RELATION BETWEEN BODY WEIGHT AND SOCIAL POSITION IN CHILDREN'S CLASSROOM FRIENDSHIP NETWORK

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CHAPTER I

INTRODUCTION

Obesity is a growing problem for many Americans (Center for Disease Control and Prevention, 2006). Since 1980 the national percentage of obese children ages 2-5 has doubled, from 5% to 12. 4%; obesity has also doubled for children ages 6-11, from 6.5% to 17%; lastly, obesity has tripled for adolescents ages 12-19, from 5%-17.6% (Center for Disease Control and Prevention, 2009). Approximately 31.9% of 2-19 year olds are estimated to be overweight, or greater than the 85th percentile (Center for Disease Control and Prevention, 2009). The obesity problem is not only limited to America but is present in many other countries as well. Canada, Great Britain, and China are a few of the other countries that have also shown an increase in obesity (Johnston, 2004; Ogden, 2006). In 2000, the Surgeon General estimated that obesity cost the United States 117 billion dollars in direct and indirect costs. Overweight children are at higher risk for physical health concerns as well as mental health concerns (Braet et al., 1997; Fenning & Fenning, 2006; Flegal, Graubard, Williamson, & Gail, 2005; U.S. Department of Health and Human Services, as cited in Baskin, Ard, Franklin, & Allison, 2005; Vila et al., 2004; Zeller, Saelens, Roehrig, Krik, & Daniels, 2004). Despite the epidemic of obesity, the literature relating to childhood obesity is limited.

Socially, obesity is a concern because of the negative stigma associated with being obese, which negatively affects peers' attitudes and ratings of likability (Jarvie, Lahey, Graziano, & Framer, 1983; Sigelman, 1991). The negative stigma toward overweight people can be found in children as young as three years of age (Bell & Morgan, 2000; Reilly et al., 2003). The negative likability ratings directed toward obese children are similar to the negative likability ratings associated with children who are physically handicapped (Sigelman, Miller, & Whiteworth, 1986) or physically ill (Klacyznski, 2007). Being liked by peers is important, as peer relationships are considered to be critical for children's healthy development (La Greca & Bearman, 2000; Ladd, 1990). Because obesity is negatively correlated with likability ratings, overweight children may receive fewer friendship responses from their classmates, limiting the overweight child's social position in the classroom friendship network.

The number of relationships a person has in comparison to the number of possible relationships within a given network provides one of the most basic definitions of centrality (Scott, 2000; Wasserman & Faust, 1994). Centrality, or social inclusion is important to children; with children as young as five to six years old reporting that social acceptance is one of the most important issues they face (Ladd, 1990). Positive social interaction among children is correlated with higher self-esteem and self-concept ratings (Ladd, 1990; McGee, Williams, Howden-Chapman, Martin, & Kwachi, 2006). The amount of positive interaction with peers may be limited for obese children, since obesity is a negative stigmatizing condition and may negatively affect other children's preferences for playing with an overweight child (Bell et al., 2000).

The lack of preference for overweight children can be observed by the increased teasing overweight children receive compared to normal weight children (Hayden-Wade, Stein, Shaderi, Saelens, & Zabinski, 2005). The teasing that overweight children face is often personal and directly related to their physical appearance (Hayden-Wade et al., 2005). This lack of preference from peers and increased teasing may limit overweight children's desire to participate in school activities, which have been shown to increase children's self-esteem, self-concept, and social acceptance (Mahoney, Lord, & Carryl, 2005; McGee et al., 2006). Since obesity is highly visible, stigmatizing, and can be accompanied by physical complications and limitations, it may be expected that obesity may interfere with the development of peer relationships within their friendship network.

An individual's social position in most informal networks (friendship network, advice network, etc.) is greatly influenced by an individual's perceived level of social power. Equity theory would suggest that the relationship be "fair" for each person in the relationship. Being high-status or low-status greatly influences an individual's level of social inclusion and their position within a social network (Barley, 1990; Ibarra, 1992). The negative stigma associated with overweight individuals may limit the perceived "fairness" of any friendship they are part of, causing the overweight child to be less desirable to peers (e.g., the normal weight child may think that bring friends with an overweight child detracts from their own social standing, thus they would not be friends with the overweight child as they do not perceive each party bringing something equal to the friendship). The relationship formed in a network between an individual and their peers is important, as the relationships help establish a sense of belongingness (La Greca et al., 2000).

Researchers use the friendship network in the behavioral sciences to explain many developmental concepts: changes in friendships (Chan & Poulin, 2007), differences in friendship structure for unpopular and popular children (George & Hartmann, 1996), relation between social capital and extracurricular participation (Glanville, Sikkink, & Hernandez, 2008), similarities in friends (Haselager, Lieshout, & Walraven, 1998), and developmental changes in gender composition of friendship networks in adolescence (Poulin & Pedersen, 2007). The friendship network is a valuable network that offers insight into children's friendships.

The contribution of the current research is that it examined the social positioning, known as centrality, of overweight and obese children within their classroom environment. The goal of the proposed research was to understand overweight children's social positioning in their classroom friendship network. Specifically, it was expected that overweight children would not hold central positions within their classroom friendship network. Lacking in centrality may suggest that overweight children do not have access to the same amount and quality of information that is shared by normal weight peers. Lacking information may be negatively related to the child's social development. Future research may benefit from this study by better understanding overweight children's social position in friendship networks, specifically friendship networks in the classroom environment where children spend much of their time. These findings may help develop more precise interventions that also positively influence overweight and obese children's position within their classroom friendship network.

CHAPTER II

LITERATURE REVIEW

The following literature review will cover issues that obese or overweight children face. In addition, the peer interaction literature, with a focus on issues related to overweight children, will then be reviewed. It will end with an overview of the current study, including a brief exposition of the methodology being employed.

Obesity

Physical and Mental Health Issues

Overweight and obesity describe varying levels of excess body fat. An individual's Body Mass Index (BMI) is used to determine a child's overweight or obesity status. BMI is the most often used method to determine a person's body fat by the ratio between an individual's height and weight. The Center for Disease Control has specific definitions for overweight and obese for adults and children. Despite the similarity in calculating BMI for children and adults, it is interpreted differently for children than adults. Instead of using a particular BMI cut-point, as is done with adults, children's weight status groups are defined as what percentile of the CDC growth chart they fall on. For children, BMI is adjusted for sex and for age and a percentile is then calculated. The

weight groups for children are underweight (BMI-for-age-and-gender < 5^{th} percentile), healthy weight (5^{th} percentile to less than the 85^{th} percentile), overweight (85^{th} to less than the 95^{th} percentile), and obese (BMI-for-age ≥ 95^{th} percentile; Center for Disease Control and Prevention, 2006).

Overweight is a condition that increases the risk of many chronic diseases and mobility impairments (Sturm, 2002). Overweight children are more likely than healthy weight children to have hyperlipidemia (Caprio et al., 1996), glucose intolerance and diabetes (Chan, Rimm, Colditz, Stampfer, & Willett, 1994), hepatic steatosis (Kinugasa, 1984), and cholelithiasis (Crichlow, Seltzer, & Jannetta, 1972). Rare medical conditions related to childhood/adolescent obesity include hypertension (Rames et al., 1978), pseudotumor cerebri (Weisberg & Chutorian, 1977), sleep apnea (Mallory, Fiser, & Jackson, 1989), Blount disease (Dietz, Gross, & Kirkpatrick, 1982), and polycystic ovary disease (Polson, Wadsworth, Adams, & Franks, 1972).

Despite the large amount of research over medical conditions related to obesity, little research has been conducted on musculoskeletal conditions related to pediatric obesity (Taylor et al., 2006). Slipped capital femoral epiphysis and Blount's disease are unique orthopedic disorders related to childhood obesity (Dietz et al., 1982; Loder, Aronson, & Greenfield, 1993). Specifically, overweight children report pain in their back, hip, leg, knee, ankle, or foot more often than healthy weight children (Taylor et al., 2006). The impact of orthopedic musculoskeletal conditions unique to children who are overweight or obese may negatively affect the social development and physical activity of overweight children by minimizing their mobility.

Most physical activities provided by educational systems require that an individual be mobile. Participating in school activities are important to the development of social skills and coping techniques (Hayden-Wade et al., 2005; Mahoney et al., 2005; McGee et al., 2006), as well as improved self-concept, self-esteem, and peer acceptance (Mahoney et al., 2005; McGee et al., 2006). However, Taylor et al. (2006) found that overweight children ranging between 8-14 years of age tend to have physical complications that limit mobility compared to healthy weight children. Specifically, overweight children tend to report more musculoskeletal pain and have more documented fractures compared to healthy weight children. Also, overweight children are more likely to have abnormal lower extremity alignment compared to healthy weight children (Taylor et al., 2006). Overweight children self-report greater musculoskeletal complaints at all anatomic locations; the most common complaint was knee pain, with 21.4% of overweight children self-reporting pain in the knee (Taylor, 2006). With an increase in musculoskeletal pain, risk for fracture, and abnormal alignment in this hips and legs, it could be hypothesized that overweight children's mobility and tolerance for physical activity is hindered when compared to healthy weight children. Overweight not only appears to be related to medical conditions but also psychosocial problems.

Villa et al. (2004) reported nearly 57% of the overweight children and adolescents (ages 5-17) met criteria for some type of mental disorder. Mustillo et al. (2003) also found that overweight adolescents who were overweight as children were more likely to have greater levels of oppositional defiance compared to other overweight and normal weight adolescents that were not overweight as children. More recently, it was found that increased weight is negatively related to self-esteem and positively related to self-

reported interpersonal problems with peers (Champ-Morera, 2009). The decreased ability to be mobile and the increased risk of mental health problems may both be related to the social challenges overweight children appear to face. The following section will review social problems related to overweight.

Social Issues

Negative perception toward less desirable physical traits is not a new idea. For example, Plato related beauty to the "The privilege of nature" (Montaigne & Frame, 1943). This philosophy was later expanded with the what-is-beautiful-is-good theory (Dion, Berscheid, & Walster; 1972). Specifically, Dion et al. (1972) suggested that attractive people were presumed to have positive traits (e.g., honest, loyal, kind). One group that seems to be associated with many negative traits is overweight individuals. Weight based stigmatization has been defined as "negative weight related attitudes and beliefs that are manifested through stereotypes, bias, rejection, and prejudice towards children and adolescents because they are overweight or obese" (Puhl, & Latner, 2007, p. 558). The distinction between stigmatization and stereotypes in scholarly research could best be described as "blurred" (Klaczynski, 2007). However, Klacynski (2007) suggests that the development of stigmatization for overweight children is similar to the stigmatization of children who have an illness. The stigmatization is considered "contagious" like other illnesses and may act as the antecedent to the development of stereotypes later and serve as reasons to attribute other negative attributes to the overweight child (Klacyznski, 2007). Klaczynski (2007) suggests the stigmatization may be related to the development of strong internal stereotypes associated with obese individuals.

Overweight and obese adults are often negatively labeled as undesirable, lazy, lacking in self-discipline, and as unattractive by adults (Allon, 1976; Smith, Schmoll, Konik, & Oberlander, 2007; Wells & Siegel, 1961) and overweight and obese children are negatively labeled as lazy, ugly, unintelligent, or mean by other children (Bell & Morgan, 2000; Cramer & Steinwert, 1998; Davison & Birch, 2004; Latner & Stunkard, 2003; Penny & Haddok, 2007; Puhl & Latner, 2007; Weil, 1977). The negative stereotypes related to overweight have become more negative over the last 50 years (Davison & Birch, 2004; Latner & Stunkard, 2003) and are related to increased harassment, slurs, negative judgments and assumptions, perceived discrimination, and teasing (Cossrow, Jeffery, & McGuire, 2001).

Negative stigmatization of overweight and obese children is related to how people socially categorize those who are overweight or obese. Specifically, adults rank hypothetical adults who are more overweight or obese as lower in social status than normal weight persons (Kraig & Keel, 2001). The findings that hypothetical overweight people are ranked lower socially was extended to children with the same results (Richardson, Goodman, Hastorf, & Dornbush, 1961). Richardson and colleagues' 1961 study was repeated in 2003, and it was found that negative social ranking by peers for overweight children is worse today than it was 40 years ago (Latner & Stunkard, 2003).

The negative stigma against overweight children is observable in the schools. In school, research has indicated that overweight and obese children are more likely to be discriminated against by their peers, teachers, and parents (Puhl & Latner, 2007; Shaya, Flores, Gbarayor, & Wang, 2008). Overweight children are more likely to perform poorly in school (Datar & Sturm, 2006), have low self-esteem, poor self-image, suffer from peer

rejection (Shaya et al., 2008), and for adolescents, increased suicidal behaviors (Puhl & Latner, 2007).

In conclusion, overweight and obese children face a host of negative physical and mental health issues. Specifically, not only are children at-risk for future long-term health issues, but they also have increased rates of disease in childhood. The increased levels of physical disease affect children's mobility and participation in activities with peers as well as their own self-perceptions. In addition to the negative physical health issues faced by overweight and obese children, they are also subject to negative weight-related teasing and stereotyping. A greater understanding of the effects of negative stereotypes toward overweight people, especially children, may help us better understand social interactions within the classroom environment for overweight children. For example, the negative stereotypes may facilitate a self-fulfilling prophecy that the obese child is "no good" or undesirable in some other way (Snyder, 2000; Snyder, 2003), furthering psychological and psychosocial problems for overweight children. The next section of the literature review will focus on children's friendships in general and then what is known about overweight children's friendships specifically.

Friendship

When discussing friendship networks it is important that they not be confused with the term popularity. Friendships and popularity are interrelated but provide distinct information (Aboud & Mendelson, 1998). Popularity is defined as the group-oriented view toward an individual (Bukowski & Hoza, 1989). It is the group view that makes someone popular, or receiving a density of unreciprocated ties. However, friendships

focus on an individual's subjectively defined, voluntary, and reciprocal relationships between two individuals (George & Hartmann, 1996). Friendships do not take into account the group, but are dyadic and consist of reciprocated relationships.

Relationships as Investments

Relationships often consist of complex investments between two individuals. Relational investments can vary by the type of capital: social, human, and financial (Burt, 1992; Wasserman & Faust, 1994). An individual tends to have ownership with human or self capital (e.g., their education) and financial capital (e.g., money in hand). However, social capital (e.g., access to information) is not owned by any one individual but is shared between individuals (Wasserman & Faust, 1994). Both individuals in a dyadic relationship could lose social capital if the relationship is terminated, unlike the other two forms of capital (Wasserman & Faust, 1994). The use of capital in relationships provides the foundation for social exchange theory (Homans, 1958; 1961), equity theory (Adams, 1963), and social capital theory (Burt, 1992; 2000), three important theories in the development and maintenance of relationships.

Friendship Selection

Homophily is an important aspect in the development of a friendship network for both adults and children. Homophily is defined as the interaction between individuals who are similar on physical attributes such as sex and race, as well as traits like education and socioeconomic status (Rogers & Kincaid, 1981). The attraction to similar others does not presume peer influence, but suggests that people are attracted to others who are similar, or "birds of a feather flock together" (Prinstein & Dodge, 2008). Broadly

speaking, social homogeneity tends to help encourage predictable relationships of trust and reciprocity, as well as making communication between individuals easier (Lincoln & Miller, 1979).

Although often viewed as positive, the pursuit for similar others may have negative outcomes. For example, placing deviant youth with other deviant youth is one of the most common public policy interventions (Dodge, Lansford, & Dishion, 2006). Yet, harmful effects have been found by deviant youth creating friendships with other deviant youth in mental health (Dodge & Sherrill, 2006), education (Prinstein & Dodge, 2008), and even in after-school settings (Dodge, Lansford, & Dishion, 2006; Prinstein & Dodge, 2008). The negative outcomes are partially thought to stem from the idea that the deviant youth share information on how to be more deviant when placed together. If overweight children are found to have mainly ties to other overweight children, this could lead to similar problems and encourage behaviors associated with obesity.

Interpersonal attraction of similar others suggests that overweight children may be more likely to establish relationships with other overweight children, or other children low in social status. As outlined above, networking of similar others is a concern for overweight children. Specifically, overweight children may selectively create their own environment that promotes behaviors that contribute to obesity (e.g., low activity levels, emotional eating). Sedentary playtime and poor eating behaviors are also related to being overweight (Hayden-Wade et al., 2005; Johnston, 2004). If the friendships overweight and obese children make are with similar others, poor eating behaviors may further develop, and the use of sedentary playtime might further be encouraged and worsen the child's weight status.

Social Rejection

People tend to have a strong desire to gain acceptance into social groups (Baumeister & Leary, 1995; Deci & Ryan, 2000). Ties between individuals establish relationships in which people organize their behaviors in an effort to maintain the relational tie (Steger & Kashdan, 2009). Behaviors displayed by an individual within a group that are not perceived as normal may cause the potential relationship with that individual to be perceived as undesired.

Perceptions of behavioral atypicality by peers influence the group members' decision to accept or reject another child (DeRosier & Mercer, 2009). Sherman and Burgess (1985) suggest that developmentally handicapped children are not necessarily socially rejected by their handicap, rather they suggest the misbehaviors displayed by the developmentally handicap children in the classroom are the main influence for the social rejection and social distance to peers in the classroom. Atypical behavior ratings are not only related to social rejection by group members (Sherman, 1985), but also are related to increased peer victimization (DeRosier & Mercer, 2009). Specifically, children who display behavior that is perceived by their peers to be atypical have an increased risk for being a target for bullying (Frisen, Jonsson, & Persson, 2007). Physical differences, like behavioral differences, also are considered to be very stigmatizing.

A large amount of research suggests negative affective, cognitive, and behavioral characteristics are related to social rejection (Brendgen, Wanner, Morin, & Vitaro, 2005; Dodge et al., 1986; Kistner & White, 1992; Ladd, 2006; Parker, & Asher, 1987; Robins, 1992). Traits such as physical attractiveness, cognitive ability, sociability, aggression,

and withdrawal are predictors of social rejection by peers (Furman & Buhrmester, 1985; Newcomb, Bukowski, & Pattee, 1993). Children who are perceived to be high in social status tend to be attractive, high in cognitive ability and sociability, low in aggression, and not withdrawn from the group (Newcomb et al., 1993). Children who are high status tend to associate with more high status children compared to low status children. Negative behaviors such as aggression are a concern for overweight children, as they are thought to have a greater risk for displaying aggressive behaviors (Bin, et al., 2005; Braet et al., 1997; Zeller et al., 2004). Additionally, in a study of first grade children it was found that teachers were more likely to rate overweight children as a bully compared to normal weight children, even when no differences in aggression ratings were found (Anderson, 2007).

Negative outcomes of social rejection. Social rejection has been shown to increase the risk of future psychological problems (George & Hartman, 1996; Ladd, 2006; Parker & Asher, 1987) and early school dropout (Coie, Dodge, & Kupersmidt, 1990). Also, socially rejected kids tend to be victimized by others, especially bullies (Frisen et al., 2007; Slee, 1993). The negative outcomes associated with social rejection can cause observable difficulties through the lifespan.

One particular area that may be of concern for children who are socially rejected is their coping abilities with increased teasing and rejection from peers. Rejected children may begin with poor coping techniques and through homophily they may suffer from a lack of role models for positive social interactions. The lack of positive social interactions may also increase the development of negative coping skills (Hayden-Wade et al., 2005); the negative coping skills are cyclical and may then further the social

rejection experienced. Positive conflict resolution skills are required when dealing with the teasing that overweight children often face (Hodges & Perry, 1999). If aggression should become a child's coping technique, then children who find themselves being socially rejected because of the way they look may begin to further influence their social rejection due to their aggressive coping techniques (Ladd, 2006).

Social rejection and obesity. Social rejection appears to be a major concern for overweight children, as children interact together a great deal during school. Social rejection is a concern for overweight first graders, as they appear to be at greater risk of being rejected by peers, due to body stigmatization and stereotyping (Goldfield & Chrisler, 1995) and are more likely to be nominated for rejection and isolation by peers during after school activities (Mahoney et al., 2005). Children who are repeatedly rejected by peers are more likely to act out aggressively to non-hostile interactions with peers (Dodge et al., 2003). Also, rejected children are likely to report feelings of loneliness, depression, and report greater social anxiety (Ashwer & Wheeler, 1985; Boivin et al., 1994).

Although there is limited research looking at peer relations of very young overweight or obese children (first grade or less), the literature on overweight and obese children slightly older suggests many concerns (Theodore, Bray, & Kehle, 2009). Children who are overweight are at risk for peer victimization (Fox & Farrow, 2009; Grey, Kahhan, & Janicke, 2009), discrimination by teachers (Puhl & Latner, 2007), stigmatization (Goldfield & Chrisler, 1995; Holub, 2008; Puhl & Latner, 2007), and social rejection (Mahoney et al., 2005; Shaya et al., 2008). For example, obese youth label other obese youth as being less physically attractive, less athletic, more sick, more

tired, and absent from school more often (Zeller, Reiter-Purtill, & Ramey, 2007). Peers rate obese youth as having more aggressive-disruptive behavior (Zeller et al., 2007) and teachers of first grade children are more likely to rate overweight and obese children as bullies (Anderson, 2007). Teachers, parents, and peers all report obese youth as being socially withdrawn (Zeller et al., 2007). Based on research done with children throughout elementary school and into early adolescence, it may be expected that overweight and obese first graders would be rejected at a high rate, are often the victims of bullies, and do not interact much with other children. It is noted that the above research is with children older than the age group of the current study and may not hold, however there does seem to be consistency of findings across these older age groups, thus giving confidence that these findings may also apply in younger age groups.

The current study provided further insight into the developmental obstacles overweight children may be facing in their classroom. Specifically, this study explored the relationships of overweight and obese children and their social positioning within their classroom friendships. Understanding the relationships overweight and obese children experience in the classroom may improve our understanding of overweight and obese children's psychological well-being at school. Interventions may also be developed to improve or address overweight and obese children's social relationships in the classroom.

Summary

Obesity is a growing problem for many children from ages 2 – 19 years of age (Center for Disease Control and Prevention, 2009). Previous research indicates that

children negatively stigmatize overweight children (Bell & Morgan, 2000; Cramer & Steinwert, 1998; Davison & Birch, 2004; Latner & Stunkard, 2003; Penny & Haddok, 2007; Weil, 1977) and the stigma continues through childhood (Goldfield & Chrisler, 1995). The negative stigma of overweight is observed by the greater teasing and peer rejection that overweight and obese children face, compared to normal weight children (Bell & Morgan, 2006; Coie et al., 1990; Ladd, 2006; Hayden-Wade et al., 2005). Additionally, overweight children are not preferred as playmates compared to normal weight children, or even children with other handicaps (Bell & Morgan, 2000; Harper, Wacker, & Seaborg-Cobb, 1986; Richardson, Goodman, Hastorf, & Dornbush, 1961). Acceptance from peers is important in helping children develop a sense of belongingness (La Greca & Bearman, 2000). Social rejection has many negative outcomes for children, such as victimization (DeRosier & Mercer, 2009), bullying (Frisen & Persson, 2007), early school dropout (Coie et al., 1990), psychological problems (George & Hartman, 1996; Ladd, 2006; Parker & Asher, 1987; Villa et al., 2004), and interpersonal problems (Champ-Morera, 2009), and it appears that many of the outcomes are cyclical, which may possibly strengthen negative behavior and future negative outcomes experienced by children as they grow into adulthood. The peer relations literature suggests that overweight children will not be sought out as friends by their peers, compared to other visual handicaps (Mahoney et al., 2005). The prior literature supports the hypothesis that overweight children have a greater chance of being isolated from peers in their classroom. One potential method for looking at children's friendship networks, social network analysis, is briefly outlined below.

Social Network Analysis

Networks are comprised of individuals who are connected to one another by some type of shared relationship (Scott, 2000). The interconnectedness of individuals allows researchers to graphically map each of the identified social relationships. Mapping of relationships is important and allows us to visually and numerically understand an individual's social position (Wasserman & Faust, 1994). Social network analysis (SNA) allows researchers to map and analyze an individual's social position in a network. The following section will examine a few of the important concepts found in SNA literature that focus on social positioning in a network.

Centrality

The number of relationships an actor has in comparison to the number of possible relationships within a given network provides one of the most basic definitions of centrality (Scott, 2000; Wasserman & Faust, 1994). This difference between actual relationships from possible relationships suggests that centrality is related to the idea of prominence (Wasserman & Faust, 1994). Much of the traditional influence in the development of centrality was due to the use of graph theory in social network analysis (SNA). Since the founding of graph theory many advances in mathematical concepts have been developed, which have in turn resulted in new terminology that is currently used to describe specific types of social position: degree, closeness, betweenness, information, differential status, and rank (Scott, 2000; Wasserman & Faust, 1994). Degree centrality and Global centrality will now be reviewed in more detail.

Degree centrality. Degree centrality is the most simplistic form of centrality, sometimes referred to as degree centrality. Moreno's development of the sociogram in the1930s supported the use of degree centrality in understanding actors' positions in a

network. An actor's position in the network is determined by the number, or density, of relationships they directly have with other actors. To better understand degree centrality, graph theory will be discussed in this section.

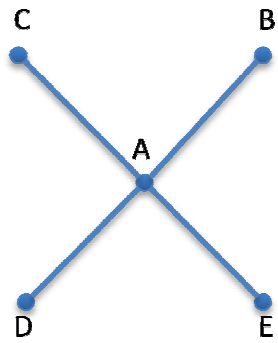
Graph theory is widely used in many disciplines and research methodologies (Wasserman & Faust, 1994). Graph theory gives researchers the ability to support theorems and spatially visualize social structures and should continue to be used in modern research (Scott, 2000; Wasserman & Faust, 1994). Also, graph theory can be useful for researchers to identify patterns of relationships that may otherwise go undetected (Scott, 2000). Most notably, graph theory influenced the development of the sociogram, which was revolutionary for the time. The star diagram presented by Moreno suggests the basic idea of degree centrality, which is sometimes referred to as local centrality (Scott, 2000). Figure 1 uses the star diagram to visually illustrate that actor A is the most central actor because actor A has more (dense) relationships than any other actor in the network.

A network must be comprised of a finite number of actors. For example, the star diagram in Figure 1 has a total of 5 actors, or $g = 5$. The total possible number of actors that any one actor may indicate a relationship with is $g - 1 = 4$. The star diagram illustrates that actor A has 4 of the possible 4 relationships while the remaining actors have only 1 of the possible 4 relationships. The "prominence" or "degree" of relationships that actor A has obtained visually illustrates actor A as the most central individual in this specific network. Degree centrality can also be quantified by taking the number of relationships obtained by an actor divided by g - 1; for actor A the degree centrality would equal 1 (see Table 2). Since the degree is dependent on *g*, degree

centrality cannot be generalized across networks that have a different *g* value. However, in some cases g can be removed from the equation by taking the actor-level degree centrality index, notated as $C_D(n_i)$, to be equal to the degree of the node, $d(n_i)$, divided by g – 1 (Wasserman & Faust, 1994).

$$C_D(n_i) = d(n_i) / (g - 1)$$

Figure 1. Moreno's star diagram



Matrices are vital in calculating centrality and contain the same information as the visual graphs. Matrices allow relationships to be quantified and can easily be computed with matrix software (e.g., UCI NET, MAGE, GRADAP, STRUCTURE). The matrix in Table 1 illustrates the same set of relationships as the star diagram in Fig 1. Also, Table 1 consists only of reciprocal relationships causing a mirror image along the matrix diagonal, also know as an undirected matrix. The ability to quantify an actor's position in a network is important to understand the types of degree an individual has, such as in-degree (e.g. the number of others who identify a relationship with an individual), out-degree (e.g. the number of relationships an individual identifies with others in the network), or strength of relationship. In matrices, an actor's row indicates the out-degree while the column represents the in-degree. Table 1 consists of only dichotomous values,

1 (related) and 0 (unrelated). However, the magnitude does not have to be dichotomous values and could be notated as 0 (unrelated), 1 (weak relation), or 2 (strong relation), which indicate the strength of the relationship. Summing the in-degree column will equal the absolute degree centrality and the standardized formula will equal our relative degree centrality (Scott, 2000; Wasserman & Faust, 1994), see Table 2.

Table 1.

Case-by-Case Matrix for Friendship

Actor	A	B	C	D	E
A	n/a	1	1	1	1
B	1	n/a	0	0	0
C	1	0	n/a	0	0
D	1	0	0	n/a	0
E	1	0	0	0	n/a

Note: The number 1 indicates a relationship and the number zero indicates no relationship. This matrix illustrates the exact same relationships as the star diagram in Figure 1.

Table 2.

Centrality Scores

		A	B	C	D	E
Degree Centrality	Absolute	4	1	1	1	1
	Relative	1.0	.25	.25	.25	.25

Global Centrality. As the networks grow larger so does the complexity in identifying central individuals. Strategic positioning in a network can be just as important as the density of relationships, know as global centralization (Scott, 2000). The previous idea of degree centrality suggested that a high density of relationships in the network equals greater centrality, and that a low density of relationships equals less centrality. However, Scott (2000) presents a diagram that illustrates the importance of global centralization and how an actor's position, and not their density, in the network can also positively influence their centrality (see Figure 2). Global centrality is mainly influenced by the distance between one actor to all other actors in the network.

Global centralization is not limited by the density of relationships but by the distance between every relationship within the network. In Figure 2 points A, B, and C are the most degree central (based off the density of relationships) actors within the network. However, point B is the most globally central actor within the network. Actor B is identified as being the most globally central because the summed distance to all the other actors in the network is the lowest, see Table 3. It is important to point out that

actors G and M are the second most globally central, despite the fact they also have fewer direct connections to other individuals in the network. It is the strategic position of actors G and M that positively influence their global centralization. For these actors the fewer number of direct ties are positively compensated for by their location within the network and act as a bridge that connects each of the three clusters surrounding actors A, B, and C.

Figure 2. *Global Centrality*

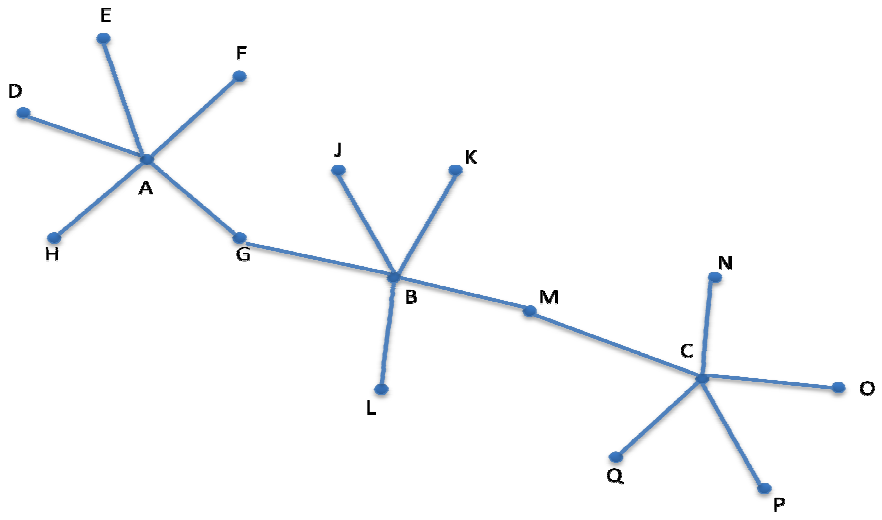


Table 3.

Diagram from Scott (2000), p. 84, illustrating global centrality compared to degree centrality

		A, C	B	G, M	J, K, L	All Others
Degree Centrality	Absolute	5	5	2	1	1
	Relative	.33	.33	.13	.07	.07
Global Centrality		43	33	37	48	57

The size of the network greatly affects how you may be able to compare central positions between networks. Figure 1 shows a network that consists of five actors. Actor A is the most central by obtaining more relationships than any other actor, a total of 4/4 = 1 possible relationships in the network. However, this actor's centrality does not equal another actor's centrality from a larger network who has the same number of relationships but exist in network with 21 actors, 4/20=.25. Also, the type of network and the ties being measured may also change an actor's centrality.

Summary

The purpose of this study was to assess how weight status (underweight, normal weight, overweight, and obese) and BMI are related to centrality in children's friendship networks. Social Network Analysis was used to analyze the social position (degree and global centrality) for each child in the friendship classroom network. It was expected that

overweight and obese children held less central positions within the classroom friendship network compared to normal weight children. The expected lack of degree and global centrality for the overweight children is a concern because they have less access to information compared to normal weight children, in the same network. Research indicated that overweight children were at greater risk for negative interactions with peers. However, this research is unique as no research to-date looked at overweight children's specific friendships through centrality in their classroom network.

H*ypotheses*

Hypothesis 1: BMI is negatively related to degree centrality; resulting in degree centrality scores to be significantly lower for obese and overweight children, compared to normal weight children.

Hypothesis 2: BMI is negatively related to global centrality; resulting in global centrality scores to be significantly lower for obese and overweight children, compared to normal weight children.

CHAPTER III

METHODOLOGY

Participants

Archival data from the Families and Schools for Health (FiSH) project, Research Grant #2004-05545 from the United States Department of Agriculture at Oklahoma State University was used for the study. Amanda Harrist, Ph.D. was the primary investigator for the FiSH project and has granted permission for the use of this archival data for the present study. The archival data consisted of two cohorts, which had a total of 1202 first grade children who were enrolled in rural schools in Oklahoma. The mean age of the first grade participants was 6.88 (*SD* = .42, range = 6.01-8.25). The sample was primarily Caucasian 71.0%, followed by Native American 18%, Hispanic 3.8%, African American 2.3%, Asian .2%, and multiple ethnic identity 2.0%. The data were collected in 29 rural Oklahoma schools, consisting of 128 first grade classrooms. For both cohorts, the true classroom size from which these data were collected was approximately 20 students. However, the average number of students in each classroom that were actually participating in the study was 9.6 (*SD* = 1.24; range 2 to 20). In other words, approximately 50% of children available in the schools were actually able to participate. Participation rates are not yet available for the second cohort, but the overall average number of children participating per class was 10.99 (*SD* = 3.63; range 6 to 20).

To best replicate the actual friendship network, classrooms were required to have at least 10 students participating in the study. Since the average classroom had 20

students, setting our minimum participation at 10 participating students allowed our networks to consist of 50% or greater participation. Thus, for this study a subset of 46 classrooms consisting of 583 first grade children was used. The mean age of the subset was 6.86 (SD = .43, range = 6.02-8.16). The subset was primarily Caucasion 72.6%, followed by Native American 16%, Hispanic 4.3%, Multiple ethnic identity 2.9%, African American 1.9%, and Asian .4%. The subset of children was similar to the full sample, according to age and ethnicity. Classroom sizes ranged from 10-20 students with the median of 12 students and a mean of 12.67 (*SD* = 2.45). In terms of BMI, the mean BMI percentile was 66.68 (*SD* = 26.91), with the median BMI percentile of 71.50. Specifically, there were 12 underweight children, 370 normal weight children, 98 overweight children, and 103 obese children in the subset. Appendix A lists the FiSH participating schools' demographic information for each school (including participating and nonparticipating children), including number of students enrolled, number enrolled in first grade, percentage of reduced and free lunches, and ethnic breakdown in each school.

Measures

Demographic Information. Demographic forms were given to the children's parents. The form requested information about the child's age, ethnicity, and tribal affiliation if the participant was Native American. The demographic forms were mailed back to the Families and Schools for Health (FiSH) office located at Oklahoma State University by the child's parent.

Body Mass Index. Body Mass Index (BMI) was used to measure how overweight a child is in relation to their peers. For children, the four weight groups (e.g. underweight,

normal weight, overweight, and obese) are defined in terms of the percentile ranking among peers of the same sex and age. The recognized level for underweight is a child less than the 5^{th} percentile, normal weight is from the 5^{th} percentile to less than the 85^{th} percentile, overweight is between the 85^{th} to less than the 95^{th} percentile, and obese is a BMI equal to or greater than the 95^{th} percentile (CDC, 2009). The formula used to determine a child's BMI is also referred to as the BMI-for-age-gender and is the child's weight (kg) / child height^2 (m^2).

$$\text{BMI} = (\text{kg}) / (\text{m}^2)$$

The child's gender, birth date, height, weight, and the date of measurement were entered into the Epi Info program to calculate an accurate BMI percentile (CDC, 2006).

Sociometric Ratings. The child's position in the friendship network was calculated based on sociometric ratings. Sociometric ratings consist of one question about how much a child likes to play with each of the other children in the class, but was limited to those participating in the research study. For example, a class could have 20 children in it, but only 10 had consent to participate in the study, thus during the sociometric interview the target child was only asked how much they liked to play with the other 9 consented children in the class. Digital photos were taken of each consented child. The target child was presented another consented child's photo and then asked how much they liked to play with child "X". For this study, reciprocal friendships were measured by the Sociometric Interview by Coie et al. (1983). This technique is an accepted way to identify friendships in young children (Bierman, 2004). The friendships were measured by each child stating if they "like to a lot", "sometimes I like to

sometimes I don't like to", and "I don't like to" play with the each of the other consented children in the study, asked one at a time.

Centrality. Social Network Analysis (SNA) was used to create centrality scores through a matrix of the children's relational ties, as identified by friendship choices. SNA allowed the social position of each child to be quantified in terms of degree or global centrality. The matrix used in the analysis was a case-by-case friendship matrix, as shown below in Figure 3. In the matrix below, a letter designates a child and a number indicates friendship responses; in terms of the 3 possibilities identified above. For example, child A rated child B as "I like to"; child C as "I don't like to"; child D as "sometimes I like to and sometimes I don't like to"; child E as "I like to, and child F as "I like to". The process of stating whom you like to play with is known as out-degree (rows), while being chosen as a friend by another student is called in-degree (columns).

Figure 3. Case-by-Case Friendship Matrix

Actor	A	B	C	D	E	F
A		2	0	1	2	2
B	2		0	1	2	2
C	0	0		2	1	2
D	1	2	0		1	2
E	2	2	0	2		2
F	2	1	2	2	2	

Note: 0 represents "I do not like", 1 represents "sometimes I like", and 2 represents "I like to a lot" play with.

The program UCI Net was used to construct the friendship matrix. The matrix was then dichotomized to represent only strong relational ties, those who like to play with another child a lot (see Figure 4). The matrix was then made symmetrical to show only reciprocated friendship ties (see Figure 5). It was important that we only use reciprocated ties (friendship must be present in both out-degree and in-degree), as the focus of the research was on friendships and not popularity (density). The final symmetrical-dichotomized-friendship network was then used to calculate both the degree and global centrality scores for each individual child. Finally, degree centrality scores were standardized by dividing the number of reciprocated friendship ties by N-1, and global

centrality scores were standardized by dividing the closeness score by the maximum geodesic distance possible, both scores were standardized for each individual classroom (Scott, 2000; Wasserman & Faust, 1994). The standardized centrality scores where then entered into an SPSS file to act as the dependent variable in order to test the study hypotheses.

Figure 4. Dichotomized Case-by-Case Friendship Matrix

Actor	A	B	C	D	E	F
A		2	0	0	2	2
B	2		0	0	2	2
C	0	0		2	0	2
D	0	2	0		0	2
E	2	2	0	2		2
F	2	0	2	2	2	

Figure 5. Reciprocated Dichotomized Case-by-Case Friendship Matrix

Actor	A	B	C	D	E	F
A		1	0	0	1	1
B	1		0	0	1	0
C	0	0		0	0	1
D	0	0	0		0	1
E	1	1	0	0		1
F	1	0	1	1	1	

Procedure

Permission to collect data from students was first obtained from each school's superintendent, then each school principle, and then from individual classroom teachers. Participants were recruited during the summer and fall of 2005 and 2006. Parents were recruited in several ways (a) in-person by FiSH personnel at back-to school events and/or (b) teachers sent consent forms home and were paid $1.00 for each consent form returned (even if the parent said no). Lastly, child assent was given prior to collecting any child data.

Trained research assistants conducted psychosocial interviews during which time the sociometric ratings and anthropometrics were obtained. Each child was individually interviewed away from their primary class. The sociometric rating questions were read aloud by the researcher. The child rated each other consented child by looking at the other child's photo and responding by pointing at a poster board and stating out loud how much they liked to play with the target child (i.e., "like to play with a lot" "sometimes like to play with" and "don't like to play with"). Either before or after the psychosocial interview, the height and weight of the child participants were taken in order to calculate BMI. A measuring board was used to measure all participants' heights. Each child's height was measured in centimeters, to the nearest tenth. Height measurements were verified by a second measurement. If the measurement was off by more than .5 cm, a third measurement was used to verify the accuracy of height measurements. Weight was measured using an electronic scale that was zeroed before the participants were weighed. Children's weight was recorded in pounds, to the nearest tenth.

CHAPTER IV

Findings

The means and standard deviations for each of the variables of interest are included in Table 4. A Tukeys post hoc test was used to interpret any significant overall difference between the three weight groups for the ANOVA results.

Table 4.

Centrality Means and Standard Deviations by Weight Classification

	Degree Centrality				Global Centrality			
	M	*SD*	*N*	*Range*	*M*	*SD*	*N*	*Range*
Underweight	.19	.14	12	0-.44	.61	.38	12	0-.98
Normal Weight	.22	.16	370	0-.90	.76	.40	370	0-1.0
Overweight	.20	.15	98	0-.63	.71	.33	98	0-1.0
Obese	.18	.14	103	0-0.6	.64	.37	103	0-1.0

Note: Underweight = BMI from 0 to less than 5th percentile; Normal weight = BMI between 5th and less than the 85th percentile; Overweight = range between 85th and less than the 95th percentile; Obese = BMI between 95th and 100th percentile.
Analyses were conducted with and without underweight children; the findings are reported using the three weight groups of interest, since the results did not differ.

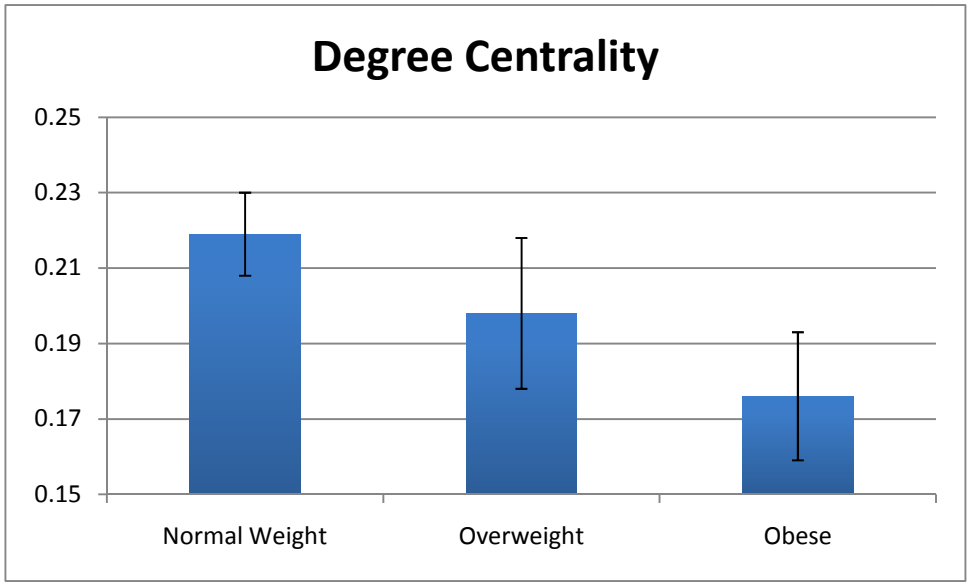
Hypothesis One:

BMI is negatively related to degree centrality; resulting in degree centrality scores to be significantly lower for obese and overweight children, compared to normal weight children.

Linear regression analysis revealed that there was a trend for BMI to be significantly related to degree centrality scores $ß = -.08$, $t(580) = -1.90$, $p = .06$, $r^2 = .01$. The first main hypothesis suggesting higher BMIs would be significantly negatively related with degree centrality scores was partially supported by this trend.

Further, the ANOVA also indicated a trend for a difference on degree centrality scores based on weight status (underweight, normal, overweight, and obese), $F(3, 581) = 2.35$, $p = .07$, $\eta^2 = .01$. The data were analyzed with and without underweight children. The findings did not change. A Tukey's post hoc showed that the trend was between normal weight and obese children, with normal weight children having higher degree centrality scores than the obese children. The mean difference between normal weight and obese children was .04, $p = .06$. Figure 6 visually illustrates the mean differences between weight groups.

Figure 6. Degree Centrality and Weight Status



Hypothesis Two:

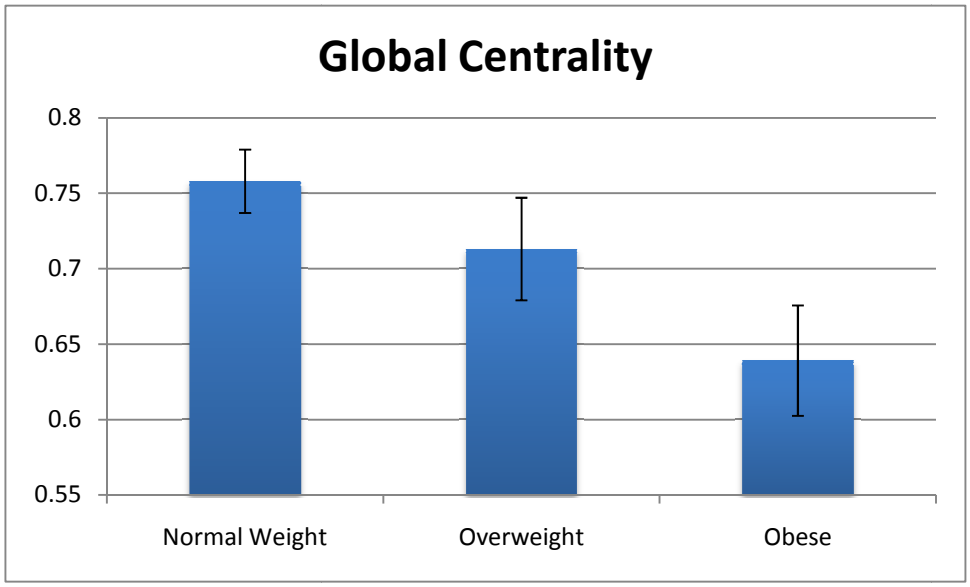
BMI is negatively related to global centrality; resulting in global centrality scores to be significantly lower for obese and overweight children, compared to normal weight children.

Linear regression analysis revealed that BMI was not significantly associated with global centrality, *ß* = -.04, $t(580) = -1.04$, $p = .30$, $r^2 = .002$. The second hypothesis stating that higher BMIs would be negatively related with global centrality scores was not supported.

However, the ANOVA indicated a significant difference between weight groups on global centrality scores, $F(3, 579) = 2.98$, $p = .03$, $\eta^2 = .02$. A Tukey's post hoc indicated a significant difference between normal weight and obese children. The mean difference between normal weight and obese children was .12, $p = .03$. The greater mean global centrality scores for normal weight children would indicate that they hold more

central positions in the classroom friendship network than do obese children. It is important to note that the overweight children did not score significantly different from the normal weight or obese children. Figure 7 illustrates the mean differences between weight groups. The main hypothesis stating that obese children will be lower in global centrality compared to normal weight children was supported when BMI was measured as a categorical variable.

Figure 7. Global Centrality Mean Differences



CHAPTER V

DISCUSSION

The purpose of the current study was to identify the relationship between obesity and first grade children's social position in their classroom friendship networks as measured by centrality. Specifically, it was hypothesized that as children's body mass index (BMI) increases, the degree and global centrality would decrease, indicating that heavier children have a less central position within the classroom network. The analyses revealed interesting information about first grade children's centrality in terms of BMI and weight status.

A trend between BMI and degree centrality was found by both the linear regression and ANOVA for hypothesis one. The data appear to suggest that at this age, obese children are starting to have significantly lower degree centrality scores compared to normal weight children. Degree centrality scores indicate that the obese first grade children are more likely to have fewer reciprocated friendships in their classroom compared to normal weight children. These findings, that differences in the number of reciprocated friendships between obese children and normal weight children, are similar

to other scholars' findings on obese children's peer relationships (Bell & Morgan, 2000; Cohen, Klesges, Summerville, & Meyers, 1989; Coie et al., 1990; Ladd, 2006; Harper et. al., 1986; Hayden-Wade et al., 2005; Jarvie, 1983; Richardson et. al., 1961; Sigelman, 1991). Specifically, Cohen et al. (1989) found that young overweight children (between first and fourth grade) were "less liked", but not "disliked" by their peers.

The second hypothesis was supported by the ANOVA analysis but not by the regression. It was found that obese children were significantly lower in global centrality compared to normal weight children. The lower global centrality scores indicate that obese children are further away from central peers and they tend to have a greater social distance between themselves and the center of the network. The global centrality scores might possibly be showing that the rejection of obese children is consistent throughout the classroom friendship network, placing obese children on the outside of the network. These findings are also consistent with the literature indicating a bias or distancing from obese children, possibly due to stigmatization and stereotypes (Cohen et al., 1989; Klacyznski, 2007; Puhl, & Latner, 2007).

The findings by both hypotheses offer a unique understanding of peer relationships in first grade children. These findings continue to support previous literature, such as Cohen et al. (1989), that obese children are "not liked" but not "disliked" by peers. This is also consistent with why we expected small, yet important effects in the present study. Both hypothesis one and two indicate that the less liking of obese children result in fewer reciprocated friends (degree centrality), and that obese children are further away from the center of the friendship network (global centrality).

There are several factors that may be contributing to the non-significant findings for the overweight group. Previous studies often used older children in their studies. As children age, so does the ratings of liking for obese peers (Cohen et al., 1989). Also, differences between states in terms of rates of obesity may have an impact on the current findings. Oklahoma has the 4th highest population of obese adults in the nation, estimated at 30.3% (CDC, 2008), see appendix C for each state. With the participants residing in a state ranked in the top five for obese adults, differences of likeability between normal-weight, overweight, and obese children may be minimized. Such high rates of obesity in Oklahoma may also be "normalizing" children's perception of overweight, or at least confining the negative perceptions to those who are morbidly obese. Finally, visually identifying overweight and obese children can be difficult in young children, as reported by researchers on the study. Unlike older children and adults, clothing can easily hide the physical differences between weight groups, thus minimizing the effect of BMI and weight status on centrality scores in first grade children.

Limitations of the Study

A major methodological issue in this study is the limited scope of factors related to centrality scores, which will be discussed below. Also, the trends and significant findings could possibly be better understood by examining the roles of other factors related to weight status and centrality scores.

The data have some limitations when using SNA. Scholars tend to prefer at least 80% of the network to participate when using SNA (Scott, 2000). In this study, in order to include a class in the analyses, at least 10 students per class had to be participating in

the study, which is approximately 50% student participation in the classroom. Also, with the limit set at 10, the subset still appeared to be similar to the total data set, according to age and ethnicity. Due to the participation being lower than 80%, the findings should be interpreted with some caution. The smaller participation in the network causes the measured networks to be smaller than the true friendship networks in the classrooms. Although 50% participation is lower than normally accepted in SNA, this exception was allowed due to the difficulty in obtaining consents for an entire class of first grade children. The lower participation rates in the classroom indicate the networks being measured are smaller than true classrooms. The results may be interpreted more conservatively than if 80% participation was acquired. However, the significant findings are important, as even in small networks obese children are lower in degree and global centrality, than normal weight peers.

Future Directions

Future studies should be conducted to help confirm the relationship between BMI and degree and global centrality scores. Longitudinal research could also help clarify how children's BMI or weight classifications affect the development of social positioning in classroom networks. Since the children who participated in the present study are in first grade, they are also still developing their physical and social identity. Longitudinal analysis may also be used to illustrate how centrality in classrooms changes for overweight or obese children over time.

The proposed research has helped connect the peer relation literature for obese children with the SNA perspective. Networks are living structures that shape our

understanding of the world. It is important to continue to understand specific issues related to overweight and obesity and networks in which children spend most of their day. The findings that the obese children are significantly lower in global centrality and demonstrate a trend of lower degree centrality compared to normal weight children should be further examined. Specifically, the outcomes of lower centrality on the psychosocial functioning of overweight and obese children should be better understood. Also, centrality could be a great way to understand possible differences within weight groups (e.g., why are some obese and overweight children higher in centrality than others). These differences may identify factors that limit or encourage the inclusion of overweight and obese children in the classroom friendship network, which should be better understood. For example, future research could use centrality in school networks to identify how social positioning impacts the mental health of overweight and obese children. This type of research could influence research to develop new interventions aimed at reducing peer rejection for overweight and obese children.

Conclusion

The purpose of this study was to examine the relation between weight status and degree and global centrality scores. Consistent with the peer relations literature, the present study revealed that differences exist between obese and normal weight children's social positioning in their classroom friendship network. Most noticeably, there was a trend for obese children to be lowest in degree centrality and they were found to be significantly lower in global centrality than normal weight children. This indicates that not only are the number of reciprocated friendships for obese children lower than normal weight children, but they are more likely to have a greater social distance to the center of

the network, compared to normal weight children. Relationships in the classroom are important for all children, as they spend a great deal of time in school. Although the outcomes of obese children being less central are not yet known, such a relationship is not expected to have positive effects on their psychosocial well-being when compared to literature examining the positive relationship between centrality and interpersonal citizenship behaviors (Bowler, Halbesleben, Stodnick, Seevers, & Little, 2009), or leadership in adults (Hossain, 2008). The relation between body weight and social positioning should further be examined to more clearly identify the factors that cause obese children to lack in degree and global centrality, compared to normal weight peers. Further understanding of the friendship ties in obese children is important. As expected, during the first semester of first grade, obese children are more likely to hold less globally central positions and are potentially more likely to have fewer reciprocated friendships. It remains to be seen how overweight and obese children fare, as they get older and weight status differences become more visible.

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APPPENDICES

Appendix A

Common Terminology in SNA

Actor Set- The entire collection of actors on which measurements will be taken (Wasserman & Faust, 1994).

Betweenness Centrality- Connects actors who do not have any direct connection. An actor in this position can often be thought of as a liaison (Wasserman & Faust, 1994).

Centrality- The number of individuals in a network that revolve around one specific individual. Centrality can be defined in one of several ways: Closeness Centrality, Degree Centrality, Betweenness Centrality, and Eigenvector Centrality, explained below (Scott, 2000; Wasserman & Faust, 1994).

Clique- groups of individuals who are all connected with each other and contain no individuals outside of the group (Wasserman & Faust, 1994).

Closeness Centrality- ability to reach multiple actors with the shortest geodesic distance (Wasserman & Faust, 1994).

Degree Centrality- number of identified ties to other actors. Two types of degree centrality exist: in-degree and out-degree. In-degree centrality is the number of ties other individuals state they have toward a specific actor. Out-degree centrality is the number of relationships a specific actor identifies to all other actors in the network (Wasserman & Faust, 1994).

Density- the number of ties between actors as a function of total possible ties in the network. The function is often known as a measure of group cohesion with quantitative values that range from 0 (no connectedness) to 1 [complete connectedness (Scott, 2000)].

Eigenvector Centrality- The number of connections a single actor has with other central actors within the same social network (Scott, 2000). This is different from indegree centrality as it values connections to central nodes (high-scoring nodes) to be of more value than non-central nodes (low-scoring nodes). Specifically, eigenvector centrality is looking at the importance of the tie in relation to the node it is connected.

Embeddedness- A theoretical perspective that work-related transactions overlap with that of social relations. An actor's behavior is considered embedded when they interact with those who currently exist in their social network. For example, entrepreneurs tend to do more business with contractors with whom they have friendship ties than with isolates in the same market (Wasserman & Faust, 1994).

Homophily- the natural tendency to interact with individuals who are similar on physical attributes such as sex and race, as well as social traits like education and socioeconomic status (Rogers & Kincaid, 1981).

Isolate- a node, or individual, who lacks connectedness to any other node in the network (Wasserman & Faust, 1994)

Node- points on a graph that represent individual actors within the network (Wasserman & Faust, 1994)

Sociomatrix- a graph of nodes connected by lines illustrating relational ties, developed by Moreno (1934)

Structural Holes- a gap between two actors or set of actors that can be brought together by one or more structural tie (Burt, 1992).

Appendix B

School Demographic Information

School	Grade Levels	Total Students	Total 1st Grade	Reduced Lunches	Free Lunches
1		161	18	17.4%	74.0%
2		119	16	24.4%	63.9%
3					
4	Pre-3rd	418	100	20.1%	40.8%
5	Pre-5th	520	117	15.0%	37.3%
6	Pre-8th	280	18		
7	Pre-5th	394	54	16.5%	54.1%
8	Pre-5th	623	95	12.2%	29.5%
9	Pre-5th	585	101	6.7%	36.2%
10	Pre-5th	461	70	12.1%	38.2%
11	Pre-5th	317	38	11.0%	73.8%
12	Pre-5th	280	34	14.6%	20.7%
13	Pre-5th	328	43	9.1%	25.3%
14	Pre-5th	293	40	17.4%	46.8%
15	Pre-5th	247	36	13%	49.0%
16	Pre-5th	298	35	9.4%	15.1%
17l	Pre-5th	547	82	14.3%	35.5
18	Pre-8th	531	39	12.1%	38.8%
19	K-8th	345	47	7.0%	17.7%
20	1st-5th	426	86	13.1%	49.1%

-Chart continues to next page

School	Native American	Asian	Hispanic	African American	Caucasian
21	130	0	1	0	30
22	40	0	0	2	77
23					
24	85	1	10	0	322
25	145	2	4	5	364
26					
27	122	0	4	13	255
28	88	0	13	14	508
29	34	2	10	35	504
30	60	1	7	28	365
31	55	2	23	22	215
32	77	1	14	14	174
33	32	5	11	19	261
34	48	0	6	12	227
35	29	2	10	14	192
36	17	4	4	8	265
37	85	0	6	4	452
38	174	2	13	12	330
39	47	4	3	3	288
40	113	4	16	37	256

Appendix C

Obesity by State in 2008

State	%	State	%	State	%	State	%
Alabama	31.4	Illinois	26.4	Montana	23.9	Rhode Island	21.5
Alaska	26.1	Indiana	26.3	Nebraska	26.6	South Carolina	30.1
Arizona	24.8	Iowa	26.0	Nevada	25.0	South Dakota	27.5
Arkansas	28.7	Kansas	27.4	New Hampshire	24.0	Tennessee	30.6
California	23.7	Kentucky	29.8	New Jersey	22.9	Texas	28.3
Colorado	18.5	Louisiana	28.3	New Mexico	25.2	Utah	22.5
Connecticut	21.0	Maine	25.2	New York	24.4	Vermont	22.7
Delaware	27.0	Maryland	26.0	North Carolina	29.0	Virginia	25.0
Washington DC	21.8	Massachusetts	20.9	North Dakota	27.1	Washington	25.4
Florida	24.4	Michigan	28.9	Ohio	28.7	West Virginia	25.4
Georgia	27.3	Minnesota	24.3	Oklahoma	30.3	Wisconsin	25.4
Hawaii	22.6	Mississippi	32.8	Oregon	24.2	Wyoming	24.6
Idaho	24.5	Missouri	28.5	Pennsylvania	27.7		

a. Retrieved on May 2, 2009 CDC (2008) http://www.cdc.gov/obesity/data/trends.html

Note: The data represent adults surveyed during the CDC's Behavioral Risk Factor Surveillance System.

Oklahoma State University Institutional Review Board

Request for Determination of Non-Human Subject or Non-Research

6. **Signatures**

Signature of PI _____ **Date** 5-22-09

Signature of Faculty Advisor _____ **Date** 5-22-09
(If PI is a student)

☒ Based on the information provided, the OSU-Stillwater IRB has determined that this project **does not** qualify as human subject research as defined in 45 CFR 46.102(d) and (f) and **is not subject to oversight by the OSU IRB.**

☐ Based on the information provided, the OSU-Stillwater IRB has determined that this research **does** qualify as human subject research and **submission of an application for review by the IRB is required.**

_____ 5/29/09
Dr. ~~Sue C. Jacobs~~, IRB Chair Date
Sheila Kennison

VITA

Jeffrey Scott Anderson

Candidate for the Degree of

Doctor of Philosophy

Thesis: RELATION BETWEEN BODY WEIGHT AND SOCIAL POSITIONS IN CHILDREN'S CLASSROOM FRIENDSHIP NETWORKS

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Pages in Study: 63 Candidate for the Degree of Doctor of Philosophy

Major Field: Psychology

Scope and Method of Study: The present study focused on the relationship between Body Mass Index (BMI) and centrality (degree and global) and the differences in centrality by weight status in first grade children. Participants in the study consisted of 583 first grade children at rural public elementary schools recruited as part of the USDA funded Families and Schools for Health study. UCInet was the social network analysis program used to calculate children's centrality scores.

Findings and Conclusions: The results suggest that obese children (95^{th} percentile or above) were significantly lower in global centrality than normal weight children. Obese children also showed a trend for being lower in degree centrality, compared to normal weight children. Together these findings suggest that BMI and weight status have a negative association with first grade children's social position, in their classroom friendship network. Most importantly, the findings illustrate that even though obese children have some friends (degree centrality), obese children are significantly further away from the center of the network (global centrality), putting obese children at a disadvantage.

ADVISER'S APPROVAL: Melanie Page, Ph.D.