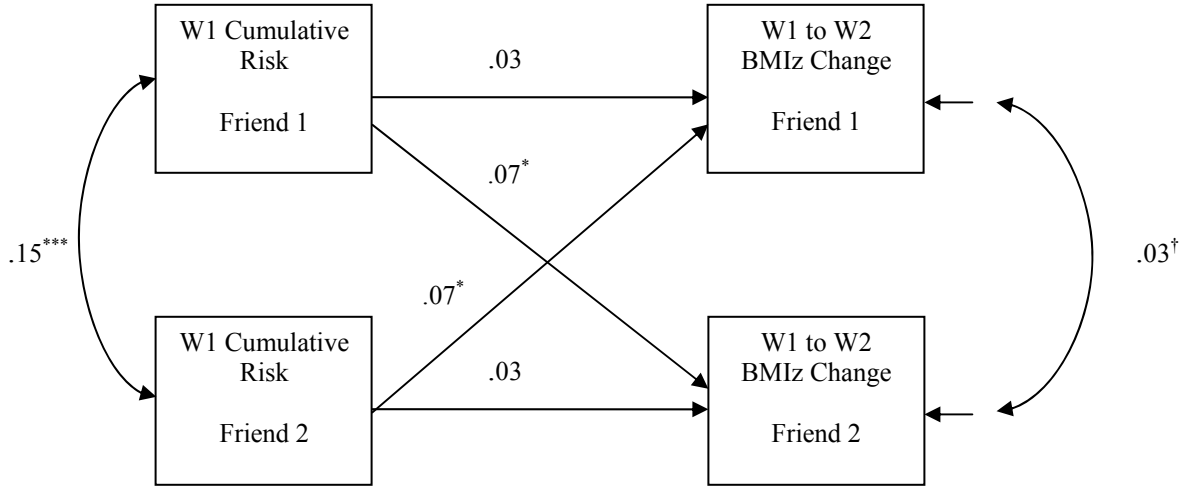

Figure 9. Link between cumulative risk of obesity-promoting behaviors and Body Mass Index change from Wave 1 to Wave 2 among reciprocal friend pairs. $^{\dagger}p < .10$; $^{*}p < .05$; $^{***}p < .001$.

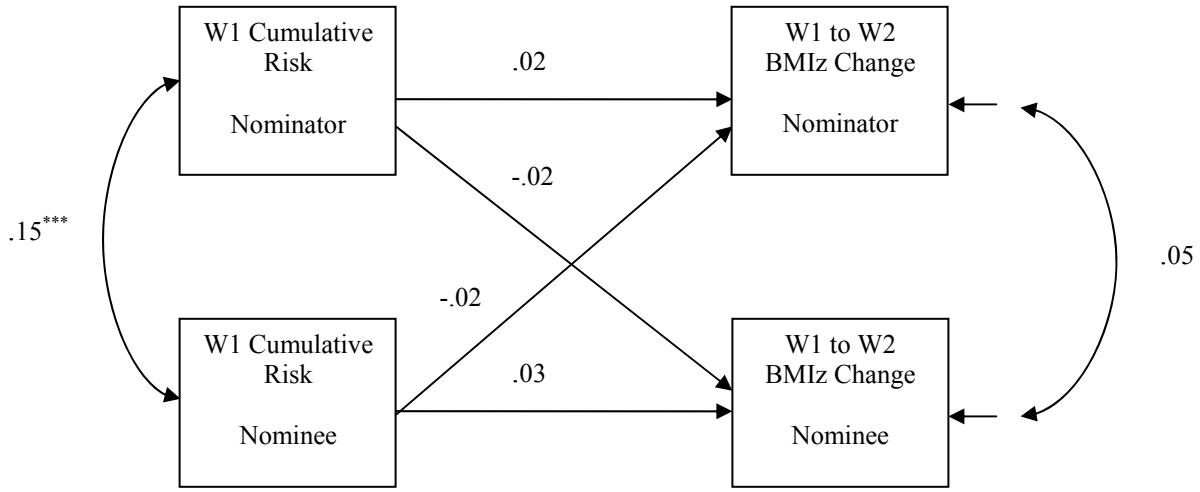

Figure 10. Link between cumulative risk of obesity-promoting behaviors and Body Mass Index change from Wave 1 to Wave 2 among nonreciprocal friend pairs. $^{***}p < .001$.

APPENDIX

CATEGORIZATION OF RECIPROCAL AND NONRECIPROCAL FRIENDSHIPS AS STABLE OR UNSTABLE

Friendship Type	Wave 1		Wave 2		Coding	Description/Rationale for Coding
	Friend 1	Friend 2	Friend 1	Friend 2		
1. Reciprocal	X	X	X	X	Stable	Coded as Stable because adolescents mutually nominated one another as friends at both Waves 1 and 2. Socialization over time is likely in this dyad because both adolescents are presumed to perceive one another as a significant social referent over time.
2. Reciprocal	X	X	●	●	Unstable	Coded as Unstable because adolescents mutually nominated one another as friends only at Wave 1. Socialization over time is less likely in this dyad because friendship dissolution implies that neither adolescent continues to perceive the other as a significant social referent.
3. Reciprocal	X	X	X	●	Unstable	Coded as Unstable because adolescents mutually nominate one another as friends at Wave 1, but only one of the two adolescents nominates the other as a friend at Wave 2. The change from a reciprocal friend dyad to nonreciprocal friend dyad suggests that adolescents have a weakened relationship that is less likely than an enduring reciprocal relationship to play a role in shaping behavior. This switch to nonreciprocal indicates that for at least one dyad member, the friendship has dissolved or lost significance, possibly due to growing differences over time between the two peers; it is reasonable to contend that over time the two peers in this dyad spend less time together and in turn have less opportunities for socialization.
	X	X	●	X		
4.Nonreciprocal	X	●	X	●	Stable	Coded as Stable because the same pattern of nonreciprocal nominations is seen at both Waves 1 and 2. Socialization is likely for the adolescent that nominated his/her peer as a friend because the nominated peer likely continues to be perceived as a significant social referent over time.
	●	X	●	X		
5.Nonreciprocal	X	●	X	X	Stable	Coded as Stable because not only does an adolescent's friend nomination persist over time, but this nomination also become reciprocated at Wave 2. Reciprocal friendships that later become reciprocal friendships have been shown to have similar levels of socialization as enduring reciprocal friendships. These friendships endure over time for the peer that initially nominated his/her peer as friend and thus could be considered as a stable source of socialization.
	●	X	X	X		
6.Nonreciprocal	X	●	●	●	Unstable	Coded as Unstable because the nonreciprocal friend nomination at Wave 1 does not persist through to Wave 2, Socialization over time is less likely in this dyad because the peer nominated as a friend at Wave 1 is less likely to be perceived as a significant social referent at Wave 2.
	●	X	●	●		
7.Nonreciprocal	X	●	●	X	Unstable	Coded as Unstable because the same reciprocal friend nomination at Wave 1 does not persist through to Wave 2. The friendship remains nonreciprocal, but the roles switch (the adolescent nominated as friend at Wave 1 becomes the nominator at Wave 2).This unilateral friendship can be considered as unstable because the peer that initially nominated his/her peer as a friend did not nominate the peer again and in turn likely did not continue to perceive the peer as a significant social model.
	●	X	X	●		

Note. X = The adolescent has been nominated as a friend. – = The adolescent was not nominated as a friend.