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# Diet and exercise of adolescents and their peers

Sophia Jihey Chung  
*University of Iowa*

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DIET AND EXERCISE OF ADOLESCENTS AND THEIR PEERS

by

Sophia Jihey Chung

A thesis submitted in partial fulfillment  
of the requirements for the Doctor of  
Philosophy degree in Nursing  
in the Graduate College of  
The University of Iowa

May 2015

Thesis Supervisors: Assistant Professor Anne L. Ersig  
Professor Ann Marie McCarthy

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Graduate College  
The University of Iowa  
Iowa City, Iowa

CERTIFICATE OF APPROVAL

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PH.D. THESIS

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This is to certify that the Ph.D. thesis of

Sophia Jihey Chung

has been approved by the Examining Committee  
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To my family

The LORD your God is with you, he is mighty to save. He will take great delight in you,  
he will quiet you with his love, he will rejoice over you with singing.  
Zephaniah 3:17

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## ABSTRACT

All over the world, adolescent obesity is a serious health problem. Many researchers have focused on diet and exercise, because those behaviors are modifiable risk factors for obesity. To reduce or prevent the prevalence of adolescent obesity, contributions of diverse contextual factors to adolescents' diet and exercise have been studied. However, little is known about peer influences on adolescents' diet and exercise, compared to the studies of other contextual factors such as parents and school.

In addition, in contrast to Western countries with higher prevalence of adolescent obesity, few studies have been conducted in countries with different cultures. Exploring the influence of peers on diet and exercise of adolescents in those countries could help to develop culturally-appropriate interventions to prevent adolescents from becoming obese. Thus, the purpose of this set of three studies was to examine adolescents' diet and exercise in the context of peer factors and relationships.

The purpose of the first study was to systematically review research assessing contribution of peer to adolescents' diet and exercise. Twenty four articles were identified, using the electronic databases, PubMed, CINAHL, Web of Science, and SCOPUS. According to the findings from this review, the diet and exercise of adolescents was positively associated with that of their peers. Additionally, gender, the type of diet and exercise, and the closeness of friends could influence these associations.

The second study identified the parent-, school-, and peer-factors contributing to dietary and exercise behaviors of adolescents in the United States, by using data from the Health Behaviour of School-Aged Children study. Findings from the current analysis indicated that parent- and peer-factors could influence either diet or exercise of adolescents; while school-factor were found to be associated only with adolescents' diet.



The third study explored the diet and exercise of Korean female adolescents within their classroom-based peer networks. Using social network analysis, dietary behaviors of female adolescents in this study were clustered within their classrooms. Several adolescents played a role in bridging two or more peer networks. However, less information about female adolescents' exercise behaviors within classroom-based peer network was obtained.

In summary, peers are an important contextual factor for developing adolescents' diet and exercise behaviors that could contribute to adolescent obesity. These associations could be influenced by the characteristics of friendships such as gender of friends, the closeness of friends, and network characteristics of friendships. Peers can be potential targets for interventions to reduce or prevent the development of adolescent obesity.

## PUBLIC ABSTRACT

Adolescent obesity is considered as the one of the serious public health problems in the world. Many researchers have found adolescents' diet and exercise behaviors could contribute to the development of obesity. Adolescents' diet and exercise behaviors are said to be influenced by parents, schools, and peers. However, there are few studies focusing on peers' contributions to adolescents' diet and exercise. Therefore, this set of three studies aimed to examine diet and exercise behaviors of adolescents within their peer relationships.

The first study reviewed prior researches which examined peers' contribution to adolescents' diet and exercise. This review found that peers actually do influence adolescents' diet and exercise behaviors. Knowing the importance of peer influence in adolescents' diet and exercise, the second study analyzed those behaviors of adolescents in the United States. It found that parents and peers influenced either diet or exercise. However, in the same study, schools' contribution was limited only to adolescents' diet. To learn more about underlying relationships between adolescents' diet and exercise and their peers, the third study examined Korean female adolescents' diet and exercise behaviors, using social network analysis. This study found that the adolescents and their peers will likely share only their dietary behaviors, not exercise behaviors.

In sum, this set of studies found that peers' influences are important in the development of adolescents' diet and exercise. Nurses should consider peers as potential targets when they provide interventions for reducing or preventing adolescent obesity.

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## CHAPTER I.

### INTRODUCTION

Adolescent obesity has been studied extensively in Western countries, which have a higher prevalence of the condition, but has only recently become an area of focus in other countries with lower rates of adolescent obesity (Wang & Lobstein, 2006). By examining studies of adolescent obesity from countries with higher prevalence rates, contributing factors and effective methods of prevention for adolescent obesity can be identified. Identification and adaptation of these findings can be used to prevent adolescent obesity in countries with lower prevalence from increasing significantly. Examining adolescent obesity in other cultures is necessary to identify unique factors that must be considered in order to appropriately intervene and prevent significant increases in rates of adolescent obesity.

In addition to multiple other factors, behaviors such as diet and exercise behaviors contribute to development of adolescent obesity. These diet and exercise behaviors are readily modifiable, compared to factors such as genetics (Barlow & the Expert Committee, 2007). Diet and exercise are related to contextual factors, including parents, schools, or peers. The impact of peers on diet and exercise of adolescents might be greater than those of parents or schools. Developmentally, adolescents are becoming less dependent on their parents (Collins & Steinberg, 2008; Papalia, Olds, & Feldman, 2005), and spend more time with their peers (Drolet & Arcand, 2013). Parental influence tends to decrease during adolescence (Bauer, Laska, Fulkerson, & Neumark-Sztainer, 2011; Story, Nannery, & Schwartz, 2009). In addition, studies of school environments have focused on physical activity facilities or school policies as contributing factor to adolescents' exercise (Foster et al., 2008; Fox, Dodd, Wilson, & Gleason, 2009; Kaphingst & French, 2006). School environments are important for creating the overall climate of

encouraging healthier diet and exercise; however, interactions with people in schools may play an important role in these behaviors of the individuals (Kaphingst & French, 2006; Townsend & Foster, 2011). Adolescents are more likely to be like their friends and select friends similar to themselves (Fowler et al., 2007; Hoffman, Monge, Chou, & Valente, 2007). Therefore, peers' contributions to adolescents' diet and exercise might be greater during adolescence. However, few studies have examined what peer-related factors are associated with adolescents' diet and exercise. In addition, the settings of most studies were limited to the United States (US) and Australia (de la Haye, Robins, Mohr, & Wilson, 2010; De La Haye, Robins, Mohr, & Wilson, 2011; Salvy, Bowker, Germeroth, & Barkley, 2012; Simpkins, Schaefer, Price, & Vest, 2013; Voorhees et al., 2005). Examining peers' contributions to diet and exercise of adolescents in countries with different cultures will provide essential information for development of culturally-appropriate interventions.

The overall purpose of this set of three studies was to explore diet and exercise in adolescents in the context of peer factors and relationships. The first paper systematically reviewed the influence of peers on adolescents' diet and exercise. By reviewing the related studies, evidence for this association could be identified, assessed, and synthesized. The purpose of the second paper was to use an existing database (the Health Behaviour in School-Aged Children study) to identify whether parent, school, and peer factors were associated with diet and exercise in US adolescents. This analysis identified contributors to diet and exercise at various levels, such as parental monitoring, excess time spent with friends at peer-level, and school breakfast/lunch program at school. The third paper examined diet and exercise of Korean female adolescents within classroom-based peer networks. This study was the first study in Korea that assessed adolescents' and their peers' diet and exercise, using social network analysis.



### Theoretical framework

An ecologically based model of childhood overweight, proposed by Davison and Birch (2001) (Figure 1.1), was adapted to provide a framework for the proposed studies. An individual's behaviors (e.g., dietary intake, sedentary behavior, and physical activity), called risk factors by Davison and Birch (2001), are associated with the development of overweight. Contextual factors include "parenting styles and family characteristics" (Davison & Birch, 2012, p.161), and provide an immediate context that an individual is embedded in, as well as "community, demographic, and societal characteristics" (Davison & Birch, 2012, p.161), which provide a larger context in which the immediate context is situated. These contextual factors can also influence the development of child overweight. In addition, interactions between an individual's behavior and contextual factors contribute to the development of childhood overweight (Davison & Birch, 2001). A child's behaviors are influenced by parenting style and family characteristics, such as parental monitoring of television viewing, encouragement of child activity, knowledge about nutrition, food preferences, or activity patterns (Davison & Birch, 2001). Interactions with peers or siblings are also included at this level of the model (Davison & Birch, 2001). School lunch programs, school physical education programs, accessibility of recreation facilities or convenience stores and restaurants, and ethnicity or socioeconomic status can be classified as community, demographic, and societal characteristics (Davison & Birch, 2001). In this model, parent-related factors are explained in detail, while school-related factors are placed in a larger context and peer-related factors are less developed. In addition, cultural differences are not mentioned.

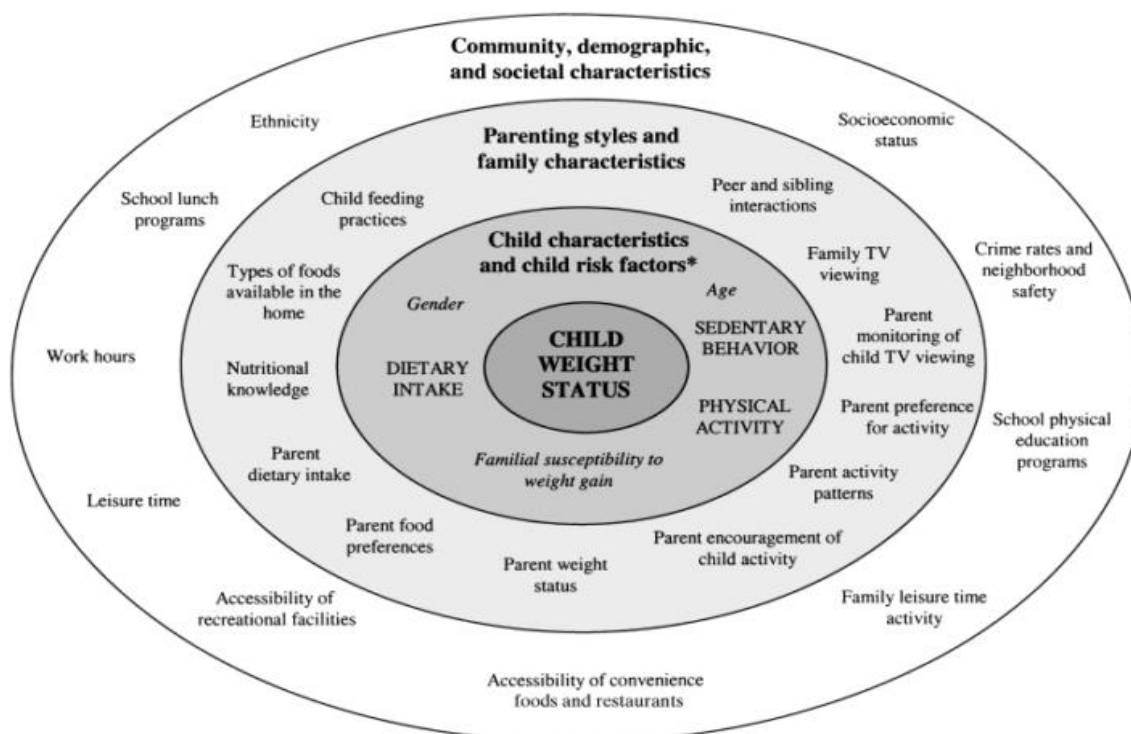


Figure 1.1. Ecological model for childhood overweight by Davison and Birch (2001)

The current studies placed diet and exercise behaviors of adolescents in the middle of the model, replacing childhood overweight. It is also necessary to pay more attention to peers because adolescents spend a significant amount of time in schools (Story et al., 2009; Wechsler, McKenna, Lee, & Dietz, 2004) with their friends (Brown, 2004; Drolet & Arcand, 2013), and their behaviors influence their friends' behaviors (Caprio et al., 2008). Thus, the model proposed by Davison and Birch (2001) was modified in order to support the proposed studies focusing on adolescents' dietary and exercise behaviors.

#### Adolescent obesity as a serious problem

##### *Prevalence of adolescent obesity*

The prevalence of adolescent obesity has been increasing. In North America, South America, the Western Pacific, and Europe, prevalence of adolescent obesity has been

significantly and rapidly increasing since the 1970s, although the exact rate varies depending on the country (Wang & Lobstein, 2006). In US, the obesity rate among adolescents ages 12 to 19 years increased from 5.0 % in 1971-1974 to 18.4% in 2009-2010 (Fryar, Carroll, & Ogden, 2012). In 2011-2012, it increased to 20.5% (Ogden, Carroll, Kit, & Flegal, 2014).

Countries in Asia have lower prevalence of adolescent obesity compared to North America and Europe (Wang & Lobstein, 2006). However, dramatic increases in prevalence of adolescent obesity have also been reported in some Eastern Asian countries, which are undergoing rapid urbanization and economic growth (Adolescent Development and Participation Unit Programme Division, 2006). South Korea provides a good example of this phenomenon. In 2012, the prevalence of obese adolescents aged between 13 and 18 was 14.1% (Ministry of Health and Wellness & Korea Centers for Disease Control and Prevention, 2013), increased from 8.2% in 1998 (Korea Centers for Disease Control and prevention, 2007). Researchers have noted that adopting a Westernized diet and a decreasing level of physical activity due to globalization and rapid economic growth has contributed to increasing rates of adolescent obesity in Korea (H. M. Kim, Park, Kim, Kim, & Park, 2006; Y. Song, Park, Paik, & Joung, 2010).

Although prevention of childhood and adolescent obesity is a governmental and educational priority in Korea (Ministry of Science, ICT, and Future Planning, 2013; Ministry of Science, ICT, and Future Planning, 2014; Seoul Metropolitan Office of Education, 2008), studies have paid more attention to prevalence (H. M. Kim et al., 2006; Oh et al., 2008; M. J. Park et al., 2009; M. J. Park, Boston, Oh, & Jee, 2009), and are less focused on identifying contributing factors or appropriate interventions. However, studies of interventions (Berkowitz et al., 2013; Eisenmann et al., 2008; Kalarchian et al., 2009; Wilson, 2007) and studies examining contributing factors (Boutelle, Fulkerson, Neumark-Sztainer, Story, & French, 2007; Hanson,

Neumark-Sztainer, Eisenberg, Story, & Wall, 2005; Lohman, Stewart, Gundersen, Garasky, & Eisenmann, 2009) have been conducted in Western cultures, including the US.

Contributing factors and interventions identified in studies of Western cultures provide healthcare providers in Korea with some knowledge of underlying causes of and effective interventions for adolescent obesity. However, similar studies in Korea and other non-Western cultures are essential to verify these findings, and identify additional contributing factors and appropriate interventions for adolescent obesity. Ultimately, studies in Korea, combined with those conducted in the US, could help prevent increases in its prevalence of adolescent obesity. Studies conducted in the US can guide further directions for studying obesity in Korean adolescents, while studies in Korea will identify what has not been found yet from the studies in the US.

#### *Obesity as a serious problem*

Increasing rates of adolescent obesity are a serious problem not only because of influences on physical and psychological health, but also because of financial cost. Adolescent obesity is associated with physical health problems, including obesity in adulthood (Engeland, Bjorge, Tverdal, & Sogaard, 2004; Lightwood et al., 2009; Suchindran, North, Popkin, & Gordon-Larsen, 2010) and diseases such as diabetes, cardiovascular disease or hypertension (Falkstedt, Hemmingsson, Rasmussen, & Lundberg, 2006; Ford, Nonnemaker, & Wirth, 2008; Narayan, Boyle, Thompson, Gregg, & Williamson, 2007; J. Park et al., 2010; Weiss et al., 2004). In addition, adolescent obesity can have a negative influence on psychological health. Compared to normal-weight adolescents, obese adolescents have lower self-esteem (Lee, S.R. & Kim, J. H., 2011; Mond, Van den Berg, Boutelle, Hannan, & Neumark-Sztainer, 2011; O'Dea, 2006; Shin & Shin, 2008) and are at a higher risk for being bullied and teased due to increasing attention to

weight stigmatization from peers (Janssen, Craig, Boyce, & Pickett, 2004; Lumeng et al., 2010; Puhl, Luedicke, & Heuer, 2011).

Increasing adolescent overweight is associated with lower work productivity during adulthood because of premature death and disability (Lightwood et al., 2009). Health care expenditures for obese children and adolescents are also significantly higher than those for normal weight due to longer hospital length of stay of obese youth (Hampl, Carroll, Simon, & Sharma, 2007; Hlaing, Messiah, Lipshultz, & Ludwig, 2011; L. Trasande, Liu, Fryer, & Weitzman, 2009). Obese children and adolescents also have more emergency department visits and mental health visits than normal weight youth (Estabrooks & Shetterly, 2007). Prevention of excessive weight gain in adolescence as an effective way to reduce the prevalence of adolescent obesity has been recommended (L. Trasande, 2011; L. Trasande et al., 2009). However, to intervene effectively with adolescent obesity, it is necessary to understand what factors contribute to it.

#### Studies of contributing factors to adolescent obesity

##### *Factors that contribute to adolescent obesity*

Studies conducted in the US have found multiple contributing factors to obesity in adolescents. Among these various contributors, obesity-related behaviors, such as diet and exercise, are worth examining for intervening with adolescent obesity. While some contributing factors are complex (e.g., genetic variation), behavioral factors can more easily be modified and are unlikely to cause harm compared to surgery or pharmacological interventions (Barlow & the Expert Committee, 2007).

Behaviors such as specific food consumption or physical inactivity contribute to adolescent obesity (Biddle, Gorely, & Stensel, 2004; Janssen et al., 2005; McNaughton, Ball, Mishra, &

Crawford, 2008; Rey-Lopez, Vicente-Rodríguez, Biosca, & Moreno, 2008), and are influenced by contextual factors, such as parents and schools. Parents influence adolescent obesity by modeling eating habits and food choices (Anderson & Butcher, 2006; Campbell et al., 2007; Hanson et al., 2005), restricting availability of high-fat foods, or encouraging adolescents' physical activity (Bauer, Neumark-Sztainer, Fulkerson, Hannan, & Story, 2011; K. van der Horst et al., 2007). Schools can also affect adolescents' dietary and exercise behaviors, by in terms of school meals and other foods, physical education programs, and classroom health education (Fox et al., 2009; Kaphingst & French, 2006). Among the various contributors to adolescent obesity, examining those associated with diet and exercise is important, because reviews have shown that intervening with these behaviors is effective in treating obesity (Ho et al., 2012; McGovern et al., 2008; Tsiros, Sinn, Coates, Howe, & Buckley, 2008).

#### *Studies conducted in Korea*

Studies of factors contributing to adolescent obesity have been conducted in Korea. In (2012) emphasized the role of schools for adolescent obesity; he focused on physical activity programs and nutritional education provided in school. Lifestyle differences are a key reason for differences in obesity prevalence between different countries (H. M. Kim et al., 2006; Moreno, Pigeot, & Ahrens, 2011). Modernization, urbanization, and economic development lead to shifts from traditional diets to Western-style diets (Misra & Khurana, 2008). These can be found among adolescents in Korea; Korean adolescents who prefer the Westernized diet have a higher total daily calorie intake (Y. Song, Joung, Engelhardt, Yoo, & Paik, 2005), which could be associated with weight gain. Finally, Ko (2008) found that familial factors, such as parental BMI and education, were not significantly associated with adolescent obesity. However, lack of

vigorous physical activity was related to obesity rates among adolescents aged between 13 and 18 years in Korea (Ko, 2008).

Other Korean studies specifically examined the role of diet and exercise. Frequent consumption of high-energy/low-nutrient food, physical inactivity, and prolonged sitting were contributors to Korean adolescent obesity (Heo, Nam, & Lee, 2013). Unlike reasons for increasing consumption from fast food restaurants in other countries, Korean adolescents consume fast food because they do not have enough time to have breakfast or dinner due to spending excessive time on studying (J. H. Kim & Lee, 2012). Korean researchers have agreed with researchers from other cultures that focusing on changing diet and exercise to a healthier form, such as helping adolescents achieve an active lifestyle and have healthy diets, is necessary for treating adolescent obesity (Heo et al., 2013; In, 2012; Y. Song et al., 2005).

Thus, how to improve dietary and exercise *behaviors* of adolescents in Korea, the US, or other countries should also be examined, and factors to promote healthier diet and exercise should be identified. Identifying these factors is helpful not only to manage adolescent obesity within a country, but also to understand the differences across countries.

#### The importance of changing behaviors

Modifying diet and exercise into healthier forms has been studied in multiple countries in North America and Europe, as well as in Australia, as an intervention for adolescent obesity. Diet and exercise of overweight or obese adolescents are different from normal-weight adolescents (Hills, King, & Armstrong, 2007; Janssen, Katzmarzyk, Boyce, King, & Pickett, 2004; Mota et al., 2008; Roseman, Yeung, & Nickelsen, 2007; Sjöberg, Hallberg, Höglund, & Hulthén, 2003). Patterns of obese adolescents' behaviors, such as physical inactivity and

unhealthy eating habits, contribute to imbalance between intake and consumption of calories (Karnik & Kanekar, 2012), and may result in adolescent obesity.

Changing diet and exercise is effective for controlling weight during adolescence (Barlow & the Expert Committee, 2007; Epstein, Paluch, Roemmich, & Beecher, 2007; Savoye et al., 2011; Williamson et al., 2007). The World Health Organization (WHO; 2009) reported that interventions for obesity, including behavioral changes, increased the chances of achieving long-term health benefits, such as reductions in risk for diseases during adulthood. To develop more effective interventions for adolescent obesity, multiple contextual factors such as parent and school characteristics should be examined, because diet and exercise behaviors may be influenced by these factors.

#### Studies related to contextual factors in adolescents

##### *Studies related to parents*

Studies have examined the influence of parents on adolescents' diet and exercise. Most found that adolescents' behaviors were associated with parental characteristics, such as parental body mass index, socio-economic status, or education level (Alavi, Eftekhari, Noot, Rafinejad, & Chinekeh, 2013; Janssen, Boyce, Simpson, & Pickett, 2006; Ko, 2008; Williams & Mummery, 2011). Researchers have explored the relationship between parenting behaviors or styles (i.e. authoritarian, authoritative, neglectful, and indulgent) and adolescents' dietary and exercise behaviors (Berge, Wall, Loth, & Neumark-Sztainer, 2010; Boutelle, Cafri, & Crow, 2012; Pearson, Atkin, Biddle, Gorely, & Edwardson, 2010; K. van der Horst et al., 2007), and have proposed parent-involved interventions.

However, studies of the effectiveness of these parent-involved interventions were inconclusive. Parents might have less influence on the diet and exercise of an adolescent than



they did when the adolescent was a child. A longitudinal study in the US found that perceived parental encouragement to eat healthy food, be physically active, and diet to control weight significantly decreased from early to middle adolescence and from middle to late adolescence (Bauer et al., 2011).

Ko (2008) conducted a cross-sectional study in Korea also found limited effects of parental influence on adolescents' diet and exercise compared to younger age groups, since adolescents spent relatively little time at home and more time at school with their friends. Because of increasing autonomy with respect to health behaviors as well as increasing conflict between parents and adolescents over these behaviors (Bauer et al., 2011; Story et al., 2009), adolescents might be influenced less by their parents and more by peers, schools or other factors.

#### *Studies related to school*

School is another significant context for adolescent obesity. More than 95% of adolescents in the United States are enrolled in and spend a significant amount of time in school (Kaphingst & French, 2006; United States Census, 2013; Story et al., 2009; Wechsler et al., 2004). US children consume 47% of their total daily food intake and expend 51% of their daily energy expenditure in school (Briefel, Wilson, & Gleason, 2009). There are no studies of calorie consumption and time spent at school among adolescents in Korea. However, Korean researchers have emphasized the role of school in the development of adolescent obesity because most schools in Korea provide meals for adolescents (Ministry of Education, 2009), have facilities for physical activity, and provide education programs on diet and exercise (Hong, 2008; In, 2012).

Because schools can affect adolescents' diet and exercise through provision of meals and physical education programs (Fox et al., 2009; Kaphingst & French, 2006), researchers have developed and evaluated school-based interventions for obesity (Carrel et al., 2005; Eisenmann

et al., 2008; Foster et al., 2008; Greening, Harrell, Low, & Fielder, 2011). However, whether schools play a key role in development of adolescents' behaviors is difficult to determine, as school-related interventions have focused on changing the environment, regulations, or policies (Foster et al., 2008; O'toole, Anderson, Miller, & Guthrie, 2007; Story et al., 2009; Wechsler et al., 2004). These interventions have been examined in conjunction with others, making it hard to determine which effectively influenced adolescents' diet and exercise. Some studies found no significant differences in dietary behaviors based on school-level variance, and controlling for student characteristics (Maes & Lievens, 2003; K. van der Horst et al., 2008). Because adolescents have intensive interactions with others in school (Kaphingst & French, 2006; Story et al., 2009), interactions among individuals within a school (Townsend & Foster, 2011), and not just the school environment, might have an important role in diet and exercise behaviors of adolescents.

#### *Studies related to peers*

Peers influences on adolescents' diet and exercise have also been studied. Compared to other developmental stages, peer relationships emerge as significant during preadolescence, ages 9 to 12 (Erdley, Nangle, Newman, & Carpenter, 2001). Adolescents might have similar behaviors based on interactions with their peers (Caprio et al., 2008), because they spend more time with their friends (Brown, 2004; Drolet & Arcand, 2013) and show a lower level of dependency on their parents (Collins & Steinberg, 2008; Papalia et al., 2005; Steinberg, 2001).

Although parental influence is still significant (Collins & Steinberg, 2008; Parke & Buriel, 2008), peers might also influence adolescents' dietary and exercise behaviors. However, few studies have examined the role of peers in the diet and exercise of adolescents. Studies of smoking habits and alcohol use have found that peers serve as role models or affect attitudes

toward certain behaviors (Ennett et al., 2008; Fowler et al., 2007; Hoffman et al., 2007; Nash, McQueen, & Bray, 2005).

Adolescents are more likely to either become similar to their friends, select friends similar to them (Fowler et al., 2007; Hoffman et al., 2007). Because of this, social position in friendship (e.g., popularity) should be evaluated when examining peer relationships among adolescents (Ennett et al., 2008; Mercken, Snijders, Steglich, Vertiainen, & De Vries, 2010). Although the impact of peers on behaviors increases during adolescence, and associations between some health behaviors and peers are significant, few studies focus on the influence of peers on *diet and exercise behaviors* of adolescents.

#### Proposed model

Based on information from studies of adolescent obesity, an adapted framework for the proposed studies was developed by modifying the ecological model for childhood overweight (Figure 1.2.). The key difference is that the framework for these studies focuses on adolescents' *diet and exercise behaviors*, while the ecological model by Davison and Birch (2001) explained childhood *overweight*. In addition, school and peers are included in the first circle, in contrast to the ecological model. Because adolescents spend more time in school with their peers during adolescence, interactions with peers or friends become increasingly more important than those with parents. Lastly, the outer circle of the adapted framework includes culture. Compared to adolescents from Western cultures, Korean adolescents spend more time studying, and might have less time to exercise. Differences between traditional and western diets might also contribute to development of adolescent obesity in Korea. In the current studies, the role of peers, which has been overlooked compared to other contextual factors, and cultural differences was examined in an effort to explain rising rates of adolescent obesity.

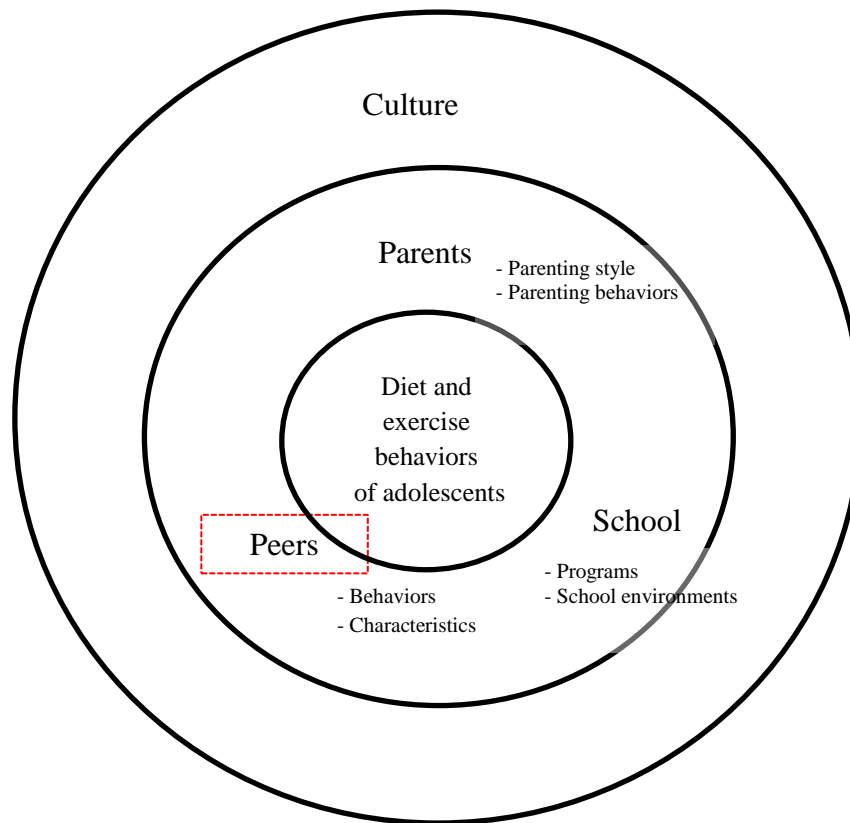


Figure 1.2. Adapted framework for adolescent diet and exercise behaviors

Despite the increasing prevalence of adolescent obesity over time, studies of factors related to adolescent obesity have been limited. Most have focused on parent or school factors, not peer factors, which can provide another important context for development of adolescent obesity. In addition, few studies have explored diet and exercise in different cultures. Thus, this set of three studies examined peers' contribution to diet and exercise of adolescents in two countries from different cultures.

### Purpose and aims

The purpose of this set of three studies is to explore obesity related behaviors in adolescents in the context of peer factors and relationships.

The aims are:

1. To systematically review the relationship between friends and peers on diet and exercise among adolescents;
2. To describe the contribution of parents, school, and peers to diet and exercise of the adolescents in the US in an existing data set; and
3. To examine the diet and exercise behaviors of Korean female adolescents within classroom-based social networks.

The long-term goals related to this project are:

1. Identifying the role of cliques in development of adolescent obesity;
2. Developing broader interventions for adolescent obesity (i.e. interventions considering the characteristics of shared behaviors within cliques);
3. Adopting what is already known in other cultural contexts (e.g. Korea); and
4. Generating information from other cultures to develop culturally-appropriate interventions.

## REFERENCES

- Adolescent Development and Participation Unit Programme Division. (2006). *Adolescent development in east asia and the pacific: Realizing their potential- A summary of trends, programming and policy experiences*. NY, New York: United Nations Children's Fund.
- Alavi, M., Eftekhari, M. B., Noot, R., Rafinejad, J., & Chinekes, A. (2013). Dietary habits among adolescent girls and their association with parental educational levels. *Global Journal of Health Science*, 5(5)
- Anderson, P. M., & Butcher, K. F. (2006). Childhood obesity: Trends and potential causes. *The Future of Children*, 16(1), 19-45.
- Barlow, S. E., & the Expert Committee. (2007). Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary report. *Pediatrics*, 120(S), 164. doi:10.1542/peds.2007-2329C
- Bauer, K. W., Laska, M. N., Fulkerson, J. A., & Neumark-Sztainer, D. (2011). Longitudinal and secular trends in parental encouragement for healthy eating, physical activity, and dieting throughout the adolescent years. *Journal of Adolescent Health*, 49(3), 306-311.
- Bauer, K. W., Neumark-Sztainer, D., Fulkerson, J. A., Hannan, P. J., & Story, M. (2011). Familial correlates of adolescent girls' physical activity, television use, dietary intake, weight, and body composition. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 1-10.
- Berge, J. M., Wall, M., Loth, K., & Neumark-Sztainer, D. (2010). Parenting style as a predictor of adolescent weight and weight-related behaviors. *Journal of Adolescent Health*, 46(4), 331-338.
- Berkowitz, R. I., Rukstalis, M. R., Bishop-Gilyard, C. T., Moore, R. H., Gehrman, C. A., Xanthopoulos, M. S., . . . Wadden, T. A. (2013). Treatment of adolescent obesity comparing self-guided and group lifestyle modification programs: A potential model for primary care. *Journal of Pediatric Psychology*, 38(9), 978-986. doi:10.1093/jpepsy/jst035
- Biddle, S. J., Gorely, T., & Stensel, D. J. (2004). Health-enhancing physical activity and sedentary behaviour in children and adolescents. *Journal of Sports Sciences*, 22(8), 679-701.
- Boutelle, K. N., Cafri, G., & Crow, S. J. (2012). Parent predictors of child weight change in family based behavioral obesity treatment. *Obesity*, 20(7), 1539-1543.
- Boutelle, K. N., Fulkerson, J. A., Neumark-Sztainer, D., Story, M., & French, S. A. (2007). Fast food for family meals: Relationships with parent and adolescent food intake, home food availability and weight status. *Public Health Nutrition*, 10(01), 16-23.
- Briefel, R. R., Wilson, A., & Gleason, P. M. (2009). Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *Journal of the American Dietetic Association*, 109(2), S79-S90.
- Brown, B. B. (2004). Adolescents' relationships with peers. *Handbook of Adolescent Psychology*, 2, 363-394.
- Campbell, K. J., Crawford, D. A., Salmon, J., Carver, A., Garnett, S. P., & Baur, L. A. (2007). Associations between the home food environment and Obesity-promoting eating behaviors in adolescence. *Obesity*, 15(3), 719-730.

- Carrel, A. L., Clark, R. R., Peterson, S. E., Nemeth, B. A., Sullivan, J., & Allen, D. B. (2005). Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: A randomized, controlled study. *Archives of Pediatrics & Adolescent Medicine*, 159(10), 963-968.
- Collins, W. A., & Steinberg, L. (2008). Adolescent development in interpersonal context. In W. Damon, & R. M. Lerner (Eds.), *Child and adolescent development: An advanced course* (pp. 551-590). Hoboken, NJ: John Wiley & Sons.
- Davison, K. K., & Birch, L. L. (2001). Childhood overweight: A contextual model and recommendations for future research. *Obesity Reviews*, 2(3), 159-171.
- de la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2010). Obesity-related behaviors in adolescent friendship networks. *Social Networks*, 32(3), 161-167.
- De La Haye, K., Robins, G., Mohr, P., & Wilson, C. (2011). How physical activity shapes, and is shaped by, adolescent friendships. *Social Science & Medicine*, 73(5), 719-728.
- Drolet, M., & Arcand, I. (2013). Positive development, sense of belonging, and support of peers among early adolescents: Perspectives of different actors. *International Education Studies*, 6(4)
- Eisenmann, J. C., Gentile, D. A., Welk, G. J., Callahan, R., Strickland, S., Walsh, M., & Walsh, D. A. (2008). SWITCH: Rationale, design, and implementation of a community, school, and family-based intervention to modify behaviors related to childhood obesity. *BMC Public Health*, 8(1), 223.
- Engeland, A., Bjorge, T., Tverdal, A., & Sogaard, A. J. (2004). Obesity in adolescence and adulthood and the risk of adult mortality. *Epidemiology* (Cambridge, Mass.), 15(1), 79-85. doi:10.1097/01.ede.0000100148.40711.59
- Ennett, S. T., Faris, R., Hipp, J., Foshee, V. A., Bauman, K. E., Hussong, A., & Cai, L. (2008). Peer smoking, other peer attributes, and adolescent cigarette smoking: A social network analysis. *Prevention Science*, 9(2), 88-98.
- Epstein, L. H., Paluch, R. A., Roemmich, J. N., & Beecher, M. D. (2007). Family-based obesity treatment, then and now: Twenty-five years of pediatric obesity treatment. *Health Psychology*, 26(4), 381.
- Erdley, C. A., Nangle, D. W., Newman, J. E., & Carpenter, E. M. (2001). Children's friendship experiences and psychological adjustment: Theory and research. *New Directions for Child and Adolescent Development*, 2001(91), 5-24.
- Estabrooks, P. A., & Shetterly, S. (2007). The prevalence and health care use of overweight children in an integrated health care system. *Archives of Pediatrics & Adolescent Medicine*, 161(3), 222-227.
- Falkstedt, D., Hemmingsson, T., Rasmussen, F., & Lundberg, I. (2006). Body mass index in late adolescence and its association with coronary heart disease and stroke in middle age among Swedish men. *International Journal of Obesity*, 31(5), 777-783.
- Ford, C. A., Nonnemaker, J. M., & Wirth, K. E. (2008). The influence of adolescent body mass index, physical activity, and tobacco use on blood pressure and cholesterol in young adulthood. *Journal of Adolescent Health*, 43(6), 576-583.
- Foster, G. D., Sherman, S., Borradaile, K. E., Grundy, K. M., Vander Veur, S. S., Nachmani, J., . . . Shults, J. (2008). A policy-based school intervention to prevent overweight and obesity. *Pediatrics*, 121(4), e794-802. doi:10.1542/peds.2007-1365; 10.1542/peds.2007-1365

- Fowler, T., Shelton, K., Lifford, K., Rice, F., McBride, A., Nikolov, I., . . . Van Den Bree, M. (2007). Genetic and environmental influences on the relationship between peer alcohol use and own alcohol use in adolescents. *Addiction*, 102(6), 894-903.
- Fox, M. K., Dodd, A. H., Wilson, A., & Gleason, P. M. (2009). Association between school food environment and practices and body mass index of US public school children. *Journal of the American Dietetic Association*, 109(2), S108-S117.
- Greening, L., Harrell, K. T., Low, A. K., & Fielder, C. E. (2011). Efficacy of a School- Based childhood obesity intervention program in a rural southern community: TEAM mississippi project. *Obesity*, 19(6), 1213-1219.
- Hampl, S. E., Carroll, C. A., Simon, S. D., & Sharma, V. (2007). Resource utilization and expenditures for overweight and obese children. *Archives of Pediatrics & Adolescent Medicine*, 161(1), 11-14.
- 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(01), 77-85.
- Heo, G. J., Nam, S. Y., & Lee, S. (2013). Factors associated with obesity among korean adolescents. *Health (1949-4998)*, 5(8)
- 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(6), 533-545.
- Hlaing, W. M., Messiah, S. E., Lipshultz, S. E., & Ludwig, D. A. (2011). Obesity and length of hospital stay in children: A retrospective review of florida agency for health care administration data. *Progress in Pediatric Cardiology*, 31(1), 67-72.
- Ho, M., Garnett, S. P., Baur, L., Burrows, T., Stewart, L., Neve, M., & Collins, C. (2012). Effectiveness of lifestyle interventions in child obesity: Systematic review with meta-analysis. *Pediatrics*, 130(6), e1647-71. doi:10.1542/peds.2012-1176; 10.1542/peds.2012-1176
- Hoffman, B. R., Monge, P. R., Chou, C., & Valente, T. W. (2007). Perceived peer influence and peer selection on adolescent smoking. *Addictive Behaviors*, 32(8), 1546-1554.
- Hong, D. S. (2008). Building partnership and collaborations for obesity prevnetion program in school. [비만 사업 실행을 위한 학교 내 협력체계 구축] *Jornal of Korean Society of School Health*, 21(1), 67-72.
- In, Y. T. (2012). The role of schools for preventing adolescent obesity. [청소년 비만 문제의 해결을 위한 학교의 역할] *Journal of Korean Society for the Study of Physical Education*, 17(3), 91-104.
- Janssen, I., Craig, W. M., Boyce, W. F., & Pickett, W. (2004). Associations between overweight and obesity with bullying behaviors in school-aged children. *Pediatrics*, 113(5), 1187-1194.
- Janssen, I., Katzmarzyk, P. T., Boyce, W. F., King, M. A., & Pickett, W. (2004). Overweight and obesity in canadian adolescents and their associations with dietary habits and physical activity patterns. *Journal of Adolescent Health*, 35(5), 360-367.
- Janssen, I., Katzmarzyk, P. T., Boyce, W. F., Vereecken, C., Mulvihill, C., Roberts, C., . . . Pickett, W. (2005). Comparison of overweight and obesity prevalence in school- aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity Reviews*, 6(2), 123-132.



- Janssen, I., Boyce, W. F., Simpson, K., & Pickett, W. (2006). Influence of individual- and area-level measures of socioeconomic status on obesity, unhealthy eating, and physical inactivity in canadian adolescents. *The American Journal of Clinical Nutrition*, 83(1), 139-145.
- Kalarchian, M. A., Levine, M. D., Arslanian, S. A., Ewing, L. J., Houck, P. R., Cheng, Y., . . . Marcus, M. D. (2009). Family-based treatment of severe pediatric obesity: Randomized, controlled trial. *Pediatrics*, 124(4), 1060-1068. doi:10.1542/peds.2008-3727; 10.1542/peds.2008-3727
- Kaphingst, K. M., & French, S. (2006). The role of schools in obesity prevention. *The Future of Children*, 16(1), 109-142.
- Karnik, S., & Kanekar, A. (2012). Childhood obesity: A global public health crisis. *International Journal of Preventive Medicine*, 3(1), 1-7.
- Kim, J. H., & Lee, D. Y. (2012). Factors associated with consumption of fast food by korean adolescents - analysis of 2007 survey data from the national youth policy institute-. [한국 청소년의 패스트푸드 섭취와 상관되는 요인-2007 청소년 생활, 의식 실태 조사 분석-] *Korean Society for the Study of Obesity*, 21(1), 37-44.
- Kim, H. M., Park, J., Kim, H. S., Kim, D. H., & Park, S. H. (2006). Obesity and cardiovascular risk factors in korean children and adolescents aged 10-18 years from the korean national health and nutrition examination survey, 1998 and 2001. *American Journal of Epidemiology*, 164(8), 787-793. doi:10.1093/aje/kwj251
- Ko, J. A. (2008). Childhood obesity and familial environmental factor according to the developmental stages: The korea NHANES study. *Journal of the Korean Academy of Family Medicine*, 29(12), 939-947.
- Korea Centers for Disease Control and prevention. (2007). *The third adolescent health policy forum* [제 3차 청소년 건강 정책 포럼]. (). Seoul, Republic of Korea: Korea Centers for Disease Control and prevention.
- Lee, S.R. & Kim, J. H. (2011). The effect of obesity on the adolescent development in korea. [비만이 청소년 발달에 미치는 영향] *Korean Association of Youth Welfare*, 13(4), 91-117.
- Lightwood, J., Bibbins-Domingo, K., Coxson, P., Wang, Y. C., Williams, L., & Goldman, L. (2009). Forecasting the future economic burden of current adolescent overweight: An estimate of the coronary heart disease policy model. *American Journal of Public Health*, 99(12), 2230-2237. doi:10.2105/AJPH.2008.152595; 10.2105/AJPH.2008.152595
- Lohman, B. J., Stewart, S., Gundersen, C., Garasky, S., & Eisenmann, J. C. (2009). Adolescent overweight and obesity: Links to food insecurity and individual, maternal, and family stressors. *Journal of Adolescent Health*, 45(3), 230-237.
- Lumeng, J. C., Forrest, P., Appugliese, D. P., Kaciroti, N., Corwyn, R. F., & Bradley, R. H. (2010). Weight status as a predictor of being bullied in third through sixth grades. *Pediatrics*, 125(6), e1301-7. doi:10.1542/peds.2009-0774; 10.1542/peds.2009-0774
- Maes, L., & Lievens, J. (2003). Can the school make a difference? A multilevel analysis of adolescent risk and health behaviour. *Social Science & Medicine*, 56(3), 517-529.
- McGovern, L., Johnson, J. N., Paulo, R., Hettinger, A., Singhal, V., Kamath, C., . . . Montori, V. M. (2008). Treatment of pediatric obesity: A systematic review and meta-analysis of randomized trials. *Journal of Clinical Endocrinology & Metabolism*, 93(12), 4600-4605.

- McNaughton, S. A., Ball, K., Mishra, G. D., & Crawford, D. A. (2008). Dietary patterns of adolescents and risk of obesity and hypertension. *The Journal of Nutrition*, 138(2), 364-370.
- Mercken, L., Snijders, T. A., Steglich, C., Vertiainen, E., & De Vries, H. (2010). Smoking-based selection and influence in gender-segregated friendship networks: A social network analysis of adolescent smoking. *Addiction*, 105(7), 1280-1289.
- Ministry of Education. (2009). *Report about school meals in 2008* (2008 학교 급식 현황). ( ). Sejong, Republic of Korea: Ministry of Education.
- Ministry of Health and Wellness & Korea Centers for Disease Control and Prevention. (2013). *2012 Korea health statistics: Korea national health and nutrition examination survey (KNHANES V-3)* [2012 국민 건강 통계: 국민건강 영양 조사 제 5기 3차년도]. ( No. 5). Sejong, Republic of Korea: Ministry of Health and Wellness.
- Ministry of Science, ICT, and Future Planning. (2013). *Research for improvement of quality of life for citizens*. Gwacheon, Republic of Korea: Ministry of Science, ICT, and Future Planning.
- Ministry of Science, ICT, and Future Planning. (2014). *An investment for eight health problems regarding lifestages*. Gwacheon, Republic of Korea: Ministry of Science, ICT, and Future Planning.
- Misra, A., & Khurana, L. (2008). Obesity and the metabolic syndrome in developing countries. *Journal of Clinical Endocrinology & Metabolism*, 93(11\_supplement\_1), s9-s30.
- Mond, J., Van den Berg, P., Boutelle, K., Hannan, P., & Neumark-Sztainer, D. (2011). Obesity, body dissatisfaction, and emotional well-being in early and late adolescence: Findings from the project EAT study. *Journal of Adolescent Health*, 48(4), 373-378.
- Moreno, L. A., Pigeot, I., & Ahrens, W. (2011). *Epidemiology of obesity in children and adolescents: Prevalence and Etiology*. Nueva York: Springer,
- Mota, J., Fidalgo, F., Silva, R., Ribeiro, J. C., Santos, R., Carvalho, J., & Santos, M. P. (2008). Relationships between physical activity, obesity and meal frequency in adolescents. *Annals of Human Biology*, 35(1), 1-10.
- Narayan, K. M., Boyle, J. P., Thompson, T. J., Gregg, E. W., & Williamson, D. F. (2007). Effect of BMI on lifetime risk for diabetes in the U.S. *Diabetes Care*, 30(6), 1562-1566. doi:10.2337/dc06-2544
- Nash, S. G., McQueen, A., & Bray, J. H. (2005). Pathways to adolescent alcohol use: Family environment, peer influence, and parental expectations. *Journal of Adolescent Health*, 37(1), 19-28.
- O'toole, T. P., Anderson, S., Miller, C., & Guthrie, J. (2007). Nutrition services and foods and beverages available at school: Results from the school health policies and programs study 2006. *Journal of School Health*, 77(8), 500-521.
- O'Dea, J. A. (2006). Self-concept, self-esteem and body weight in adolescent females: A three-year longitudinal study. *Journal of Health Psychology*, 11(4), 599-611. doi:10.1177/1359105306065020
- Oh, K., Jang, M. J., Lee, N. Y., Moon, J. S., Lee, C. G., Yoo, M. H., & Kim, Y. T. (2008). Prevalence and trends in obesity among Korean children and adolescents in 1997 and 2005. *Korean Journal of Pediatrics*, 51(9), 950-955.
- Papalia, D. E., Olds, S. W., & Feldman, R. D. (Eds.). (2005). *Human development* (10th ed.). New York, NY: McGraw Hill.

- Park, J., Hilmers, D. C., Mendoza, J. A., Stuff, J. E., Liu, Y., & Nicklas, T. A. (2010). Prevalence of metabolic syndrome and obesity in adolescents aged 12 to 19 years: Comparison between the United States and Korea. *Journal of Korean Medical Science*, 25(1), 75-82.
- Park, M. J., Boston, B. A., Oh, M., & Jee, S. H. (2009). Prevalence and trends of metabolic syndrome among Korean adolescents: From the Korean NHANES survey, 1998-2005. *The Journal of Pediatrics*, 155(4), 529-534. e1.
- Parke, R. D., & Buriel, R. (2008). Socialization in family: Ethnic and ecological perspectives. In W. Damon, & R. M. Lerner (Eds.), *Child and adolescent development: An advanced course* (pp. 95-138). Hoboken, NJ: John Wiley & Sons.
- Pearson, N., Atkin, A. J., Biddle, S. J., Gorely, T., & Edwardson, C. (2010). Parenting styles, family structure and adolescent dietary behaviour. *Public Health Nutrition*, 13(08), 1245-1253.
- Puhl, R. M., Luedicke, J., & Heuer, C. (2011). Weight- Based victimization toward overweight adolescents: Observations and reactions of peers. *Journal of School Health*, 81(11), 696-703.
- Rey-Lopez, J. P., Vicente-Rodríguez, G., Biosca, M., & Moreno, L. A. (2008). Sedentary behaviour and obesity development in children and adolescents. *Nutrition, Metabolism and Cardiovascular Diseases*, 18(3), 242-251.
- Roseman, M. G., Yeung, W. K., & Nickelsen, J. (2007). Examination of weight status and dietary behaviors of middle school students in Kentucky. *Journal of the American Dietetic Association*, 107(7), 1139-1145.
- Salvy, S. J., Bowker, J. C., Germeroth, L., & Barkley, J. (2012). Influence of peers and friends on overweight/obese youths' physical activity. *Exercise and Sport Sciences Reviews*, 40(3), 127-132. doi:10.1097/JES.0b013e31825af07b; 10.1097/JES.0b013e31825af07b
- Savoie, M., Nowicka, P., Shaw, M., Yu, S., Dziura, J., Chavent, G., . . . Caprio, S. (2011). Long-term results of an obesity program in an ethnically diverse pediatric population. *Pediatrics*, 127(3), 402-410. doi:10.1542/peds.2010-0697; 10.1542/peds.2010-0697
- Seoul Metropolitan Office of Education. (2008). *Guideline for school health 2008*. Seoul, Republic of Korea: Seoul Metropolitan Office of Education.
- Shin, N. Y., & Shin, M. S. (2008). Body dissatisfaction, self-esteem, and depression in obese Korean children. *The Journal of Pediatrics*, 152(4), 502-506.
- Simpkins, S. D., Schaefer, D. R., Price, C. D., & Vest, A. E. (2013). Adolescent friendships, BMI, and physical activity: Untangling selection and influence through longitudinal social network analysis. *Journal of Research on Adolescence*, 23(3), 537-549.
- Sjöberg, A., Hallberg, L., Höglund, D., & Hulthén, L. (2003). Meal pattern, food choice, nutrient intake and lifestyle factors in the göteborg adolescence study. *European Journal of Clinical Nutrition*, 57(12), 1569-1578.
- Song, Y., Park, M. J., Paik, H., & Joung, H. (2010). Secular trends in dietary patterns and obesity-related risk factors in Korean adolescents aged 10-19 years. *International Journal of Obesity*, 34(1), 48-56.
- Song, Y., Joung, H., Engelhardt, K., Yoo, S. Y., & Paik, H. Y. (2005). Traditional v. modified dietary patterns and their influence on adolescents' nutritional profile. *British Journal of Nutrition*, 93(06), 943-949.
- Steinberg, L. (2001). We know some things: Parent-adolescent relationships in retrospect and prospect. *Journal of Research on Adolescence*, 11(1), 1-19.

- Story, M., Nannery, M. S., & Schwartz, M. B. (2009). Schools and obesity prevention: Creating school environments and policies to promote healthy eating and physical activity. *Milbank Quarterly*, 87(1), 71-100.
- Suchindran, C., North, K. E., Popkin, B. M., & Gordon-Larsen, P. (2010). Association of adolescent obesity with risk of severe obesity in adulthood. *Journal of American Medical Association*, 304(18), 2042-2047.
- Townsend, N., & Foster, C. (2011). Developing and applying a socio-ecological model to the promotion of healthy eating in the school. *Public Health Nutrition*, 13, 1-8.
- Trasande, L. (2011). Quantifying the economic consequences of childhood obesity and potential benefits of interventions. *Expert Review of Pharmacoeconomics & Outcomes Research*, 11(1), 47-50.
- Trasande, L., Liu, Y., Fryer, G., & Weitzman, M. (2009). Effects of childhood obesity on hospital care and costs, 1999-2005. *Health Affairs (Project Hope)*, 28(4), w751-60. doi:10.1377/hlthaff.28.4.w751 [doi]
- Tsiros, M. D., Sinn, N., Coates, A. M., Howe, P. R., & Buckley, J. D. (2008). Treatment of adolescent overweight and obesity. *European Journal of Pediatrics*, 167(1), 9-16.
- van der Horst, K., Timperio, A., Crawford, D., Roberts, R., Brug, J., & Oenema, A. (2008). The school food environment: Associations with adolescent soft drink and snack consumption. *American Journal of Preventive Medicine*, 35(3), 217-223.
- van der Horst, K., Kremers, S., Ferreira, I., Singh, A., Oenema, A., & Brug, J. (2007). Perceived parenting style and practices and the consumption of sugar-sweetened beverages by adolescents. *Health Education Research*, 22(2), 295-304. doi:10.1093/her/cyl080
- Voorhees, C. C., Murray, D., Welk, G., Birnbaum, A., Ribisl, K. M., Johnson, C. C., . . . Jobe, J. B. (2005). The role of peer social network factors and physical activity in adolescent girls. *American Journal of Health Behavior*, 29(2), 183-190.
- Wang, Y., & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity*, 1(1), 11-25.
- Wechsler, H., McKenna, M. L., Lee, S. M., & Dietz, W. H. (2004). The role of schools in preventing childhood obesity. *The State Education Standard*, December, 4-12.
- Weiss, R., Dziura, J., Burgert, T. S., Tamborlane, W. V., Taksali, S. E., Yeckel, C. W., . . . Morrison, J. (2004). Obesity and the metabolic syndrome in children and adolescents. *New England Journal of Medicine*, 350(23), 2362-2374.
- Williams, S. L., & Mummery, W. K. (2011). Links between adolescent physical activity, body mass index, and adolescent and parent characteristics. *Health Education & Behavior : The Official Publication of the Society for Public Health Education*, 38(5), 510-520. doi:10.1177/1090198110385772; 10.1177/1090198110385772
- Williamson, D. A., Copeland, A. L., Anton, S. D., Champagne, C., Han, H., Lewis, L., . . . Stewart, T. (2007). Wise mind project: A School- based environmental approach for preventing weight gain in children. *Obesity*, 15(4), 906-917.
- Wilson, L. F. (2007). Adolescents' attitudes about obesity and what they want in obesity prevention programs. *The Journal of School Nursing*, 23(4), 229-238.

## CHAPTER II.

### THE INFLUENCE OF PEERS ON DIET AND EXERCISE AMONG ADOLESCENTS: A SYSTEMATIC REVIEW

#### Abstract

**Purpose:** Diet and exercise of adolescents are modifiable factors contributing to high rates of adolescent obesity. Diverse contextual factors, including family, social environment, and peers, affect adolescents' diet and exercise behaviors. Thus, these factors should be examined as potential targets for intervention to reduce the prevalence of adolescent obesity. The purpose of this systematic review is to present the findings of the research to date examining the contribution of peers to diet and exercise of adolescents.

**Methods:** A broad search of electronic databases, including PubMed, CINAHL, Web of Science, and SCOPUS, was conducted.

**Results:** A total of 24 articles were included in this review: seven examined diet only, fourteen studied exercise only, and three explored diet and exercise. This review provided evidence that diet and exercise of adolescents were significantly associated with those of their peers. However, these associations differed depending on gender, the type of diet and exercise, and the closeness of friends.

**Conclusions:** The findings from this review suggest that peer factors are related to adolescents' diet and exercise, providing possible targets for peer-based interventions to promote healthier diet and exercise among adolescents.

## Introduction

Globally, adolescent obesity is a significant public health problem. The prevalence of adolescent obesity has been increasing in developed countries for decades (Wang & Lobstein, 2006). Adolescent obesity can negatively influence current and future physical (Falkstedt, Hemmingsson, Rasmussen, & Ludnberg, 2006; Ford, Nonnemaker, & Wirth, 2008; Tirosh et al., 2011) and psychological health (Mond, Van den erg, Boutelle, Hannan, & Neumark-Sztainer, 2011; O'Dea, 2006; Puhl, Luedicke, & Heuer, 2011), while also increasing medical costs (Estabrooks & Shetterly, 2007; Hampl, Carroll, Simon, & Sharma, 2007; Hlaing, Messiah, Lipshultz, & Ludwig, 2011). Because of the potential negative consequences, it is important to intervene early to either prevent adolescent obesity or reduce its prevalence and related health issues.

In order to reduce obesity rates in adolescents, the World Health Organization (WHO, 2015) issued recommendations for diet and exercise, designed to support a proper balance between calorie intake and expenditure. The WHO provides guidelines for physical activity and recommends increasing whole grain, fruit and vegetable intake and restricting total fat consumption. Several researchers have found the effectiveness of interventions including healthy diets and adequate exercise for controlling weight during adolescence (Barlow & Committee, 2007; Epstein, Paluch, Roemmich, & Beecher, 2007; Savoye et al., 2011).

In addition, countries in North America, Europe, and Asia support adoption of healthier diets and exercise behaviors for adolescents. In the United States, the Healthy People 2020 initiative highlights behavioral interventions and dietary guidelines to reduce the prevalence of obesity in adolescents aged 12 to 19 years (Office of Disease Prevention and Health Promotion, 2015). Similarly, in the United Kingdom, the National Child Measurement Programme (NCMP)

has been established not only to monitor the prevalence of obesity but also to provide information about healthy lifestyles and weight control (Public Health England, 2015). In Korea, the prevalence of adolescent obesity is lower than in North America or Europe, but it is steadily increasing (*Statistics for 2013 Korea Youth Risk Behaviors Web-Based Survey*, 2014); therefore, intervening early in order to prevent further increases in adolescent obesity, by increasing physical activity and modifying eating behavior has become a governmental and educational priority in Korea (Noh, 2013). A first step in achieving the goals of healthy diet and exercise for all adolescents is to understand what factors influence those behaviors.

Studies in other countries have identified diverse factors related to diet and exercise among adolescents. Many studies have focused on the roles of parents and school. Developmentally, relationships between adolescents and their parents evolve from those established in childhood, with adolescents becoming more independent from their parents over time. However, parents continue to influence perspectives and behaviors of adolescents (Laursen & Collins, 2009; Smetana, Campione-Barr, & Metzger, 2006). Parental diet and exercise (Arcan et al., 2007; Salvy, Elmo, Nitecki, Kluczynski, & Roemmich, 2011), monitoring behaviors (Ornelas, Perreira, & Ayala, 2007; Stewart & Menning, 2009), and support to adolescents (Bauer, Neumark-Sztainer, Hannan, Fulkerson, & Story, 2011; Dowda, Dishman, Pfeiffer, & Pate, 2007; Hohepa et al., 2007) influence adolescent diet and exercise.

School factors also influence adolescents' diet and exercise behaviors (Kaphingst & French, 2006; Story, Nannery, & Schwartz, 2009). Studies have examined the availability of specific foods in schools, school breakfast and lunch programs, and school physical education programs as factors that contribute to adolescents' overall diet and exercise (Bauer et al., 2011; Fox, Dodd, Wilson, & Gleason, 2009; Kaphingst & French, 2006; Story et al., 2009). The availability of

certain food items at school was found to be associated with increasing intake of these foods among adolescents (Bigornia et al., 2014; Minaker et al., 2011; Rovner et al., 2011; Wiecha, Finkelstein, Troped, Fragala, & Peterson, 2006). Relative to the accessibility of physical activity facilities in school, some researchers found that the provision of any physical activity facilities could be positively associated with the improvement of adolescents' exercise (Durant et al., 2009; Haug, Torsheim, Sallis, & Samdal, 2010), while others found no associations between access to physical activity facilities and adolescents' exercise (Kirby, Levin, & Inchley, 2012; Scott et al., 2007).

Peers are another contributing factor to adolescents' diet and exercise. As adolescents become more independent from their parents, they spend more time with their friends (Brown & Larson, 2009), and the importance of peer relationships increases (Collins & Steinberg, 2008; Papalia, Olds, & Feldman, 2005). In addition, during adolescence, peer relationships become more important than during childhood and preadolescence, as their influence peaks during adolescence (Brown & Larson, 2009; Collins & Steinberg, 2008; Erdley, Nangle, Newman, & Carpenter, 2001). Therefore, peers could play an important role in diet and exercise of adolescents, along with other factors such as parents and school. However, the impact of peers on adolescents' diet and exercise behaviors has been studied less than that of parents and school. It is important to identify what is currently known about the influence of peers on the diet and exercise behaviors of adolescents in order to develop appropriate interventions that support healthy diet and exercise.

Therefore, the purpose of this systematic review was to examine the research to date on the contribution of peers to diet and exercise behaviors of adolescents. The review identifies which peer factors and diet and exercise behaviors were assessed, and whether any relationships among



diet, exercise, and peer factors were found. This review was conducted and reported according to the PRISMA guidelines (Appendix) (Liberati et al., 2009; Moher, Liberati, Tetzlaff, Altman, and the PRISAM group, 2009).

## Method

### *Information sources & Search strategy*

The following keywords were used to search the literature in the electronic databases PubMed and CINAHL in May and June 2014: [Adolescent] AND [Obesity] AND [Friends OR Peer network OR peer]. MeSH terms for PubMed and subject terms for CINAHL were also applied. Once the list of articles from PubMed and CINAHL was created, Web of Science and SCOPUS were searched in June 2014 to identify additional studies that cited or were related to articles from the initial list.

### *Inclusion and exclusion criteria*

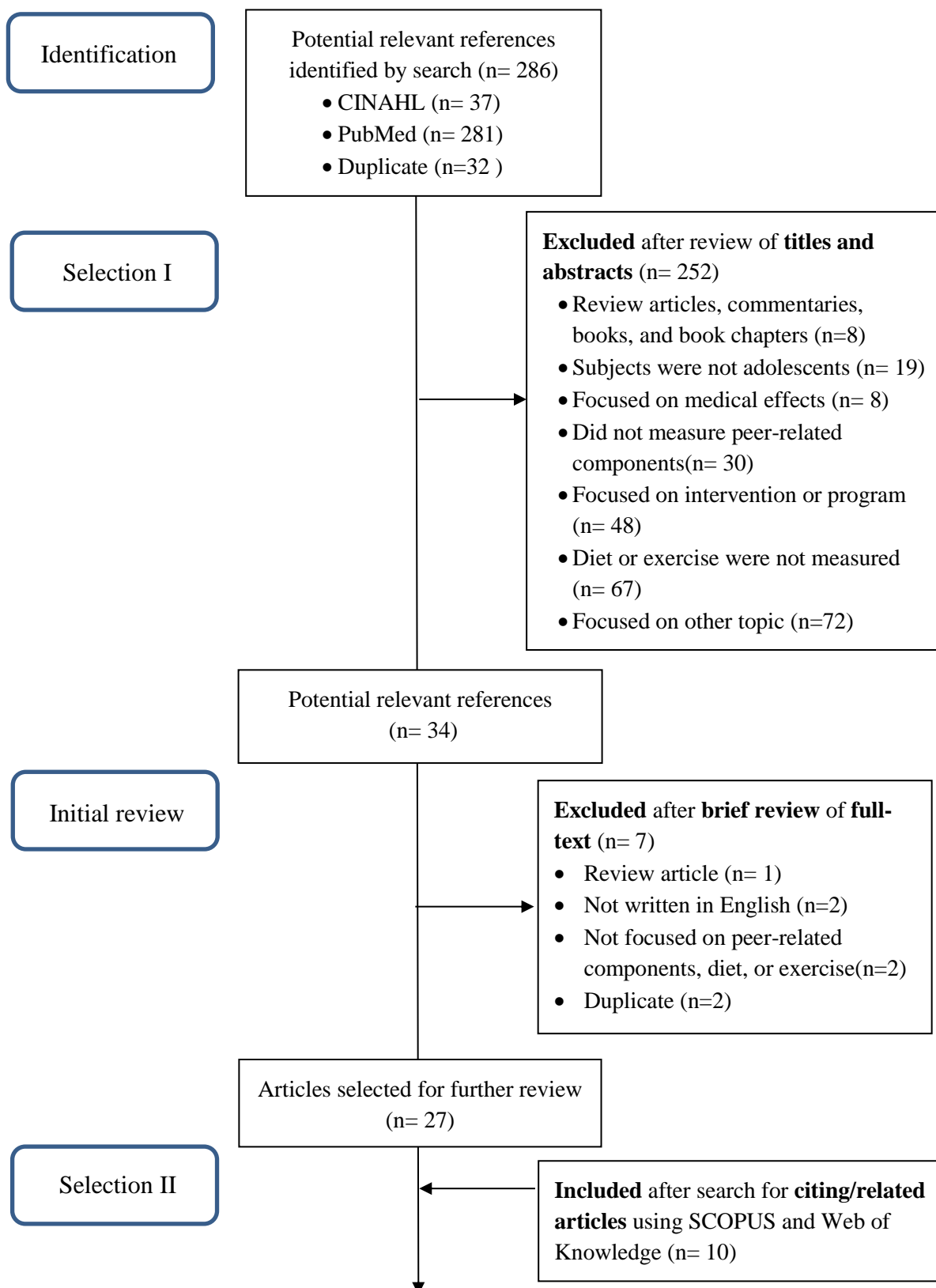
Articles included were those that (1) were published in English, (2) were published between 2004 and 2014, (3) included a sample aged 13-19 years, and (4) examined diet or exercise or both. Articles excluded were (1) review articles, commentaries, books, or book chapters, (2) animal studies, (3) examinations of medical effects, such as outcomes from surgery, and (4) evaluation of specific interventions.

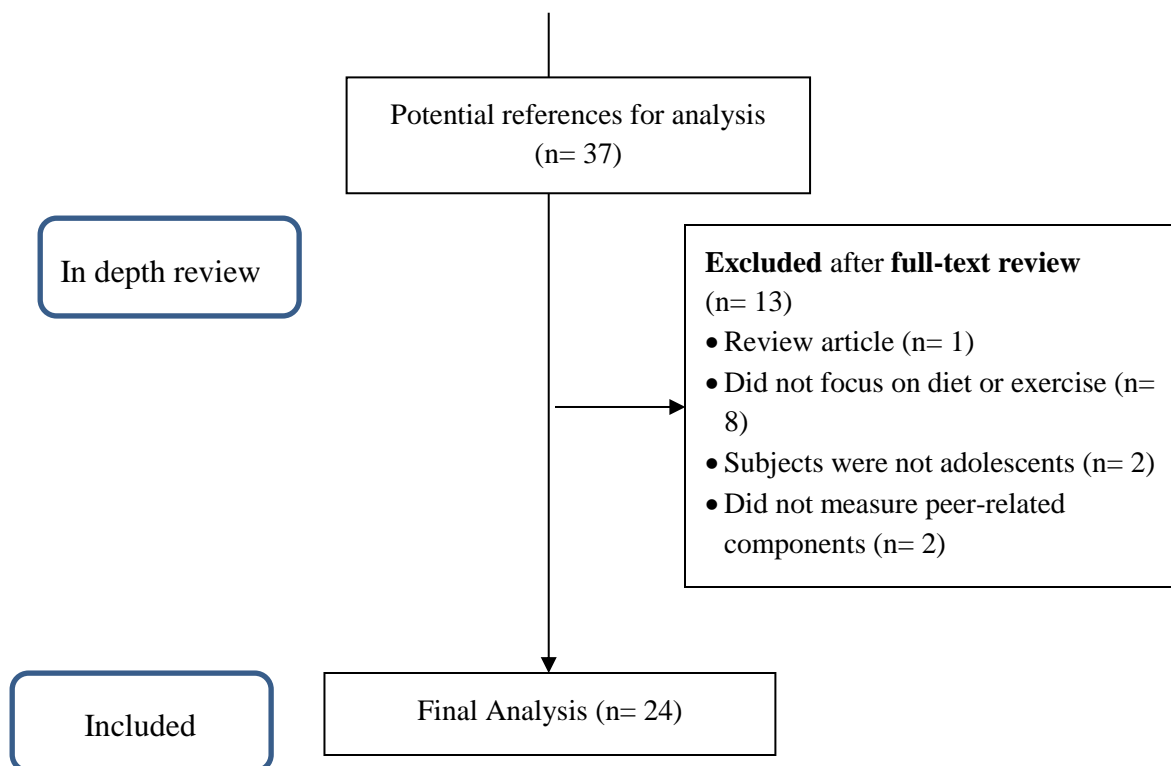
### *Data extraction*

The data extraction process is summarized in Figure 2.1. Studies under consideration were evaluated according to the inclusion and exclusion criteria. The initial search strategy identified 286 unique articles after duplicates were removed. Titles and abstracts of these studies were screened by one reviewer (SJC). An independent reviewer (ALE) then performed a second

screening using titles and abstracts to establish agreement on eligibility for inclusion. After 252 articles were excluded, the initial review of 34 full text articles was conducted. This review identified an additional 7 articles that did not meet inclusion criteria, yielding a list of 27 complete articles. The first reviewer (SJC) then used Web of Science and SCOPUS to identify articles that cited or were related to these 27 full text articles. Of 83 articles identified through this search, 10 unique citing or related articles meeting the inclusion criteria were identified by both reviewers. After final, in-depth review of the 37 complete articles, 24 articles were ultimately included in this systematic review.

Figure 2.1. Flow chart of the study selection process





## Results

The 24 studies included in this systematic review examined peer factors and their relationship to diet and exercise in adolescents. However, the studies differed in their focus: seven studied diet only, fourteen examined exercise only, and three focused on both diet and exercise.

### *Diet Only*

Table 2.1 summarizes the seven studies that assessed diet and peer factors. Three were conducted in the United States; the remaining four were done in Australia, the Netherlands, Fiji, and South Africa. Two qualitative studies examined the contribution of parent or school factors in addition to those related to peers (Waqā & Mavoa, 2006; Voorend et al., 2013). The five quantitative studies, one of which was experimental, measured peer factors only (Bruening et al., 2012; Bruening et al., 2014; De la Haye, Robins, Mohr, & Wilson, 2013; Salvy, Howard, Read, & Mele, 2009; Wouters, Larsen, Kremers, Dagnelie, & Geenen, 2010). The smallest sample size was 58, comprising only female participants (Voorend et al., 2013); the largest was 2,793, including both males and females (Bruening et al., 2012).

Peer-related data were collected using three different approaches: 1) having participants nominate friends, 2) observing the behavior of participants in the presence of familiar or unfamiliar peers within a controlled setting, or 3) interviewing the friends of participants. In four of the studies, food consumption or food frequency was evaluated by self-report or observation (Bruening et al., 2012; Bruening et al., 2014; De la Haye et al., 2013; Wouters et al., 2010). In the two qualitative studies, the eating behaviors of participants were obtained by asking for their thoughts about diet and their food choices (Waqā & Mavoa, 2006; Voorend et al., 2013).

Significant associations were found between adolescents' and friends' diets. When the intake of different kinds of food such as soft drinks (Bruening et al., 2014; Wouters et al., 2010) and snacks (Wouters et al., 2010) was examined, friends' intake was found to be an influential factor for adolescents' food intake. However, Bruening et al. (2012) found that the significance of that association differed, depending on the kind of food. Significant positive associations were found for intake of whole grain and dairy foods between adolescents and their friends; no association was found for fruit intake (Bruening et al., 2012). In addition, positive associations between adolescents' and their best friends' vegetable intake were found; however, there were no significant associations of vegetable intake between adolescents and more casual friends (Bruening et al., 2012). De la Haye et al. (2013) examined the influence of peers on food consumption over time and found that similar patterns of food intake among adolescents and their peers persisted over one year.

The two qualitative studies explored why adolescents and their peers had similar diets. Findings showed that adolescents shared food with their friends (Waq & Mavo, 2006; Voorend et al., 2013) and discussed their food choices or food intake with their friends (Waq & Mavo, 2006). Both studies reported that these behaviors could easily occur at school or in shopping malls where adolescents tend to spend time with their peers (Waq & Mavo, 2006; Voorend et al., 2013), where adolescents tend to spend time with their peers. Because adolescents shared food with their friends and ate lunches or snacks together, similar patterns of food consumption were observed among adolescents and their peers.

### *Exercise Only*

Table 2.2 summarizes the fourteen studies that examined exercise only. These studies were conducted in the United States (n=7), Europe (n=4), Australia (n=2), and Brazil (n=1). Nine studies were cross-sectional, while five were longitudinal. Sample sizes varied greatly: the smallest sample was 20 (Salvy et al., 2008) and the largest, 2,793 (Graham, Wall, Larson, & Neumark-Sztainer, 2014).

Methods of measurement also varied. In nine studies, participants were asked to nominate their friends. Two of these studies asked additional questions to further characterize friends and their relationships with adolescents, such as how often participants spent time with their friends and whether the nominated friends were physically active (Graham, Wall, Larson, & Neumark-Sztainer, 2014; Voorhees et al., 2005). In four studies, support from peers or peer encouragement were measured by asking whether adolescents perceived any support or encouragement from their friends for participating in physical activities (Cheng, Mendonca, & Junior, 2014; Keresztes, Piko, Pluhar, & Page, 2008; Kirby et al., 2011; Zook, Saksvig, Wu, & Young, 2014). Peer factors were also measured by observing the physical activity of participants in the presence of peers (Salvy, et al., 2008) and asking adolescents about how difficult they found making new friends, as well as the amount of times they spent with friends (Page, Ihasz, Simonek, Klarova, & Hantiu, 2006).

Exercise was examined either by self-report questionnaires or by accelerometers or pedometers. Various self-report instruments were used, such as the Physical Activity Questionnaire for Children (PAQ-C), the Youth Risk Behavior Survey, and the International Physical Activity Questionnaire (IPAQ) (Graham, Wall, Larson, & Neumark-Sztainer, 2014; Kirby et al., 2011; Lopes, Gabbard, & Rodrigues, 2013; Page et al., 2006; Sirard et al., 2013;

Voorhees et al., 2005). Adolescents were asked how frequently they participated in formal sports teams and how many hours they engaged in exercise (e.g. moderate or vigorous physical activities) or in sedentary behaviors (e.g. watching TV or playing computer games) during specific time periods (e.g. a week or a year) (Cheng et al., 2014; De La Haye, Robins, Mohr, & Wilson, 2011; Keresztes, Piko, Pluhar, & Page, 2008; Salvy et al., 2008; Shoham et al., 2012; Simpkins, Schaefer, Price, & Vest, 2013). In other studies, accelerometers or pedometers were used to assess the frequency and intensity of physical activity during specific periods (e.g. four days) (Schofield, Mummery, Schofield, & Hopkins, 2007; Zook et al., 2014).

Most studies found significantly positive associations between adolescents' and peers' exercise. Adolescents were more likely to engage in exercise when their peers spent more time on exercise (Cheng, Mendonca, & Junior., 2014; Graham, Wall, Larson, & Neumark-Sztainer, 2014; Lopes, Gabbard, & Rodrigues, 2013; Sirard et al., 2013; Voorhees et al., 2005); when they had more physically active friends (Schofield et al., 2007); or when they were with their peers, compared to being alone (Salvy et al., 2008). Two longitudinal studies (Kirby, Levin, & Inchley, 2011; Simpkins et al., 2013) indicated that the influence of peers on adolescents' physical activity was maintained over time.

The influence of peers on adolescents' physical activity differed depending on gender and the closeness of the relationship. Three studies found no gender difference in associations between adolescents' and their peers' physical activities (Cheng, Mendonca, & Junior, 2014; Graham, Wall, Larson, & Neumark-Sztainer, 2014; Kirby, Levin, & Inchley, 2011); however, two other studies did identify differences related to gender, and the type of physical activities examined (Page et al., 2006; Sirard et al., 2013). Sirard and colleagues found that adolescents' and their opposite-sex friends' moderate to vigorous physical activity levels were positively



associated. However, positive associations of screen time were only found for female adolescents and their opposite-sex friends, not among male adolescents and their opposite-sex friends. Page and colleagues (2006) focused on muscle-strengthening exercises, and found a positive association for males but not females. Two studies explored closeness of peer-adolescent relationships, and found that closer or best friends had a greater influence on physical activity of adolescents than more casual friends (Schofield et al., 2007; Sirard et al., 2013).

### *Both diet and exercise*

Only three of the 24 studies examined both diet and exercise (see Table 2.3). One was cross-cultural, collecting data from Hungary, Poland, Turkey, and the United States (Luszczynska, Gibbons, Piko, & Tekozel, 2004). The other studies were conducted in Australia (De la Haye et al., 2010) and the United States (Ali, Amialchuk, & Heiland, 2011).

Peer-related data were collected from questionnaires in which adolescents nominated friends; responses of adolescents and their friends were then compared in two of the studies (Ali, Amialchuk, & Heiland, 2011; De la Haye et al., 2010). In the other study, the number of friends who engaged in certain behaviors (e.g. regular exercise) or were concerned about their own diet was obtained (Luszczynska et al., 2004), but not compared to findings from adolescents. To examine exercise, adolescents in all three studies were asked how frequently they engaged in exercise or how physically active they were. Diet was measured by asking how frequently adolescents monitored their diet, whether they had breakfast, and how often they had various foods such as fast food, high-calorie drinks, and fruits/vegetables.

In these three studies, diet and exercise of adolescents were positively associated with their friends' behaviors. These associations were found in same-sex friendships (De la Haye et al., 2010) and across countries (Luszczynska et al., 2004). However, when gender was included in

the analyses, findings for associations of specific behaviors with those of their peers differed. While similar sedentary behaviors were found only for female friendship networks, only male adolescents and their male friends had similar high-calorie food intake (De la Haye et al., 2010). After controlling for demographics such as age, gender, ethnicity, parental characteristics (e.g. parental education level, household income, and family rules for watching TV), and school-level characteristics (e.g. availability of vending machines, and physical activity facilities), peers influenced adolescents' engagement in exercise, playing active sports, and eating fast food (Ali et al., 2011). Across countries, if adolescents had more friends who were concerned about eating healthy food, they were more likely to have healthy dietary behaviors, although actual consumption of healthy foods differed (Luszczynska et al., 2004).

### Discussion

The results of this review provide evidence that diet and exercise of adolescents were positively related to those of their peers, although these associations differed depending on gender, the type of diet and exercise, and the closeness of friends. The associations between adolescents' diet and exercise and those of their peers could be partially explained by the importance of friendship and peer relationships in adolescence (Brown & Larson, 2009; Collins & Steinberg, 2008; Papalia, Olds, & Feldman, 2005). In addition, several studies revealed that associations of diet and exercise between adolescents and their peers persisted from one (De la Haye et al., 2013; Simpkins et al., 2013) to five years (Kirby, Levin, & Inchley, 2011).

Associations of dietary behaviors of adolescents and their friends were consistent across studies. Adolescents tend to share their food with friends and discuss the amount and type of food consumed (Waq & Mavo, 2006; Voorend et al., 2013), leading to similar dietary behaviors among adolescents and their peers. However, food intake associations also differed, depending

on the kind of food (Bruening et al., 2012). Because few studies examined diverse kinds of foods, more studies examining these associations are necessary.

In some studies, gender influenced exercise (Page et al., 2006; Sirard et al., 2013; De la Haye et al., 2010), but not in others (Cheng et al., 2014; Graham, Wall, Larson, & Neumark-Sztainer, 2014; Irby, Levin, & Inchley, 2011). Gender differences may be associated with the type of exercise evaluated; for female adolescents, time spent on muscle-strengthening exercise was not significantly associated with that of their peers, while positive associations were found for male adolescents and their friends (Page et al., 2006). However, in another study, levels of moderate to vigorous physical activity of female adolescents and their same-sex friends were positively associated, although no associations were found among male adolescents and their male friends (Graham, Wall, Larson, & Neumark-Sztainer, 2014; Sirard et al., 2013). Sedentary behaviors of female adolescents and their friends were also significantly associated, but this was not found for male adolescents (De la Haye et al., 2010; Sirard et al., 2013). Based on this review, gender is a potential moderator of the influence of peers on adolescents' exercise behaviors.

Relationship closeness also affected the association between adolescents' and their peers' diet and exercise. Page et al. (2006) asked adolescents how difficult they found it to make new friends and how frequently they spent time with friends. They found that spending time with friends was positively associated with adolescents' team sports participation, while difficulty making new friends was not. Bruening et al. (2012) and Schofield et al. (2007) found that best friends had a greater influence on diet and exercise than more casual friends. Adolescents tend to maintain existing friendships, and hesitate to make new friends (Collins & Steinberg, 2008); thus, they could be more susceptible to influences from established friendships than from new friends. In addition, adolescents interact more closely with their best friends (Miller & Hoicowitz, 2004)

and are known to share specific behaviors with them (Collins & Steinberg, 2008). Because of this, best friends could have a greater influence on diet and exercise compared to more casual friends.

Another interesting finding is the influence of opposite-sex friends. Beginning in early adolescence, the gender composition of friendships changes (Poulin & Pedersen, 2007), with mixed-sex friendship groups becoming more common (Collins & Steinberg, 2008). Thus, the influence of opposite-sex friends' exercise on adolescents' exercise was observed in some studies (Graham, Wall, Larson, & Neumark-Sztainer, 2014; Sirard et al., 2013), although the influence of same-sex friends was maintained (Schofield et al., 2007; Voorend et al., 2012). Sirard and colleagues found a relationship between the exercise behaviors of male and female adolescents and those of their opposite-sex friends. However, another study (Graham et al) found an association only for female adolescents' exercise with that of their male friends, and not *vice versa*. Because few studies examined the influence of opposite-sex friendships on diet and exercise, further studies are needed.

Findings from this review have implications for clinical care and future research. First, it could be helpful for health care providers such as nurses to promote healthy diet and exercise for adolescents and their friends. Because school is where adolescents and their peers spend time together, school nurses could play an important role in intervening with adolescents' and their peers' diet and exercise. School-based assessment of adolescents' diet and exercise could facilitate development of effective peer-based interventions in school settings. School nurses are ideally suited to performing these assessments, and identifying appropriate interventions for the school setting, with contributions from school administrators, nutritionists, and educators.

Next, gender may be important for healthier diet and exercise of adolescents when interventions are planned. Because sedentary behaviors among female adolescents were positively related, providing peer involved interventions for female adolescents could be effective to improve their physical inactivity. However, those behaviors between male adolescents and their same-sex friends were not associated, and peer-based interventions might not be appropriate to improve male adolescents' sedentary behaviors. Because some studies indicated the importance of opposite-sex friends on adolescents' exercise, considering mixed-sex friendship could be helpful to promote exercise behaviors of adolescents. From this review, gender could potentially moderate the influence of peers, but few studies examined the influence of same-sex or opposite-sex friends on adolescents' diet and exercise. Future research should examine the influence of friends' gender on adolescents' diet and exercise.

Last, the influence of romantic relationships on diet and exercise of adolescents should be examined. During adolescence, romantic relationships become more common (Rubin et al., 2008) and the number of adolescents who interact with romantic partners increases (Collins, Welsh, & Furman, 2009). Romantic relationships influence adolescents' development (Brown & Larson, 2009; Collins & Steinberg, 2008), and adolescents' diet and exercise could be associated with their romantic partners' diet and exercise.

There are several limitations in this review. First, it is possible that some published studies were missed. In this review, two databases were used for the primary search, with two additional databases used to identify citing or related articles. There might be some relevant studies not indexed in those databases. In addition, the majority of studies included in this review were cross-sectional designs. Because of this, cause-effect associations between adolescents' and peers' diet and exercise cannot be concluded. More longitudinal and experimental studies are

necessary to better characterize the influence of diet and exercise of peers on those of adolescents. In addition, peer factors, diet, and exercise were evaluated using self-report questionnaires in most of the studies. Thus, the findings from the studies might be biased, compared to the outcomes using objective measures such as pedometers. Consistency between self-reported questionnaires and objective measures must also be established.

### Conclusion

This review of the literature summarized existing research on the relationships between adolescents' and their peers' diet and exercise. Twenty four studies were identified and then classified into three categories, depending on the type of behaviors investigated: exercise, diet, and both diet and exercise. Findings of this review indicated that diet and exercise of adolescents and their peers were significantly associated. Gender and closeness of friends could influence the associations between adolescents and peers. Few studies indicated that opposite-sex friendships were found to be associated with exercise of adolescent; more related studies are needed. The findings from this review suggest that peer-based interventions could be effective in order to promote healthier diet and exercise of adolescents.

Table 2.1. Studies assessing diet

Author (Year) Country	Study design	Sample		Measurement			Main findings	
		N	Age (yr)	Peers	Other factors	Diet		
Salvy et al. (2009) USA	Experimental	72	9 – 15	With friends or with an unfamiliar peer			Observation of participants' actual food intake	Compared to being with unfamiliar peer, participants ate more energy-dense and nutrient-dense food when they were with friends ( $p < .01$ and $p < .03$ , respectively). Overweight youth who ate with an overweight partner consumed more food than did overweight participants who ate with a non-overweight eating partner ( $p < .02$ ). However, food intake of non-overweight was not associated with the weight status of the friends.
Wouters et al. (2010) Netherlands	Cross-sectional	749	12.4 ± 17.6	Friendship nomination			The consumption of snacks and carbonated soft drinks	Adolescents' consumption of snacks and soft drinks was significantly related to those of friendship group ( $p < .001$ and $p < .001$ , respectively). Snack and soft drink consumption was influenced by the combination of friends' consumption and the availability of snack or soft drink ( $p = .007$ and $p = .001$ , respectively).
Bruening et al. (2012) USA	Cross-sectional	2,793	14.4 ± 2.0	Friendship nomination			Youth Adolescent Food Frequency Questionnaire	Friend group's and best friends' breakfast was significantly positively associated with adolescent breakfast eating ( $p < .001$ and $p = .004$ , respectively). Adolescent's vegetable intake was related to their best friends' consumption of vegetables ( $p = .04$ ). Dairy intake and whole grain intake was associated with friend groups' and best friends' dairy intake ( $p = .01$ , $p = .002$ for dairy food; and $p < .001$ , $p = .003$ for whole grain).

Table 2.1. (continue)

de la Haye et al. (2013) Australia	Longitudinal	378	12.3 ± 15.6	Friendship nomination		Low nutrition and energy dense food frequency questionnaire	The effect of friend influence on adolescent intake was significantly positive ( $p < .05$ for both school 1 and 2). Adolescents from school 1 were likely to adopt similar food intake; however, this tendency was persisted over time ( $p < .05$ ).
Bruening et al. (2014) USA	Cross-sectional	2,043	14.2 ± 1.9	Friendship nomination		Youth Adolescent Food Frequency Questionnaire	Adolescents' and friends' beverage consumption were significantly associated ( $p < .05$ ). The relationship between adolescents' and friends' fast-food restaurant visits was significant ( $p < .05$ ).
Waqā & Movoā (2006) Fiji	Qualitative	96	16 – 18	Key influences on at-school eating behavior	Key influences on at-school eating behavior	To ask what a balanced diet is; to examine the eating behaviors	Friends influenced participants' food choices at school by sharing food and by providing comments about the amount of food that others ate.
Voorend et al. (2012) South Africa	Qualitative	58 (female only)	18 ± 1.2	Interview with best friends who the participants brought	Sharing food and money at school or at the shopping mall	Food choices	Most friends reported that they shared food consumption. Shared food was occurred mainly in the school environment and during visits to the shopping mall.



Table 2.2. Studies examining exercise

Author (Year) Country	Study design	Sample		Measurement			Main findings
		N	Age in years	Peers	Other factors	Exercise	
Voorhees et al. (2005) USA	Cross- sectional	488	Not reported, 6 <sup>th</sup> and 8 <sup>th</sup> graders	Friendship nomination, additional questions		Physical Activity Questionnaire for Children (PAQ-C)	Adolescents' PA was positively related to their perception of friends' PA, regardless of grade (all <i>ps</i> <.05).
Page et al. (2007) Central- Europe	Cross- sectional	1,886	16.5 ± 1.22	Friendship- making ability  Involvement with friends		Youth Risk Behavior Survey	Friendship-making ability was not significantly related to physical activity, regardless of gender ( <i>p</i> =.51for boys and <i>p</i> =.43 for girls). However, involvement with friends and various kinds of physical activities were significantly related among boys (all <i>ps</i> <.01). For girls, only muscle- strengthening exercise was not significantly associated with the involvement with friends ( <i>p</i> =.15).
de la Haye at al. (2011) Australia	Longitudinal	378	12.3 – 15.6	Friendship nomination		The number of hours doing physical activity	Adolescents were likely to nominate friends whose PA was similar to them ( <i>p</i> <.05). Adolescents PA was significantly influenced by the behavior of their friends ( <i>p</i> <.01).
Shoham et al. (2012) USA	Longitudinal *Secondary data analysis	2,043	14.2 ± 1.9	Friendship nomination		Total number of hours doing sedentary behavior	Social influences on adolescents' behaviors were significant; while homophily on screen time was not.

Table 2.2. (continue)

Lopes et al. (2013) Portugal	Cross-sectional	268	13 – 18	Friendship nominations	IPAQ (International Physical Activity Questionnaire)	Intra-class correlations for vigorous physical activity (VPA), moderate physical activity and sitting are significant ( $p < .001$ , $p < .001$ , and $p = .01$ , respectively).
Schofield et al. (2007) Australia	Cross-sectional	318 (female only)	15 – 18	Friendship nomination	The number of steps taken per day, recorded by pedometers	Female adolescents are more likely to be active when they have higher number of active friends ( $p = .02$ ). The first-nominated reciprocal friend's steps were highly related to a female adolescent's steps ( $p < .001$ ).
Simpkins et al. (2013) USA	Longitudinal *Secondary data analysis	1,896	15.97 (mean)	Friendship nomination	The number of times doing active sports or exercise	Adolescents' levels of PA were similar to their friends over time ( $p < .001$ for school A and $p < .05$ for the school B).
Sirard et al. (2013) USA	Cross-sectional	2,126	14.1 ± 2.0	Friendship nomination	Godin-Shephard PA recall Sedentary behaviors: how many hours watching TV, using a computer/video games	The levels of moderate-vigorous physical activity (MVPA) of adolescents were related to the levels of MVPA of opposite-sex friends ( $p = .049$ for male and $p = .007$ for female). The MVPA of female adolescents were also significantly associated with MVPA of their same-sex friends and same-sex best friends ( $p < .001$ and $p = .05$ , respectively). The screen time of female adolescents was related to the screen time of male friends ( $p = .007$ ). However, nothing was significantly associated with the screen time of male adolescents.

Table 2. 2. (continue)

Keresztes et al. (2008) Hungary	Cross-sectional	548	10 – 15	Social influence	Social influence	Sports activity participation	Among boys, none of the social influence factors related to friends were significantly associated to participation of sport activity, except for parents' and sisters' or brothers' sports activity ( $p < .05$ and $p < .05$ , respectively). However, classmates' and friends' sports activity as well as parents' and siblings' activity was contributing factor to girls' sports activity (all $ps < .05$ ).
Salvy et al. (2008) USA	Cross-sectional	20	12 – 14	The presence of peers of friends	The presence of family	Questions about activity intensity	Youth engaged in more intense activity when in the presence of peers or friends ( $p < .001$ ). Overweight youth were more likely to do physical activity than lean ones when they were with peers ( $p < .05$ ).
Kirby et al. (2011) Scotland	Longitudinal	1,632	11 – 15	Peer support Peer socializing	Parents: perceived paternal and maternal support	PAQ-C	There was a positive relationship between peer support and physical activity. For boys, peer socializing and peers support were significant with being active ( $p < .001$ and $p < .001$ , respectively). This relationship was significant over time. For girls, peer support was the significant contributing factor to physical activity, regardless of time period ( $p < .05$ ).
Cheng et al. (2014) Brazil	Cross-sectional	2,361	14 – 19	PA level of friends Social support from friends	PA level of parents	The frequency and duration of MVPA in the week	Adolescents' PA was directly related to friends' PA, regardless of gender ( $p < .001$ for male; and $p < .05$ for female).

Table 2. 2. (continue)

Graham et al. (2014) USA	Cross-sectional	2,793	14.4 ± 2.0	Friendship nomination Friends' PA participation	Parents: PA resource at home, parental PA level, support for PA School personal: school policies regarding PA, availability of PA resource	The modified Leisure Time Exercise Questionnaire Sports team participation	Girls' weekly MVPA were significantly related to their perceived friends' support for participation in PA, male friends' MVPA, and female friends' MVPA ( $p < .001$ , $p = .001$ , and $p < .001$ , respectively). Male adolescents were more likely to physically active when they have more male friends who participated in team sports ( $p < .001$ ). Their MVPA were also significantly associated with friend support for PA and female friends' MVPA ( $p < .001$ , and $p = .001$ , respectively).
Zook et al. (2014) USA	Longitudinal	561	12.29 ± 1.48	Friendship nomination Support from peers	Support from parents, Distance to school or park	Actigraph accelerometers	Participants with higher social support from friends, and frequency of physical activity with friends score were more likely to be physically active.

Table 2.3. Studies examining both diet and exercise

Author (Year) Country	Study design	Sample		Measurement		Main findings
		N	Age (yr)	Peers	Diet and exercise	
Luszczynska et al. (2004) Hungary, Poland, Turkey, and USA	Cross-cultural	2,387 (560 Hungarian; 662 Polish, 626 Turkish, and 539 US adolescents)	13 – 20	Perception of peer's behaviors	PA: The number of days exercising at least a half hour  Eating: Frequency of monitoring diet	Both the levels of PA and eating behaviors were significantly different depending on the countries ( $p < .001$ and $p < .001$ , respectively). However, regardless of the countries, having more physically active friends was related to adolescents' more frequent engagement in exercise (all $ps < .001$ ). If adolescents had more friends who cared about healthy diet, they were more likely to select the healthy diet (all $ps < .001$ ).
de la Haye et al. (2010) Australia	Cross-sectional	385	Not reported, 8 <sup>th</sup> and 9 <sup>th</sup> graders	Friendship nomination	PA: Participation in physical activities, Hours having screen time  Eating: Food Frequency	Female friendship networks had similar patterns of playing computer/video games or using the internet ( $p = .05$ ). Male friends in networks were likely to consume similar amounts of high-calorie foods ( $p = .05$ ).
Ali et al. (2011) USA	Longitudinal * Secondary data analysis	3,898	Not reported, 7 <sup>th</sup> and 12 <sup>th</sup> graders	Friendship nomination	PA: exercise, playing an active sport  Eating: Having breakfast, having fast food and food intake	Having friends more engaged in weight-related behaviors, such as exercise, spending hours of TV, having breakfast, or consuming calorie-dense snack, was associated with an increase in adolescents' participation in those behaviors, when school-level factors were not controlled (all $ps < .01$ ). With school-level fixed effects, exercise, playing an active sport, and having fast food were the significant obesity-related behaviors influenced by peers ( $p < .01$ , $p < .001$ , and $p < .001$ , respectively).

## REFERENCES

- Ali, M. M., Amialchuk, A., & Heiland, F. W. (2011). Weight-related behavior among adolescents: The role of peer effects. *PLoS ONE*, *6*(6), e21179.
- Arcan, C., Neumark-Sztainer, D., Hannan, P., van den Berg, P., Story, M., & Larson, N. (2007). Parental eating behaviours, home food environment and adolescent intakes of fruits, vegetables and dairy foods: longitudinal findings from Project EAT. *Public Health Nutrition*, *10*(11), 1257-1265.
- Barlow, S. E., & the Expert Committee. (2007). Expert Committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary Report. *Pediatrics*, *120*(6, Suppl. 4), S164-S192.
- Bauer, K. W., Neumark-Sztainer, D., Hannan, P. J., Fulkerson, J. A., & Story, M. (2011). Relationships between the family environment and school-based obesity prevention efforts: can school programs help adolescents who are most in need? *Health Education Research*, *26*(4), 675-688.
- Brown, B. B., & Larson, J. (2009). Adolescents' relationships with peers. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (3 ed., Vol. 2, pp. 74-103). Hoboken, NJ: Wiley.
- Bruening, M., Eisenberg, M., MacLehose, R., Nanney, M. S., Story, M., & Neumark-Sztainer, D. (2012). Relationship between adolescents' and their friends' eating behaviors: Breakfast, fruit, vegetable, whole-grain, and dairy intake. *Journal of the Academy of Nutrition and Dietetics*, *112*(10), 1608-1613.
- Bruening, M., MacLehose, R., Eisenberg, M. E., Nanney, M. S., Story, M., & Neumark-Sztainer, D. (2014). Associations between sugar-sweetened beverage consumption and fast-food restaurant frequency among adolescents and their friends. *Journal of Nutrition Education and Behavior*, *46*(4), 277-285.
- Cheng, L. A., Mendonca, G., & Junior, F. (2014). Physical activity in adolescents: Analysis of the social influence of parents and friends. *Jornal de Pediatria*, *90*(1), 35-41.
- Collins, W. A., & Steinberg, L. (2008). Adolescent development in interpersonal context. In W. Damon & R. M. Lerner (Eds.), *Child and adolescent development: An advanced course* (pp. 551-590). Hoboken, NJ: John Wiley & Sons, Inc.
- Collins, W. A., Welsh, D. P., & Furman, W. (2009). Adolescent romantic relationships. *Annual Review of Psychology*, *60*, 631-652.
- De la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2010). Obesity-related behaviors in adolescent friendship networks. *Social Networks*, *32*(3), 161-167.
- De la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2011). How physical activity shapes, and is shaped by, adolescent friendships. *Social Science & Medicine*, *73*(5), 719-728.
- De la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2013). Adolescents' intake of junk food: Processes and mechanisms driving consumption similarities among friends. *Journal of Research on Adolescence*, *23*(3), 524-536.
- Epstein, L.H., Paluch, R. A., Roemmich, J. N., & Beecehr, M. D. (2007). Family-based obesity treatment, then and now: Twenty-five years of pediatric obesity treatment. *Health Psychology*, *26*(4), 381-391.

- Erdley, C. A., Nangle, D. W., Newman, J. E., & Carpenter, E. M. (2001). Children's friendship experiences and psychological adjustment: Theory and research. *New Directions for Child and Adolescent Development*, 2001(91), 5-24.
- Estabrooks, P. A., & Shetterly, S. (2007). The prevalence and health care use of overweight children in an integrated health care system. *Archives of Pediatrics & Adolescent Medicine*, 161(3), 222-227.
- Falkstedt, D., Hemmingsson, T., Rasmussen, F., & Lundberg, I. (2006). Body mass index in late adolescence and its association with coronary heart disease and stroke in middle age among Swedish men. *International Journal of Obesity*, 31(5), 777-783.
- Ford, C. A., Nonnemaker, J. M., & Wirth, K. E. (2008). The influence of adolescent body mass index, physical activity, and tobacco use on blood pressure and cholesterol in young adulthood. *Journal of Adolescent Health*, 43(6), 576-583.
- Fox, M. K., Dodd, A. H., Wilson, A., & Gleason, P. M. (2009). Association between school food environment and practices and body mass index of US public school children. *Journal of the American Dietetic Association*, 109(2), S108-S117.
- Graham, D. J., Wall, M. M., Larson, N., & Neumark-Sztainer, D. (2014). Multicontextual correlates of adolescent leisure-time physical activity. *American Journal of Preventive Medicine*, 46(6), 605-616.
- Hampl, S. E., Carroll, C. A., Simon, S. D., & Sharma, V. (2007). Resource utilization and expenditures for overweight and obese children. *Archives of Pediatrics & Adolescent Medicine*, 161(1), 11-14.
- Hlaing, W. M., Messiah, S. E., Lipshultz, S. E., & Ludwig, D. A. (2011). Obesity and length of hospital stay in children: A retrospective review of Florida Agency for Health Care Administration data. *Progress in Pediatric Cardiology*, 31(1), 67-72.
- Hohepa, M., Scragg, R., Schofield, G., Kolt, G. S., & Schaaf, D. (2007). Social support for youth physical activity: Importance of siblings, parents, friends and school support across a segmented school day. *International Journal of Behavioral Nutrition and Physical Activity*, 4(1), 54.
- Janssen, I., Craig, W. M., Boyce, W. F., & Pickett, W. (2004). Associations between overweight and obesity with bullying behaviors in school-aged children. *Pediatrics*, 113(5), 1187-1194.
- Kaphingst, K. M., & French, S. (2006). The role of schools in obesity prevention. *The Future of Children*, 16(1), 109-142.
- 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(1), 21-25.
- Kirby, J., Levin, K. A., & Inchley, J. (2011). Parental and peer influences on physical activity among Scottish adolescents: a longitudinal study. *Journal of Physical Activity and Health*, 8(6), 785.
- Laursen, B., & Collins, W. A. (2009). Parent-child relationships during adolescence. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (3 ed., Vol. 2, pp. 3-42): Hoboken, NJ: Wiley.
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C, et al. (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Med*, 6(7): e1000100. doi:10.1371/journal.pmed.1000100

- Lopes, V. P., Gabbard, C., & Rodrigues, L. P. (2013). Physical activity in adolescents: examining influence of the best friend dyad. *Journal of Adolescent Health, 52*(6), 752-756.
- 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 & Health, 19*(5), 577-593.
- Mond, J., Van den Berg, P., Boutelle, K., Hannan, P., & Neumark-Sztainer, D. (2011). Obesity, body dissatisfaction, and emotional well-being in early and late adolescence: findings from the project EAT study. *Journal of Adolescent Health, 48*(4), 373-378.
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med 6*(6): e1000097. doi:10.1371/journal.pmed1000097
- Noh, E. E. (2013). The policy support plans of obesity prevention and management for childhood and adolescents. [아동·청소년 비만예방을 위한 정책적 지원방안]. *Policy Report, 142*, 1-24.
- O'dea, J. A. (2006). Self-concept, Self-esteem and Body Weight in Adolescent Females A Three-year Longitudinal Study. *Journal of Health Psychology, 11*(4), 599-611.
- Office of Disease Prevention and Health Promotion. (2015). Healthy People 2020. Retrieved January, 2015, from [www.healthypeople.gov](http://www.healthypeople.gov)
- 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*(1), 3.
- Page, R., Ihasz, F., Simonek, J., Klarova, R., & Hantiu, I. (2006). Friendships and physical activity: Investigating the connection in Central-Eastern European adolescents. *International Journal of Adolescent Medicine and Health, 19*(2), 187-198.
- Papalia, D. E., Olds, S. W., & Feldman, R. D. (2005). *Human development* (10th ed.). New York: McGraw Hill.
- Poulin, F., & Pedersen, S. (2007). Developmental changes in gender composition of friendship networks in adolescent girls and boys. *Developmental psychology, 43*(6), 1484.
- Public Health England. (2015). PHE Obesity. Retrieved January, 2015, from <http://www.noo.org.uk/>
- Puhl, R. M., Luedicke, J., & Heuer, C. (2011). Weight-based victimization toward overweight adolescents: Observations and reactions of peers. *Journal of School Health, 81*(11), 696-703.
- Rubin, K. H., Bukowski, W. M., Parker, J. G., & Bowker, J. C. (2008). Peer interactions, relationships, and groups. In W. Damon & R. M. Lerner (Eds.), *Child and adolescent development: An advanced course* (pp. 141-180). Hoboken, NJ: John Wiley & Sons, Inc
- Salvy, S.-J., Bowker, J. W., Roemmich, J. N., Romero, N., Kieffer, E., Paluch, R., & Epstein, L. H. (2008). Peer influence on children's physical activity: An experience sampling study. *Journal of Pediatric Psychology, 33*(1), 39-49.
- Salvy, S.-J., De La Haye, K., Bowker, J. C., & Hermans, R. C. (2012). Influence of peers and friends on children's and adolescents' eating and activity behaviors. *Physiology & Behavior, 106*(3), 369-378.



- Salvy, S.-J., Elmo, A., Nitecki, L. A., Kluczynski, M. A., & Roemmich, J. N. (2011). Influence of parents and friends on children's and adolescents' food intake and food selection. *The American Journal of Clinical Nutrition*, 93(1), 87-92.
- Salvy, S.-J., Howard, M., Read, M., & Mele, E. (2009). The presence of friends increases food intake in youth. *The American Journal of Clinical Nutrition*, 90(2), 282-287.
- Savoie, M., Nowicka, P., Shaw, M., Yu, S., Dziura, J., Chavent, G., ... Caprio, S. (2011). Long-term results of an obesity program in an ethnically diverse pediatric populations. *Pediatrics*, 127(3), 402-410. doi: 10.1542/ped.2010-0697
- Schofield, L., Mummery, K. W., Schofield, G., & Hopkins, W. (2007). The association of objectively determined physical activity behavior among adolescent female friends. *Research Quarterly for Exercise and Sport*, 78(2), 9-15.
- Shoham, D. A., Tong, L., Lamberson, P. J., Auchincloss, A. H., Zhang, J., Dugas, L., . . . Luke, A. (2012). An actor-based model of social network influence on adolescent body size, screen time, and playing sports. *PLoS ONE*, 7(6), e39795.
- Simpkins, S. D., Schaefer, D. R., Price, C. D., & Vest, A. E. (2013). Adolescent friendships, BMI, and physical activity: Untangling selection and influence through longitudinal social network analysis. *Journal of Research on Adolescence*, 23(3), 537-549.
- Sirard, J. R., Bruening, M., Wall, M. M., Eisenberg, M. E., Kim, S. K., & Neumark-Sztainer, D. (2013). Physical activity and screen time in adolescents and their friends. *American Journal of Preventive Medicine*, 44(1), 48-55.
- Smetana, J. G., Campione-Barr, N., & Metzger, A. (2006). Adolescent development in interpersonal and societal contexts. *Annual Review of Psychology*, 57, 255-284.
- Statistics for 2013 Korea Youth Risk Behaviors Web-Based Survey*. (2014). Osong, Chungchungbookdo: Korea Center for Disease Control and Prevention Retrieved from <http://yhs.cdc.go.kr>.
- Stewart, S. D., & Menning, C. L. (2009). Family structure, nonresident father involvement, and adolescent eating patterns. *Journal of Adolescent Health*, 45(2), 193-201.
- Story, M., Nannery, M. S., & Schwartz, M. B. (2009). Schools and obesity prevention: creating school environments and policies to promote healthy eating and physical activity. *Milbank Quarterly*, 87(1), 71-100.
- Tirosh, A., Shai, I., Afek, A., Dubnov-Raz, G., Ayalon, N., Gordon, B., . . . Vinker, S. (2011). Adolescent BMI trajectory and risk of diabetes versus coronary disease. *New England Journal of Medicine*, 364(14), 1315-1325.
- Voorend, C. G., Norris, S. A., Griffiths, P. L., Sedibe, M. H., Westerman, M. J., & Doak, C. M. (2013). 'We eat together; today she buys, tomorrow I will buy the food': adolescent best friends' food choices and dietary practices in Soweto, South Africa. *Public Health Nutrition*, 16(03), 559-567.
- Voorhees, C. C., Murray, D., Welk, G., Birnbaum, A., Ribisl, K. M., Johnson, C. C., . . . Jobe, J. B. (2005). The role of peer social network factors and physical activity in adolescent girls. *American Journal of Health Behavior*, 29(2), 183-190.
- Waq, G., & Mavo, H. (2006). Sociocultural factors influencing the food choices of 16-18 year-old indigenous Fijian females at school. *Pacific Health Dialog*, 13(2), 57-64.
- Wang, Y., & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity*, 1(1), 11-25.

- World Health Organization. Global Strategy on Diet, Physical Activity and Health. Retrieved January, 2015, from [http://www.who.int/dietphysicalactivity/childhood\\_what\\_can\\_be\\_done/en/](http://www.who.int/dietphysicalactivity/childhood_what_can_be_done/en/)
- Wouters, E. J., Larsen, J. K., Kremers, S. P., Dagnelie, P. C., & Geenen, R. (2010). Peer influence on snacking behavior in adolescence. *Appetite*, 55(1), 11-17.
- Zook, K. R., Saksvig, B. I., Wu, T. T., & Young, D. R. (2014). Physical activity trajectories and multilevel factors among adolescent girls. *Journal of Adolescent Health*, 54(1), 74-80.

CHAPTER III.  
PARENT, SCHOOL, AND PEER FACTORS RELATED TO U.S.  
ADOLESCENTS' DIET AND EXERCISE

Abstract

**Purpose:** Adolescent obesity in the United States is a public health problem because it negatively influences physical and psychological health outcomes. To prevent or reduce adolescent obesity, it is necessary to identify factors influencing adolescents' diet and exercise that contribute to development of adolescent obesity. The purpose of this secondary data analysis is to identify parent, school, and peer factors related to diet and exercise of adolescents in the United States, which contribute to development of obesity.

**Methods:** The 2009/2010 Health Behaviour in School-Aged Children survey for the United States was used. To examine the influence of parent, school, and peer factors on diet and exercise of adolescents, logistic regression analyses were conducted using SAS Enterprise Guide.

**Results:** Parent, school, and peer factors were associated with adolescents' dietary behaviors. For exercise behaviors, parent and peer factors were associated, but no school factors.

**Conclusion:** Parent and peer factors were associated with adolescents' diet and exercise behaviors. Involving parents and peers in interventions designed to prevent or reduce adolescent obesity could be an effective way to modify diet and exercise behaviors.

## Introduction

Adolescent obesity is a significant public health problem in the United States (US). The prevalence of adolescent obesity tripled from 1976-1980 to 2009-2010 (Fryar, Carroll, & Ogden, 2012), although rates have been stable for adolescents ages 12-19 since 2003 (Ogden, Carroll, Kit, & Flegal, 2014). Despite this, overweight and obesity remain a significant public health problem: data from 2011-2 indicate that more than 30% of US adolescents ages 12 to 19 are either overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014). In spite of this stability, a prevalence rate of 30% is still high enough to consider adolescent obesity a significant health problem.

Because adolescent obesity is a known risk factor for adult obesity (Biro & Wien, 2010; Gordon-Larsen, The, & Adair, 2010) and physical and psychological health problems during adolescence and adulthood (Lo, et al., 2014; Mond, Van den Berg, Boutelle, Hannan, & Neumark-Sztainer, 2011; Nguyen, magno, Lane, Hinojosa, & lane, 2008; Puhl, Luedicke, & Heuer, 2011; Weiss et al., 2004), developing interventions to prevent the development of or attenuate obesity in adolescence should have a positive impact on physical and mental health outcomes across the lifespan. However, in order to develop effective interventions, it is important to identify factors that contribute to its development.

Davison and Birch (2001) developed an ecological model of individual characteristics and broader contextual factors contributing to childhood overweight. Individual characteristics include age, gender, dietary intake, and physical activity, while contextual factors include characteristics of the adolescent's parents, family, community, and society (Davison & Birch, 2001, p. 161; see Figure 3.1.). These factors can influence diet and exercise, which in turn contributes to the development of adolescent obesity. According to this model, preventing and

reducing adolescent obesity will require interventions designed to modify adolescents' diet and exercise that also account for contextual factors that influence diet and exercise.

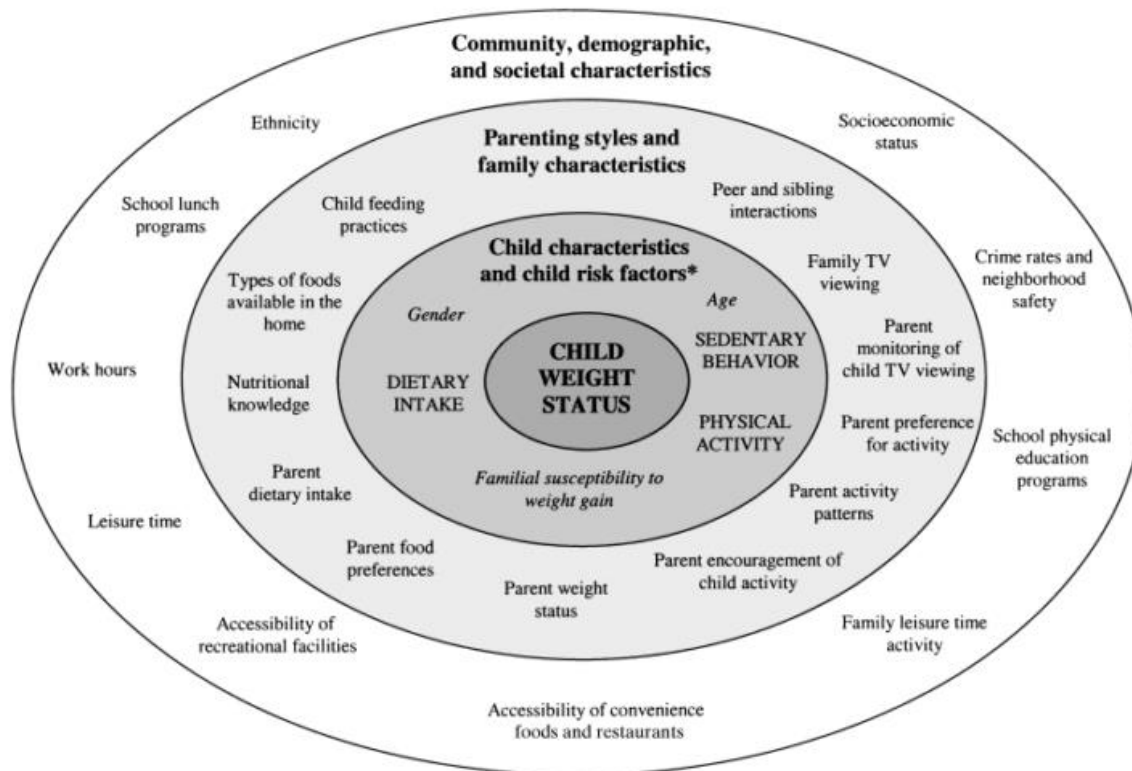


Figure 3.1. Ecological model for childhood overweight from Davison and Birch (2001)

Many studies of adolescent obesity have focused on parental factors that influence the adolescent's diet and exercise behaviors. Parents still have a strong impact on adolescents' behaviors, despite normal developmental changes in parent-adolescent relationships (Laursen & Collins, 2009; Smetana, Campione-Barr, & Metzger, 2006). A number of studies found that parental behaviors were positively associated with adolescents' diet and exercise (Bauer, Neumark-Sztainer, Hannan, Fulkerson, & Story, 2011; Cheng, Mendonca, & Junior, 2014; Graham, Wall, Larson, & Neumark-Sztainer, 2014; Kirby, Levin, & Inchley, 2011). For example, adolescents engaged in exercise more frequently if their parents exercised more often, or if they perceived higher parental support for exercise (Graham, Wall, Larson, & Neumark-Sztainer,

2014). Relationships between adolescents and their parents are also related to adolescents' diet. If adolescents perceive their parents to be strict, they are more likely to have healthier diets and exercise behaviors (Alia, Wilson, Geroge, Schneider, & Kitzman-Ulrich, 2013; Pearson, Atkin, Biddle, Gorely, & Edwardson, 2010; Van der Horst et al., 2007). Berge, Wall, Loth, and Neumark-Sztainer (2010) found that close relationships with parents did not predict a higher level of physical activity in female adolescents in a longitudinal five-year follow up study. In other studies, evaluation of the relationships between family structure (e.g. living with single parent or double parents) and diet and exercise of adolescents was inconclusive. Some researchers reported a significant impact of family structure (Levin & Kirby, 2012; Pearson et al., 2010; Stewart & Menning, 2009), while others found no association (Hohepa et al., 2007; Ornelas, Perrira, & Ayala, 2007).

School is another contextual factor that influences adolescents' diet and exercise. Because school is where adolescents spend the most time apart from their homes (Kaphingst & French, 2006; Story, Nanne, & Schwartz, 2009), researchers have studied the relationship between school environments, including the availability of specific foods, kinds of school breakfast or lunch programs, and provision of physical education during the school day, and diet and exercise (Fox, Dodd, Wilson, & Gleason, 2009; Kaphingst & French, 2006; Story et al., 2009). If adolescents could purchase certain items in school vending machines or at school stores, an increase in adolescents' consumption of those items was found, regardless of whether the foods were healthy options or not (Bigornia et al., 2014; Minaker et al., 2011; Rovner et al., 2011; Wiecha, Finkelstein, Troped, Fragala, & Peterson, 2006). Some researchers were concerned about soft drinks because adolescents' soft drink consumption has been increasing and the increase in intake was found to be associated with the development of obesity (Denney-Wilson,

Crawford, Dobbins, Hardy, & Okely, 2009; Ebbeling et al., 2006). In some studies, availability of soft drinks at school (e.g. vending machine, school store, or school meal programs) was associated with higher intake (Briefel, et al., 2009; Wiecha et al., 2006), whereas no association between availability of soft drinks at school and adolescents' consumption was found in others (Minaker et al., 2011; Terry-McElrath, O'Malley, & Johnston, 2013). Accessibility of physical activity facilities in school has also been studied. Some studies found that adolescents were likely to be more physically active, if a school provided any kind of physical activity facilities (Durant et al., 2009; Haug, Torsheim, Sallis, & Samdal, 2010). However, Kirby, Levin, and Inchley (2012) found that provision of physical activity facilities was not associated with adolescents' exercise. Instead, providing extracurricular school activities or after school sports clubs was related to an increase in adolescents' exercise (Haerens et al., 2009; Kirby et al., 2012).

Finally, relationships between adolescents and their peers are another important contextual factor that may have an impact on diet and exercise. Adolescents are less likely to be dependent on their parents during their teenage years (Collins & Steinberg, 2008; Steinberg & Monahan, 2007) and more likely to spend time with their peers (Brown & Larson, 2009); and thus, adolescents could be influenced by their peers and develop similar behaviors to their peers (Brown & Larson, 2009; Smetana et al., 2006). Previous studies found that adolescents' diet and exercise are significantly associated with diet and exercise of their peers; that is, adolescents with peers who consumed more of certain types of food (e.g. soft drink, whole grains) were likely to have higher intake of those foods (Bruening et al., 2014; Bruening et al., 2012; Wouters, Larsen, Kremers, Dagnelie, & Geenen, 2010); exercise behaviors of adolescents and their peers were also positively related (De la Haye, Robins, Mohr., & Wilson, 2011; Lopes, Gabbard, & Rodrigues, 2013; Voorhees et al., 2005). Closer friends may have a greater impact on diet and

exercise of adolescents than more casual friends (Bruening et al., 2012; Schofield et al., 2007). Finally, gender is another important factor to consider related to peer influence on adolescents' diet and exercise, with positive associations of diet and exercise for adolescents and their opposite-sex friends (Graham, Wall, Larson, & Neumark-Sztainer, 2014; Sirard et al., 2013).

Given these findings, a framework (Figure 3.2.) was developed to guide this study on adolescent obesity, which is based on Davison and Birch's (2001) ecological model for childhood overweight (Figure 3.1). The key difference from the Davison and Birch model is that the modified framework focuses on adolescent *behaviors* (specifically, diet and exercise) instead of the *outcome* of childhood overweight. In addition, as can be seen in Figure 3.2., school, peer, and parent factors are now included in the same level, given their potentially significant contributions to adolescents' diet and exercise.

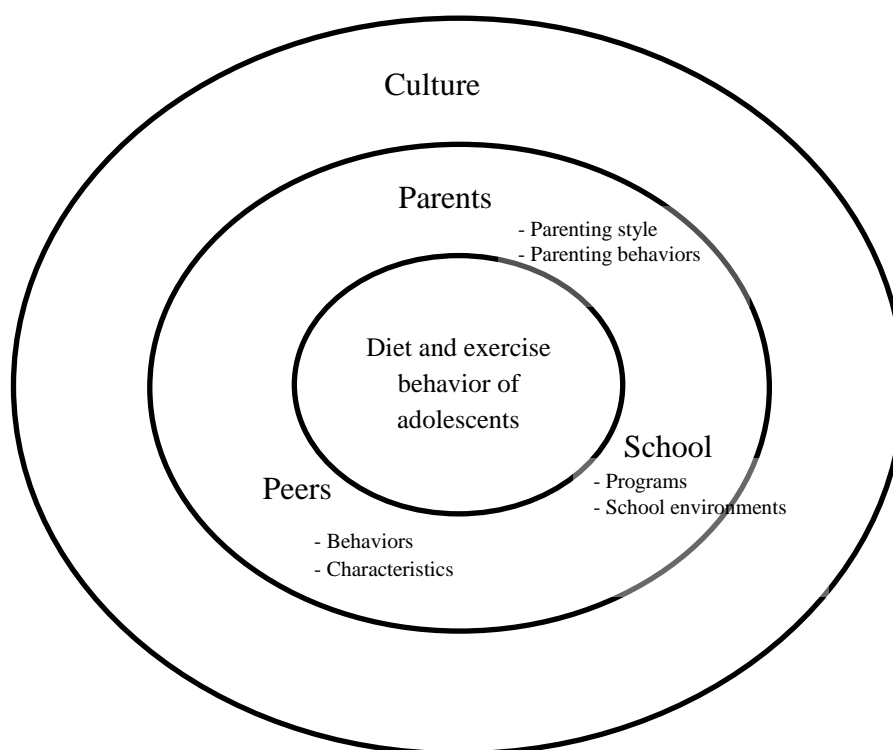


Figure 3.2. Adapted framework for diet and exercise of adolescents.



Although multiple contextual factors can influence adolescents' diet and exercise, there can be differences in the extent of these contributions. Identifying the most significant factors and developing interventions that address those factors can be an effective and efficient way to improve diet and exercise among adolescents. However, to do so, the contributions of parent-, school-, and peer-related factors to diet and exercise must first be identified and compared. Therefore, this study examined associations among parent-, school-, and peer-related factors and diet and exercise of adolescents in the United States. The specific aims of this study were to identify:

Aim 1. Which parent-, school-, and peer-related factors are related to diet?

- a. Which factors contribute to eating breakfast?
- b. Which factors are related to drinking soft drinks?

Aim 2. Which parent-, school-, and peer-related factors are related to exercise?

- a. Which factors are associated with engaging in physical activity?
- b. Which factors contribute to spending time on exercise (getting out of breath or sweating)?
- c. Which factors are related to watching TV?

### Method

A cross-sectional secondary data analysis was conducted. Data were obtained from the World Health Organization's (WHO) 2009/2010 survey of Health Behaviour in School-Aged Children (HBSC) for the United States, which includes all variables of interest for the three factors considered (parents, school, and peers). Since 1982, the WHO Regional Office for Europe has sponsored independent HBSC national surveys every four years, with more than 40 countries in Europe and North America participating. The HBSC study is the first nationally

representative cross-sectional survey to examine the well-being, health behaviors, and social context of adolescents (Roberts et al., 2009). The surveys are school-based; data are obtained via self-report questionnaires distributed to 11-, 13-, and 15-year-old children selected on the basis of geography, ethnicity, and school type (Roberts et al., 2009). Ethical approvals are obtained according to each country's guidelines. Questions focus on demographic factors, social background, social context, health outcomes, health behaviors, and risk behaviors (Roberts et al., 2009).

### *Description of survey*

The 2009/2010 survey in the United States used three-stage stratified sampling (census divisions, grades, and school districts) to identify a nationally representative sample (Iannotti, 2013). A total of 12,642 adolescents in grades 5 through 10 from 314 schools participated (Iannotti, 2013). Adolescents in the 5th and 6th grades completed 76 items. Those in the 7<sup>th</sup>, 8<sup>th</sup>, and 9<sup>th</sup> grades completed 86 items; the 10 additional items focused on eating habits (e.g. having breakfast with parents, having a snack while watching television), family relationships (e.g. parental control, parental help) and friendships (e.g. age of friendship group). Tenth graders responded to 88 items, with the additional two items related to drinking and drug use.

The HBSC study also asked school administrators to complete 23 items about their schools. These items examined provision of physical education and availability of food program, including a USDA reimbursable national school breakfast or lunch program, providing nutritionally balanced meals that meet the federal standards and free or reduced price meals for qualified students (United States Department of Agriculture, 2015), or *a la carte* breakfast or lunch program. To protect anonymity of participants, all variables that could be used to identify individuals were collapsed or recoded in the public use files (Iannotti, 2013).

For the present analysis, predictive variables of interest were selected from one of three categories: parent-, peer-, and school-related factors. The variables for parent- and peer-related factors were from students' questionnaires; those for school-related factors were from school administrators' questionnaires. Table 3.1 provides more detailed information on study variables. The outcome variables were diet and exercise behaviors (Table 3.2).

*1) Variables for parent-related factors*

Parent-related variables included living with parents, parental communication, and parental monitoring. Living with parents was classified into two categories, double parents and single parent. Adolescents who answered that they were living in a foster home, children's home, or with grandparents were excluded. Parental communication and monitoring were originally measured separately for mothers and fathers. For the present analysis, these results were combined into the variables of parental communication and parental monitoring. All parent-level variables were re-coded as dichotomous variables.

*2) Variables for peer-related factors*

Peer-related variables included number of close friends, time spent with friends, frequency of calling or texting friends, and communication with friends. Based on the answers for the number of close female and male friends, the number of same-sex friends and opposite-sex friends were created by comparing their reported gender to the respondent. Responses for the number of days or evenings per week that adolescents spent time with their friends were collapsed and converted to categorical variables. Communication with same-sex friends and opposite-sex friends were reverse coded and dichotomized.

Table 3.1. Description of parent-, peer-, and school-level variables

Factor	Variable	Description
Parent-related	Living with parents	The students were asked to report whether their mothers/stepmothers or fathers/stepfathers are in the main home. The students who answered living with grandparents or living in a foster house were excluded for analysis. The responses were recoded into “living with double parents,” if they lived with both mother and father, and “living with single parent,” if they lived with either mother or father.
	Communication with parents	The students were asked to answer how easy it is to talk to their mother or father. A four-point scale ranges from 1 “very easy” to 4 “very difficult.” The higher scores mean worse communication with parents. Communication with parents was created based on the question about communication with mothers and fathers. Responses for communication with parents were collapsed to “easy” and “difficult.”
	Monitoring by mothers/fathers	The students were asked to respond to the questions “How much does your mother/father really know about: who your friends are, how you spend your money, where you are after school, where you go at night and what you do with your free time?” The possible answers were as follows: “know a lot”, “know a little”, and “doesn’t know anything.” After obtaining an individual student’s mean score for the five questions, the average of overall students’ mean scores was calculated. If a student’s mean score was above the overall average score, the answer was “know” to the abovementioned questions; while if the mean score was below the overall average, the answer was “doesn’t know.”

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Peer-related	Number of close friends	The students were asked how many close male and female friends they had. The possible answers were none, one, two, and three or more. These variables were re-coded based on their gender to create how many close same-sex or opposite-sex friends. The answers were dichotomized: “less than three” and “equal to or more than three.”
	Excess time spent with friends	The students responded to how many days they spent time with friends after school or in the evening. They could answer from 0 to 7 days for these questions. For each of the variables, answers were re-coded into “0 - 1 day”, “2 - 3 days”, and “4 - 7 days.”
	Call or text	The students were asked to respond to how often they call/text their friends during a week. Possible answers were: rarely or never; 1 or 2 days a week; 3 or 4 days a week; 5 or 6 days a week; and everyday. Response categories were dichotomized: “0 - 6 days” and “7 days.”
	Communication with same-sex/opposite-sex friends	The students were asked to answer how easy it is to talk to their same-sex friends, and opposite-sex friends. Possible responses range from 1 “very easy” to 4 “very difficult”; re-coded into “easy” and “difficult.”
School-related	Physical activities provided during the school day	The school administrators were asked to respond to how many days physical activities during the school day and outside physical education classes were provided before school hours/at lunchtime/during breaks/after school/ and other times during the school day. They could answer none, 1-2 days, 3-4 days, or every day. The answer was re-coded into “no” if they answered none; otherwise, the answer was “yes.”

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Accessibility of physical activity facilities	The school administrators responded to whether students could access the physical activity facilities in unstructured school time such as breaks or free time. The physical activity facilities that more than 70% of schools had were selected. Response categories were “yes” and “no.”
Items from vending machines or at school	The school administrators were asked to answer which kinds of items are available to students to purchase from vending machines or at the school store, cafeteria, or snack bars. Only soda-related questions were selected among various items. Possible answers were no, yes: some days, and yes: daily. The response categories were recoded into “yes” and “no.”
Breakfast/lunch program	The school administrators responded to whether the school participated in the USDA reimbursable school breakfast or lunch program, <i>a la carte</i> program or any other program. A new variable, what kind of breakfast or lunch program provided by schools, was created from the answers of three questions. The possible answers were <i>a la carte</i> only, USDA only, both, and others.

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### 3) *Variables for school-related factors*

School-related variables included physical activities during the school day in addition to formal physical education, accessibility of physical activity facilities, opportunities for obtaining food items from vending machines or at school (e.g. school store, cafeteria, or snack bar), and school participation in a breakfast or lunch program. A dichotomous variable, whether or not physical activities were provided during the school days, was created, based on data on physical activity facilities. Of the items obtained on food availability through vending machines or at school, only soda-related items were examined. Most schools provided some kind of breakfast or lunch program. A new variable, what kind of breakfast or lunch program the schools provided, was created, with possible answers of *a la carte* only, USDA only, both, and others. .

### *Outcome variables*

Table 3.2 provides descriptions of the outcome variables for diet and exercise. Diet included the number of days on which they ate breakfast and how frequently they drank soft drinks. Physical activity variables included how frequently the students were physically active, how many hours per week they exercised, and how many hours a day they watched television. Responses for the exercise variables were recoded based on the guidelines for physical activity (*2008 Physical activity guidelines for Americans*, 2008) or television time (American Academy of Pediatrics, n.d.). If there was no guideline, variables were recoded as dichotomous variables based on median values (Table 3.2.).

Table 3.2. Description of outcome variables

Factors	Variables	Description
Diet	Having breakfast	The students were asked to respond to how many days they had breakfast during weekdays or weekends. They could answer never, one day, two days, three days, four days, or five days for weekdays and never, one day or two days for weekend. Because the median of this variable was 6 days, the responses were re-coded into “0 to 5 days” and “6 or 7 days”
	Drinking soft drinks	The students responded to how many times they usually had soft drinks. The response options were never, less than once a week, once a week, 2-4 days a week, 5-6 days a week, once every day, and more than once every day. Because the median was 2 - 4 times a week, the response categories were dichotomized into “equals to or less than once a week” and “more than once a week.”
Exercise	Frequency of physical activity	The students were asked to answer how many days in the past 7 days they were physically active. Possible answers ranged from 0 days to 7 days. Children and adolescents aged 6-17 years are recommended to engage in physical activity an hour or more daily ( <i>2008 Physical activity guidelines for Americans</i> , 2008). Thus, the responses were re-coded into “0 to 5 days” and “6 or 7 days.”



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Spending time on exercise	After being provided with a definition of exercise (“getting out of breath or sweat”), the students responded to how many hours they exercise during a week. The answers for exercise were categorized as none, 30 minutes, 1 hour, 2-3 hours, 4-6 hours, and 7 hour and more. Based on the recommendation of the Physical Activity Guidelines for American ( <i>2008 Physical activity guidelines for Americans</i> , 2008), response categories were dichotomized: “less than 7 hours per week” and “equal to or more than 7 hours per week.”
Watching TV	The students were asked to response how many hours they watch television during weekdays or weekends. They could answer none at all, about 1 hour a day, about 2 hours a day, etc., up to about 7 or more hours a day for weekdays and weekend. Because the American Academy of Pediatrics recommends adolescents should have less than 2 hours of screen time per day (American Academy of Pediatrics, n.d.), the response categories were re-coded into “less than 2 hours per day” and “equal to or more than 2 hours per day.”

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*Sample selected for this study*

Data for 5,248 adolescents from 184 schools (out of 12,642 from 314) were included in the present analysis. Data were excluded for adolescents who did not provide information for the following descriptive variables: age, gender, ethnicity, grade, family affluence, height, and weight. Adolescents were also excluded whenever the data related to their school, as provided by the school administrator, were incomplete. This yielded 184 school administrators' responses for analysis of school-related factors. The included adolescents were evenly distributed by gender (46.8% female). About half were Caucasian (49.3%). Only 5% had low socio-economic status. Thirty-three percent were overweight or obese, using the BMI-for-age percentiles and z-scores based on CDC growth charts from 2000 (CDC, 2014). More detailed demographic characteristics of the population in this analysis are presented in Table 3.3.

Table 3.4 provides the descriptive statistics for diet and exercise outcome variables. In this study, 56.2 % of participants had breakfast 6 or 7 days per week. About half of the participants consumed soft drinks more than once a week. Less than 40% of participants met the guidelines for physical activity (*2008 Physical activity guidelines for Americans*, 2008). Only 10.4% spent recommended amount of time on exercise (*2008 Physical activity guidelines for Americans*, 2008), while about half of the participants spent the appropriate time on watching television based on the recommendation from American Academy of Pediatrics (n.d.) (46.2%).

Table 3.3. Demographic characteristics of the participants ( $N = 5,248$ )

Variables		$n$	%
Sex	Male	2,790	53.2
	Female	2,458	46.8
Ethnicity	African American	876	16.7
	Caucasian	2,583	49.2
	Asian	235	4.5
	Hispanic	1,024	19.5
	Others	530	10.1
Age (year)	10 – 11	1,195	22.8
	12 – 14	3,089	58.9
	15 ≤	964	18.4
Grade	5 <sup>th</sup> and 6 <sup>th</sup>	1,491	28.4
	7 <sup>th</sup> , 8 <sup>th</sup> , and 9 <sup>th</sup>	3,094	59.0
	10 <sup>th</sup>	663	12.6
Weight status <sup>§</sup>	Underweight	268	5.1
	Normal	3,217	61.3
	Overweight	998	19.0
	Obesity	765	14.6
Family	Low	257	4.9
Affluence	Middle	1851	35.3
Scale	High	3,140	59.8

<sup>§</sup> Weight status was categorized based on the BMI percentile: underweight (< 5<sup>th</sup> percentile), normal weight (5<sup>th</sup> to < 85<sup>th</sup> percentile), overweight (85<sup>th</sup> to < 95<sup>th</sup> percentile), and obese ( $\geq$  95<sup>th</sup> percentile).

Table 3.4. Frequency of diet and exercise of the participants ( $N = 5,248$ )

Outcome variable <sup>§</sup>		<i>n</i>	%
Having breakfast	0 - 5 days	2,212	43.9
	6 or 7 days	2,833	56.2
Drinking soft drinks	≤ 1 time/week	1,990	49.2
	> 1 time/week	2,052	50.8
Engaging in physical activity	0 - 5 days	3,216	62.1
	6 or 7 days	1,964	37.9
Spending time on exercise	< 7 hours/week	4,656	89.6
	≥ 7 hours/week	541	10.4
Watching television	< 2 hours/week	2,351	46.2
	≥ 2 hours/week	2,736	53.8

<sup>§</sup> Depending on number of missing data, the total number of participants for each outcome variable was different: n= 2,685 for having breakfast, n= 2, 676 for drinking soft drinks, n=2,838 for engaging in physical activity, n=2, 835 for spending time on exercise, and n=2,783 for watching television.

### *Statistical analysis*

SAS Enterprise Guide version 5.1 (SAS Institute, Cary, NC) was used for statistical analyses. Descriptive statistics were used to identify characteristics of the sample and outcome variables. To examine the influence of parent-, school-, and peer-related factors on diet and exercise, logistic regression analyses were conducted using PROC GENMOD in SAS. All analyses were conducted separately for each outcome variable. Variables with a significance of at least .15 on bivariate analyses were included in multivariable analyses. Covariates including demographic characteristics, emotional variables such as loneliness or sadness, and self-reported feelings about appearance were included given their potential relationship to diet and exercise. The Akaike information criterion (AIC) was used as a measure of model fitness for multiple regression models.

### Results

#### *Aim 1a. Having breakfast*

Predictors for models related to diet are summarized in Table 3.5 and shown in Figure 3.3. Analyses controlled for Gender ( $p = .004$ ), age ( $p = .003$ ), ethnicity ( $p = .001$ ), socio-economic status measured by the Family Affluence Scale ( $p = .004$ ), feeling anger toward one's body ( $p = .001$ ), feeling comfortable with own body ( $p = .006$ ), and feeling lonely ( $p < .001$ ). Adolescents had higher odds of having breakfast 6 or 7 days during a week when they had the following characteristics: living with double parents (OR = 1.36,  $p = .001$ ), feeling difficult communicating with parents (OR = 1.48,  $p < .001$ ), having 0 to 2 opposite-sex friends (OR = 1.26,  $p = .02$ ), and not calling or texting friends every day (OR = 1.38,  $p < .001$ ). However, adolescents had lower odds of having breakfast if they were not monitored by their parents (OR = 0.81,  $p = .02$ ). The type of lunch program provided by school was also a significant

contributing factor to having breakfast 6 or 7 days (OR = 2.69,  $p = .02$ , for other lunch programs vs. USDA only; OR = 0.41,  $p = .04$ , for *a la carte* vs. other program; and OR = 0.31,  $p = .005$ , for both *a la carte* and USDA vs. other program).

*Aim 1b. Drinking soft drinks*

Analyses for drinking soft drinks controlled for gender ( $p < .001$ ), age ( $p = .006$ ), ethnicity ( $p = .01$ ), and feeling sad ( $p = .02$ ). Adolescents who were not monitored by their parents had higher odds of drinking soft drinks more than once a week (OR = 1.27,  $p = .006$ ). Adolescents who spent less time with friends (0-1 evenings /week) had lower odds of having soft drinks more than once a week, compared with those who spent 4 to 7 evenings with friends (OR = 0.68,  $p < .001$ ). However, there were no significant differences between adolescents who spent 2 to 3 evenings a week with friends and those who spent time with friends 4 to 7 evenings a week (OR = 0.84,  $p = .12$ ). If adolescents did not call or text friends every day, they had lower odds of drinking soft drinks more than once a week (OR= 0.72,  $p < .001$ ).

*Aim 2a. Engaging in physical activity*

Predictors for each model related to exercise are summarized in Table 3.6 and shown in Figure 3.4. Analyses controlled for gender ( $p < .001$ ), ethnicity ( $p < .001$ ), and feeling frustrated or satisfied with one's appearance ( $p = .01$  and  $p = .006$ , respectively). Adolescents had higher odds of participating in physical activity 6 or 7 days per week when they lived with double parents rather than a single parent (OR = 1.35,  $p = .001$ ). However, adolescents had lower odds of engaging in physical activity 6 or 7 days per week if they were not monitored by parents, compared to adolescents who were monitored by parents (OR = 0.75,  $p = .001$ ). Adolescents who had 0 to 2 opposite-sex friends had lower odds of exercising than those who had more than 3 opposite-sex friends (OR = 0.71,  $p < .001$ ), as did adolescents who spent fewer days with their

friends during the week (OR = 0.61,  $p < .001$ , for spending 0 to 1 day with friends; OR = 0.69,  $p < .001$ , for 2 to 3 days, compared to spending time on 4-7 days with friends). The frequency of spending time with friends in the evening was a significant contributing factor to participating in physical activity 6 or 7 days per week (OR = 0.67,  $p < .001$ , for spending 0 to 1 evening; OR = 0.70,  $p = .002$ , for spending 2 to 3 evenings). However, there were no significant differences between adolescents who spent 0 to 1 day or 0 to 1 evening with friends and those who spent 2 to 3 days or evenings (OR = 0.88,  $p = .23$ , and OR = 0.95,  $p = .62$ , respectively).

*Aim 2b. Spending time on exercise*

Analyses of time spent on exercise controlled for gender ( $p < .001$ ), ethnicity ( $p < .001$ ), feeling frustrated with appearance ( $p = .03$ ), and feeling sad ( $p = .005$ ). Adolescents who had difficult communication with opposite-sex friends had higher odds of spending 7 or more hours per week in exercise (OR = 1.48,  $p = .01$ ). However, adolescents who spent 0 to 1 day or 2 to 3 days with friends had lower odds of spending 7 or more hours in exercise during a week when compared with those who spent 4 to 7 days with friends (OR = 0.66,  $p = .01$ , and OR = 0.70,  $p = .02$ , respectively). No parent or school factors were associated with spending time on exercise.

*Aim 2c. Watching television*

Table 3.6 presents the final model for variables related to time spent watching TV, and the model is provided in Figure 3.4. Ethnicity ( $p < .001$ ), socio economic status measured by the Family Affluence Scale ( $p = .03$ ), and being frustrated with own appearance ( $p = .01$ ) were controlled. Adolescents were less likely to watch television 2 or more hours during a day, given the following characteristics: living with double parents (OR = 0.74,  $p = .001$ ), having 0 to 2 same-sex friends, compared to having 3 or more same-sex friends (OR = 0.77,  $p = .02$ ), and having 0 to 2 opposite-sex friends, compared to having 3 or more opposite-sex friends (OR =

0.80,  $p = .01$ ). Adolescents who spent 2 to 3 evenings a week with friends had lower odds of spending 2 or more hours watching TV when compared with those who spent 4 to 7 evenings with their friends (OR = 0.80,  $p = .04$ ). Adolescents who were not monitored by their parents had higher odds of spending 2 or more hours watching TV (OR = 1.34,  $p < .001$ ).



Table 3.5. Odds ratio for factors related to diet

Variables		Having a breakfast 6 or 7 days per week (n = 2,685)		Drinking soft drink more than once a week (n = 2,138)	
		OR	95% CI	OR	95% CI
<i>Parent-level</i>					
Living with parents (vs. Single parent)	Double parents	1.36	1.14 – 1.63		
Communication with parents (vs. Easy)	Difficult	1.48	1.22 – 1.78		
Monitoring by parents (vs. Yes)	No	0.81	0.68 – 0.97	1.27	1.07 – 1.50
<i>Peer-level</i>					
No. of same-sex friends (vs. $\geq 3$ friends)	0-2 friends	0.80	0.63 – 1.00		
No. of opposite-sex friends (vs. $\geq 3$ friends)	0-2 friends	1.26	1.04 – 1.51		
Evenings spending with friends (vs. 4-7 days)	0-1 day			0.68	0.55 – 0.83
	2-3 days			0.84	0.68 – 1.05
Call/text with friends (vs. 7 days)	0-6 days	1.38	1.17 – 1.64	0.72	0.61 – 0.86
<i>School-level</i>					
Breakfast program (vs. USDA only)	<i>A la carte</i>	0.81	0.40 – 1.61		
	Both	1.05	0.83 – 1.33		
	Other	0.58	0.32 – 1.97		
Lunch program (vs. USDA only)	<i>A la carte</i>	1.10	0.59 – 2.05		
	Both	0.82	0.63 – 1.07		
	Other	2.69	1.16 – 6.21		
<i>Covariates</i>					
Gender (vs. Male)	Female	0.78	0.66 – 0.92	0.68	0.57 – 0.80
Age (vs. 15-17 years)	10-11	1.55	1.17 – 2.04	0.71	0.55 – 0.92
	12-14	1.06	0.86 – 1.31	0.98	0.80 – 1.21
	Ethnicity (vs. Caucasian)	African American	0.74	0.59 – 0.94	1.39
	Asian	0.63	0.42 – 0.96	0.73	0.49 – 1.09
	Hispanic	0.69	0.55 – 0.87	1.21	0.97 – 1.51
	Others	1.05	0.80 – 1.38	1.11	0.85 – 1.45
Family Affluence Scale (vs. Middle)	High	1.34	1.12 – 1.59		
	Low	0.99	0.67 – 1.47		
Feeling anger toward body (vs. Neither)	Agree	1.05	0.72 – 1.53		
	Disagree	1.56	1.19 – 2.06		
Feeling comfortable with own body (vs. Neither)	Agree	1.13	0.89 – 1.44		
	Disagree	0.74	0.55 – 1.00		
Feeling sad (vs. Very often)	Rarely			1.27	1.07 – 1.50
Feeling lonely (vs. Very often)	Rarely	0.77	0.61 – 0.96		

Table 3.6. Odds ratios for factors related to exercise

Variables		Doing physically activity 6 or 7 days per week (n = 2,838)		Spending ≥ 7 hours in exercise during a week (n = 2,835)	
		OR	95% CI	OR	95% CI
<i>Parent-level</i>					
Living with parents (vs. Single parents)	Double parents	1.35	1.13 – 1.60	1.22	0.92 – 1.62
Monitoring by parents (vs. Yes)	No	0.75	0.63 – 0.88		
<i>Peer-level</i>					
No. of same-sex friends (vs. ≥ 3 friends)	0-2 friends				
No. of opposite-sex friends (vs. ≥ 3 friends)	0-2 friends	0.71	0.59 – 0.85		
Communication with same-sex friends (vs. Easy)	Difficult	1.25	0.99 – 1.57		
Communication with opposite- sex friends (vs. Easy)	Difficult	1.17	0.97 – 1.41	1.48	1.11 – 1.98
Days spending with friends (vs. 4-7 days)	0-1 day 2-3 days	0.61 0.69	0.48 – 0.76 0.57 – 0.85	0.66 0.70	0.48 – 0.91 0.52 – 0.94
Evenings spending with friends (vs. 4-7 days)	0-1 day 2-3 day	0.67 0.70	0.53 – 0.84 0.56 – 0.88		
<i>School-level</i>					
Providing PA in school (vs. Yes)	No			0.69	0.48 – 1.01
<i>Covariates</i>					
Gender (vs. Male)	Female	0.62	0.52 – 0.73	0.50	0.38 – 0.66
Ethnicity (vs. Caucasian)	African American	0.88	0.70 – 1.10	0.43	0.29 – 0.64
	Asian	0.36	0.22 – 0.59	0.18	0.06 – 0.57
	Hispanic	0.61	0.49 – 0.77	0.28	0.18 – 0.43
	Others	0.98	0.75 – 1.27	1.07	0.75 – 1.54
Frustrated with appearance (vs. Neither)	Agree Disagree	1.24 1.46	0.93 – 1.65 1.14 – 1.85	1.16 1.56	0.72 – 1.86 1.07 – 2.27
Satisfied with my appearance (vs. Neither)	Agree Disagree	1.48 1.37	1.16 – 1.89 1.03 – 1.83		
Feeling sad (vs. Very often)	Rarely			0.64	0.46 – 0.87

Table 3.6. (continued)

Variables		Watching TV 2 or more hours per day ( <i>n</i> = 2,783)	
		OR	95% CI
<i>Parent-level</i>			
Living with parents (vs. Single parents)	Double parents	0.74	0.63 – 0.88
Monitoring by parents (vs. Yes)	No	1.34	1.14 – 1.58
<i>Peer-level</i>			
No. of same-sex friends (vs. $\geq 3$ friends)	0-2 friends	0.77	0.62 – 0.97
No. of opposite-sex friends (vs. $\geq 3$ friends)	0-2 friends	0.80	0.67 – 0.95
Evenings spending with friends (vs. 4-7 days)	0-1 day	0.94	0.77 – 1.14
	2-3day	0.80	0.65 – 0.99
<i>School-level</i>			
Providing PA in school (vs. Yes)	No		
Accessibility of PA facilities (vs. Yes)	No		
<i>Covariates</i>			
Ethnicity (vs. Caucasian)	African	2.69	2.13 – 3.41
	American		
	Asian	1.27	0.86 – 1.88
	Hispanic	1.76	1.43 – 2.18
	Others	1.29	0.99 – 1.66
Family Affluence Scale (vs. Middle)	High	0.91	0.77 – 1.08
	Low	1.52	1.02 – 2.25
Frustrated with appearance (vs. Neither)	Agree	1.43	1.12 – 1.84
	Disagree	1.28	1.04 – 1.57

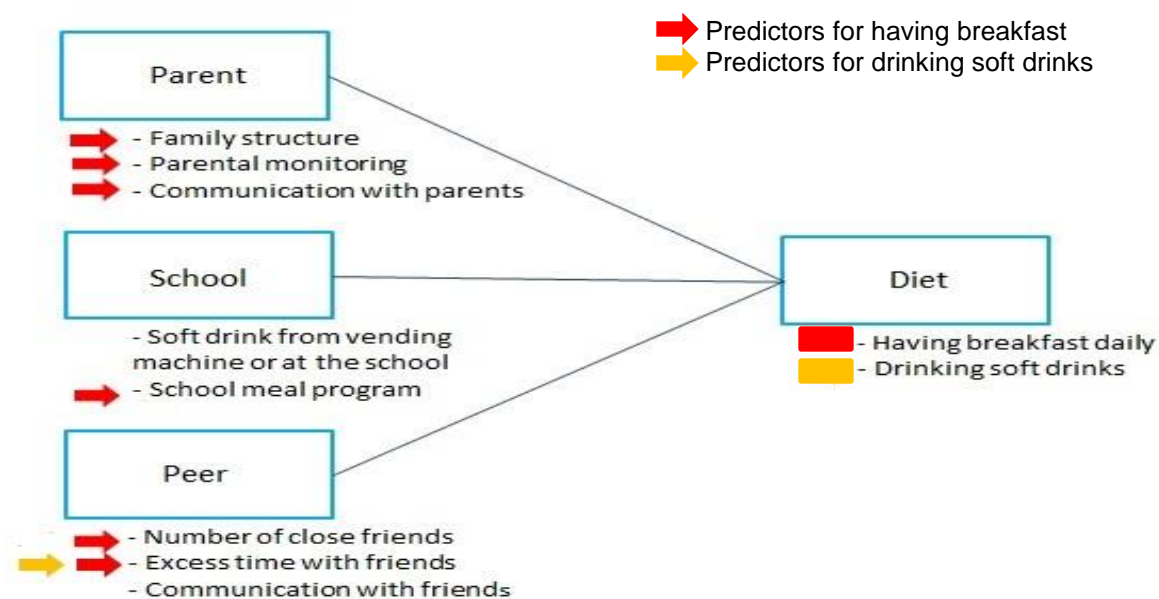


Figure 3.3. Models for diet of adolescents in the United States

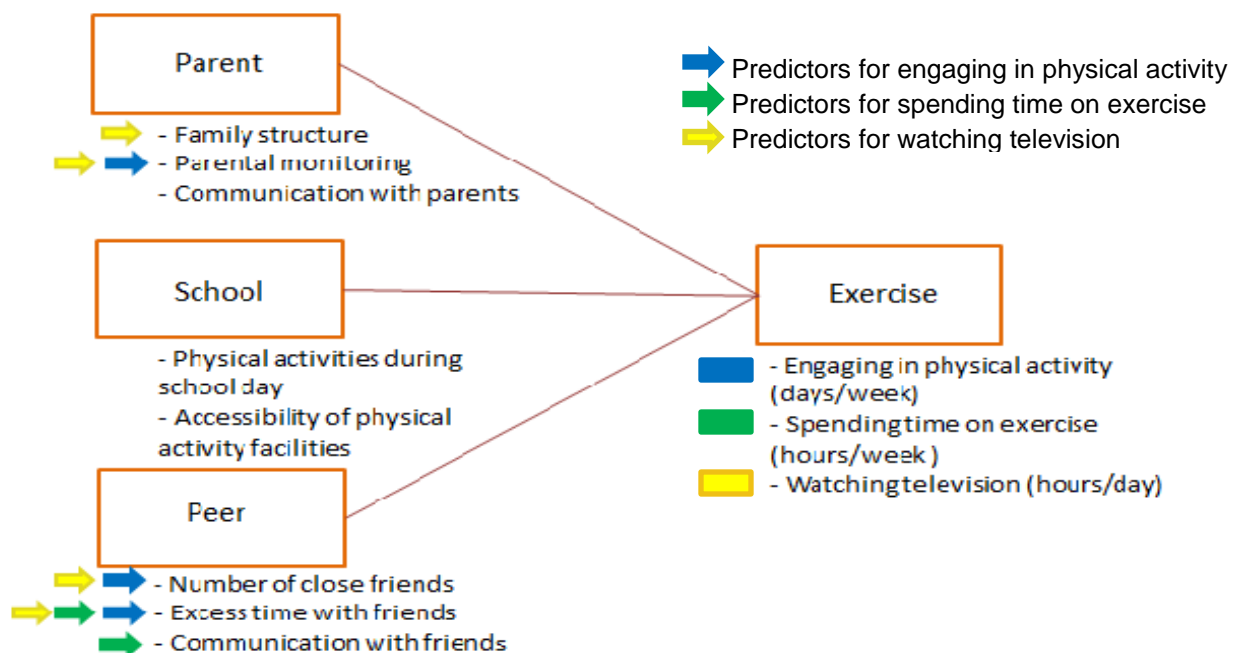


Figure 3.4. Models for exercise of adolescents in the United States.

## Discussion

This analysis examined the contributions of parent-, school-, and peer-related factors to diet and exercise of adolescents, using data obtained from a nationally representative sample of U.S. teens. Across all outcome variables, except one, both parent- and peer-related factors were associated with diet and exercise of adolescents. Only peer-related factors were associated with spending time on exercise. What type of lunch program was provided by the school was the only school factor associated with diet of adolescents; none were associated with exercise.

Parent-related factors were important determinants of adolescents' diets. In this analysis, adolescents were more likely to have breakfast daily if they lived with double parents. This supports findings from previous studies that living with double parents was associated with more frequent breakfast consumption (Levin & Kirby, 2012; Pearson et al., 2010; Stewart & Menning, 2009). Parental monitoring was also associated with diet. Parenting style was not measured in this analysis; however, it could be inferred from parent monitoring. If adolescents perceive higher parental monitoring, their parents are more likely to control their behaviors, including diet and exercise. In this analysis, adolescents with higher parental monitoring were more likely to have breakfast daily and had soft drinks less frequently. This supported the findings of previous studies that a stricter parenting style was positively associated with a healthier diet (Alia, Wilson, Geroche, Schneider, and Kitzman-Ulrich, 2013; Pearson, Atkin, Biddle, Gorely, & Edwardson, 2010; Van der Horst et al., 2007).

Peer-related factors were also associated with diet. Adolescents with more opposite-sex friends were less likely to have breakfast daily. During adolescence, opposite-sex friendships become more common (Connolly, Craig, Goldberg, & Pepler, 2004; Poulin & Pedersen, 2007), as do interactions with opposite-sex friends (Collins & Steinberg, 2008). Thus, relationships with

opposite-sex friends could play an important role in adolescents' dietary behaviors. Adolescents with more opposite-sex friends might have more concern about their weight and body shape. To control their body weight, they might use healthier eating habits, including skipping breakfast. Little is known about the relationships between adolescents' breakfast consumption and their opposite-sex friends, making additional studies necessary. Another peer-related factor was spending time with friends. If adolescents spent fewer evenings with their friends or did not call/text friends every day, they consumed fewer soft drinks. Previous studies found that food intake of adolescents was positively associated with those of their peers (Bruening et al., 2012; De la Haye, Robins, Mohr, & Wilson, 2013; Wouters et al, 2010), with some studies indicating that peers influenced adolescents' food choices by commenting on their choice or sharing food with them (Waga & Mavoia, 2006; Voorend et al., 2013). Therefore, peers could have greater impact, either positive or negative, on adolescents' diets if adolescents had more interactions with their friends like spending evenings together or calling/texting to them.

Findings also indicated that the type of lunch program available in a school was associated with diet. In this analysis, adolescents who were provided lunch programs other than *a la carte* or the USDA national school lunch program (NSLP), had a higher frequency of having breakfast, compared to adolescents whose school provided only NSLP. Although previous studies found associations between school lunch programs and a healthier diet (e.g. increased fruit and vegetable intake, lower consumption of soft drinks) (Briefel, et al., 2009; Hanson & Olson, 2013; Robinson-O'Brien et al., 2010), these studies were conducted with adolescents from low-income families to examine the effectiveness of the NSLP. In the present analysis, socioeconomic status as measured by the Family Affluence Scale was controlled; and thus, the associations between NSLP and adolescents' diet were not found.

Adolescents' exercise was related to family structure and parental monitoring. Adolescents living with double parents were more likely to engage in more frequent physical activity and spend fewer hours watching television, consistent with some previous studies (Bagley, Salmon, & Crowford, 2006; Dagkas & Stathi, 2007). In contrast, other studies examining the contribution of family structure to exercise produced opposite results (Hohepa et al., 2007; Ornelas, Perrira, & Ayala, 2007). Hohepa et al. (2007) found that family structure was not significantly related to adolescents' physical activity if adolescents perceive higher support from their parents, indicating a possible interaction effect. Their results cannot be directly compared to the present analysis, because parental support was not measured in the current data set. In addition, differences in control variable selection make it difficult to directly compare findings in this analysis with the work of Hohepa et al.

No clear consensus has emerged on the influence of family structure on adolescents' exercise; thus, it is important for future studies to examine further the influence of family structure in order to develop more effective programs to improve adolescents' exercise. Parental monitoring and adolescents' exercise were also associated in this analysis, consistent with a study of younger children ages 10 to 11 (Jago et al., 2011) but not with one on older adolescents (grades 7 to 12) (Ornelas et al., 2007). Because the importance of peer relationships increases in early adolescence (10 to 14 years) (Brown & Larson, 2009; Collins & Steinberg, 2008), parental influence on exercise might diminish over time. Further analysis of the HBSC data set that differentiates adolescents by age group or grade level could reveal differences, as only adolescents in grades 5 through 10 were included in this analysis.

Peer factors were also important for adolescents' exercise. Opposite-sex friends were found to be important for adolescents' exercise. As mentioned before, relationships with

opposite-sex friends become more common in adolescence (Connolly, Craig, Goldberg, & Pepler, 2004; Poulin & Pedersen, 2007), and previous studies indicated the importance of opposite-sex friends in adolescents' exercise (Graham, Wall, Larson, & Neumark-Sztainer, 2014; Sirard et al., 2013). Based on the findings in this analysis, if adolescents had more opposite-sex friends, they were likely to spend more time on engaging in either physical activity and watching television. Having more opposite-sex friends enables adolescents to more interact with those friends. That is, they could have more chance to spend time together participating in any kind of activities. Graham et al. indicated that female adolescents' exercise was positively associated with their male friends' exercise, although no associations were found among male adolescents and their female friends. However, in this analysis only number of opposite-sex friends was measured and an interaction effect of gender for adolescents' and friends' exercise was not considered. More detailed examination of the effect of gender on adolescents' exercise should be completed in order to identify potential gender-specific interventions to improve adolescents' exercise.

Spending more time with friends, whether during days or evenings, was associated with increases in adolescents' exercise. Previous studies indicated that adolescents were more likely to engage in physical activity when they were with friends, compared to being alone (Salvy et al., 2008; Salvy, De La Haye, Bowker, & Hermans, 2012; Salvy et al., 2009). With friends, it is possible that adolescents play ball or Frisbee, and participate in team sports such as soccer. Times with friends are important to adolescents because adolescents could have more chance to engage in exercise when they hang out more days or evenings together. Because peers are important determinants for adolescents' exercise behaviors, it is important to further explore underlying mechanisms explaining these effects in order to increase the effectiveness of interventions for adolescents' exercise.



No associations were found between school-related factors and adolescents' exercise in this analysis. This result was consistent with some previous studies (Kirby, Levin, & Inchley, 2012; Scott et al.2007). However, one study (Durant et al., 2009) found that access to school physical activity facilities was positively related to physical activity and was not associated with television watching. Some researchers indicated that provision of sports or physical activity clubs was more important to promote adolescents' exercise than just accessibility of physical activity facilities (Haerens et al., 2009; Kirby et al., 2012). It would be helpful to understand adolescents' expectations about school programs (e.g. what kinds of extracurricular physical activities adolescents want) to improve their exercise.

There are clinical and research implications of this analysis. First, parents should be involved in interventions for adolescents' diet and exercise as they still influence these behaviors. In settings such as primary care, nurses could assess parenting behaviors or parental limits for adolescents' diet or exercise. Based on the assessment, nurses could provide information about healthy diet and exercise and what kinds of resources are available (e.g. school programs, neighborhood facilities, Internet websites) to improve adolescents' diet and exercise and prevent adolescents from being overweight or obese. Next, more studies examining the influence of school lunch programs and physical activity programs on adolescents' diet and exercise are needed. Because evidence supporting the influence of school programs has been inconclusive, school nurses could help develop diverse school programs to determine which are most appropriate for improving adolescents' diet and exercise. Nurses in schools could also collaborate with clinical nurse researchers to assess needs for programs, develop appropriate programs, and evaluate effectiveness.

Finally, peer relationships should also be considered when planning interventions for healthier diet and exercise. Studies examining the characteristics of friendship such as popularity or reciprocity are needed to provide more nuanced information about the influence of peer relationships. Interventions for mixed-sex friendships could also be effective because opposite-sex friends as well as same-sex friends are important to adolescents' diet and exercise. Because relationships with peers are important for diet and exercise of adolescents, nurses should consider group of peers in interventions to improve diet and exercise of adolescents. To assess diet and exercise and to develop better interventions for adolescents and their peers, nurses from diverse settings (e.g. high school, community health centers, and primary care), other health care providers such as psychologists or physicians, and others with expertise in nutrition or exercise should develop collaborative interventions.

There are several limitations in this analysis. First, this is a secondary data analysis. Variables included in the present analysis might be biased. For example, only variables examining the relationships with friends were included in this analysis, because no variables that examined relationships with peers—a broader concept than friends—were included. In addition, because data from the HBSC study were collected based on self-report, there could be a social desirability bias. Next, some variables potentially associated with adolescents' diet and exercise might have been missed because multivariable models included only those variables significant at  $\alpha < .15$  on bivariate analyses. Last, findings from this analysis cannot support cause-effect associations between adolescents' and peers' diet and exercise because the HBSC study was cross-sectional. More longitudinal and experimental studies are necessary.

### Conclusion

In the present analysis, parent, school, and peer contributions to diet and exercise of U.S. adolescents were examined using nationally representative data from the WHO 2009/2010 HBSC survey. Findings from this analysis extended the previous research that there are associations between parent- and peer-related factors and diet and exercise of adolescents. However, in this analysis, school-related factors were not associated with adolescents' exercise; while school lunch program was the only school-related factor for adolescents' diet. The present analysis could help identify focal areas to target for improving adolescents' healthier dietary and exercise behaviors.

## REFERENCES

- 2008 Physical activity guidelines for Americans. (2008). Rockville, MD: The U.S. Department of Health and Human Services
- Alia, K. A., Wilson, D. K., George, S. M. S., Schneider, E., & Kitzman-Ulrich, H. (2013). Effects of parenting style and parent-related weight and diet on adolescent weight status. *Journal of Pediatric Psychology*, 38(3), 321-329.
- American Academy of Pediatrics. Media and children Retrieved November 2014, 2014, from <https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Pages/Media-and-Children.aspx>
- Bagley, S., Salmon, J., & Crawford, D. (2006). Family structure and children's television viewing and physical activity. *Medicine and Science in Sports and Exercise*, 38(5), 910-918.
- Bauer, K., Neumark-Sztainer, D., Hannan, P., Fulkerson, J., & Story, M. (2011). Relationships between the family environment and school-based obesity prevention efforts: Can school programs help adolescents who are most in need? *Health Education Research*, 26(4), 675-688.
- Berge, J. M., Wall, M., Loth, K., & Neumark-Sztainer, D. (2010). Parenting style as a predictor of adolescent weight and weight-related behaviors. *Journal of Adolescent Health*, 46(4), 331-338.
- Bigornia, S. J., LaValley, M. P., Noel, S. E., Moore, L. L., Ness, A. R., & Newby, P. (2014). Sugar-sweetened beverage consumption and central and total adiposity in older children: a prospective study accounting for dietary reporting errors. *Public Health Nutrition*, 1-9.
- Biro, F. M., & Wien, M. (2010). Childhood obesity and adult morbidities. *The American Journal of Clinical Nutrition*, 91(5), 1499S-1505S.
- Briefel, R. R., et al. (2009). Consumption of low-nutrient, energy-dense foods and beverages at school, home, and other locations among school lunch participants and nonparticipants. *Journal of the American Dietetic Association*, 109(2), S79-S90.
- Brown, B. B., & Larson, J. (2009). Adolescents' relationships with peers. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (3 ed., Vol. 2, pp. 74-103). Hoboken, NJ: Wiley.
- Bruening, M., Eisenberg, M., MacLehose, R., Nanney, M. S., Story, M., & Neumark-Sztainer, D. (2012). Relationship between adolescents' and their friends' eating behaviors: Breakfast, fruit, vegetable, whole-grain, and dairy intake. *Journal of the Academy of Nutrition and Dietetics*, 112(10), 1608-1613.
- Bruening, M., MacLehose, R., Eisenberg, M. E., Nanney, M. S., Story, M., & Neumark-Sztainer, D. (2014). Associations between sugar-sweetened beverage consumption and fast-food restaurant frequency among adolescents and their friends. *Journal of Nutrition Education and Behavior*.
- Centers for Disease Control and Prevention. (2014). A SAS program for the 2000 CDC growth chart. Retrieved October, 2014, from <http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm>
- Cheng, L. A., Mendonca, G., & Junior, F. (2014). Physical activity in adolescents: analysis of the social influence of parents and friends. *Journal de Pediatria*, 90(1), 35-41.
- Collins, W. A., & Steinberg, L. (2008). Adolescent development in interpersonal context. In W. Damon & R. M. Lerner (Eds.), *Child and adolescent development: An advanced course* (6th ed., pp. 551-590). Hoboken, NJ: Wiley.

- Dagkas, S., & Stathi, A. (2007). Exploring social and environmental factors affecting adolescents' participation in physical activity. *European Physical Education Review*, 13(3), 369-384.
- Davison, K. K., & Birch, L. L. (2001). Childhood overweight: a contextual model and recommendations for future research. *Obesity Reviews*, 2(3), 159-171.
- De la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2011). How physical activity shapes, and is shaped by, adolescent friendships. *Social Science & Medicine*, 73(5), 719-728.
- De la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2013). Adolescents' intake of junk food: Processes and mechanisms driving consumption similarities among friends. *Journal of Research on Adolescence*, 23(3), 524-536.
- Denney-Wilson, E., Crawford, D., Dobbins, T., Hardy, L., & Okely, A. D. (2009). Influences on consumption of soft drinks and fast foods in adolescents. *Asia Pacific Journal of Clinical Nutrition*, 18(3), 447-452.
- Durant, N., Harris, S. K., Doyle, S., Person, S., Saelens, B. E., Kerr, J., . . . Sallis, J. F. (2009). Relation of School Environment and Policy to Adolescent Physical Activity. *Journal of School Health*, 79(4), 153-159.
- 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(3), 673-680.
- Fox, M. K., Dodd, A. H., Wilson, A., & Gleason, P. M. (2009). Association between school food environment and practices and body mass index of US public school children. *Journal of the American Dietetic Association*, 109(2), S108-S117.
- Fryar, C. D., Carroll, M. D., & Ogden, C. L. (2012). Prevalence of obesity among children and adolescents: United States, trends 1963–1965 through 2009–2010. *National Center for Health Statistics*.
- Gordon-Larsen, P., The, N. S., & Adair, L. S. (2010). Longitudinal trends in obesity in the United States from adolescence to the third decade of life. *Obesity*, 18(9), 1801-1804.
- Graham, D. J., Wall, M. M., Larson, N., & Neumark-Sztainer, D. (2014). Multicontextual correlates of adolescent leisure-time physical activity. *American journal of Preventive Medicine*, 46(6), 605-616.
- Hanson, K. L. & Olson, C. M. (2013). School meals participation and weekday dietary quality were associated after controlling for weekend eating among US school children aged 6 to 17 years. *The Journal of Nutrition*, 143(5), 714-721.
- Haerens, L., Craeynest, M., Deforche, B., Maes, L., Cardon, G., & De Bourdeaudhuij, I. (2009). The contribution of home, neighbourhood and school environmental factors in explaining physical activity among adolescents. *Journal of Environmental and Public Health*, 2009.
- Haug, E., Torsheim, T., Sallis, J. F., & Samdal, O. (2010). The characteristics of the outdoor school environment associated with physical activity. *Health education research*, 25(2), 248-256.
- Hohepa, M., Scragg, R., Schofield, G., Kolt, G. S., & Schaaf, D. (2007). Social support for youth physical activity: Importance of siblings, parents, friends and school support across a segmented school day. *International Journal of Behavioral Nutrition and Physical Activity*, 4(1), 54.
- Iannotti, R. J. (2013). *Health Behavior in School-Aged Children (HBSC), 2009-2010*. Retrieved from: <http://doi.org/10.3886/ICPSR34792.v1>
- Jago, R., Davison, K. K., Thompson, J. L., Page, A. S., Brockman, R., & Fox, K. R. (2011). Parental sedentary restriction, maternal parenting style, and television viewing among 10- to 11-year-olds. *Pediatrics*, 128(3), e572-e578.

- Kaphingst, K. M., & French, S. (2006). The role of schools in obesity prevention. *The Future of Children*, 16(1), 109-142.
- Kirby, J., Levin, K. A., & Inchley, J. (2011). Parental and peer influences on physical activity among Scottish adolescents: a longitudinal study. *Journal of Physical Activity and Health*, 8(6), 785.
- Kirby, J., Levin, K. A., & Inchley, J. (2012). Associations between the school environment and adolescent girls' physical activity. *Health Education Research*, 27(1), 101-114.
- Laursen, B., & Collins, W. A. (2009). Parent-child relationships during adolescence. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (3 ed., Vol. 2, pp. 3-42): Hoboken, NJ: Wiley.
- Levin, K. A., & Kirby, J. (2012). Irregular breakfast consumption in adolescence and the family environment: underlying causes by family structure. *Appetite*, 59(1), 63-70.
- Lo, J. C., Chandra, M., Sinaiko, A., Daniels, S. R., Prineas, R. J., Maring, B., . . . Kharbanda, E. O. (2014). Severe obesity in children: prevalence, persistence and relation to hypertension. *International Journal of Pediatric Endocrinology*, 2014(1), 1-8.
- Lopes, V. P., Gabbard, C., & Rodrigues, L. P. (2013). Physical activity in adolescents: examining Influence of the best friend dyad. *Journal of Adolescent Health*, 52(6), 752-756.
- Minaker, L. M., Storey, K. E., Raine, K. D., Spence, J. C., Forbes, L. E., Plotnikoff, R. C., & McCargar, L. J. (2011). Associations between the perceived presence of vending machines and food and beverage logos in schools and adolescents' diet and weight status. *Public Health Nutrition*, 14(08), 1350-1356.
- Mond, J., Van den Berg, P., Boutelle, K., Hannan, P., & Neumark-Sztainer, D. (2011). Obesity, body dissatisfaction, and emotional well-being in early and late adolescence: findings from the project EAT study. *Journal of Adolescent Health*, 48(4), 373-378.
- Nguyen, N. T., Magno, C. P., Lane, K. T., Hinojosa, M. W., & Lane, J. S. (2008). Association of hypertension, diabetes, dyslipidemia, and metabolic syndrome with obesity: findings from the National Health and Nutrition Examination Survey, 1999 to 2004. *Journal of the American College of Surgeons*, 207(6), 928-934.
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of American Medical Association*, 307(5), 483-490.
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Journal of American Medical Association*, 311(8), 806-814.
- 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(1), 3.
- Pearson, N., Atkin, A. J., Biddle, S. J., Gorely, T., & Edwardson, C. (2010). Parenting styles, family structure and adolescent dietary behaviour. *Public Health Nutrition*, 13(08), 1245-1253.
- Puhl, R. M., Luedicke, J., & Heuer, C. (2011). Weight-based victimization toward overweight adolescents: Observations and reactions of peers. *Journal of School Health*, 81(11), 696-703.
- Roberts, C., Freeman, J., Samdal, O., Schnohr, C. W., De Looze, M. E., Gabhainn, S. N., . . . Rasmussen, M. (2009). The Health Behaviour in School-aged Children (HBSC) study: Methodological developments and current tensions. *International Journal of Public Health*, 54(2, Suppl.), 140-150.

- Robinson-O'Brien, R., et al. (2010). Associations Between School Meals Offered Through the National School Lunch Program and the School Breakfast Program and Fruit and Vegetable Intake Among Ethnically Diverse, Low-Income Children. *Journal of School Health*, 80(10), 487-492.
- Rovner, A. J., Nansel, T. R., Wang, J., & Iannotti, R. J. (2011). Food sold in school vending machines is associated with overall student dietary intake. *Journal of Adolescent Health*, 48(1), 13-19.
- Salvy, S.-J., Bowker, J. W., Roemmich, J. N., Romero, N., Kieffer, E., Paluch, R., & Epstein, L. H. (2008). Peer influence on children's physical activity: An experience sampling study. *Journal of Pediatric Psychology*, 33(1), 39-49.
- Salvy, S.-J., De La Haye, K., Bowker, J. C., & Hermans, R. C. (2012). Influence of peers and friends on children's and adolescents' eating and activity behaviors. *Physiology & Behavior*, 106(3), 369-378.
- Salvy, S.-J., Elmo, A., Nitecki, L. A., Kluczynski, M. A., & Roemmich, J. N. (2011). Influence of parents and friends on children's and adolescents' food intake and food selection. *The American Journal of Clinical Nutrition*, 93(1), 87-92.
- Salvy, S.-J., Roemmich, J. N., Bowker, J. C., Romero, N. D., Stadler, P. J., & Epstein, L. H. (2009). Effect of peers and friends on youth physical activity and motivation to be physically active. *Journal of Pediatric Psychology*, 34(2), 217-225.
- Schofield, L., Mummery, K. W., Schofield, G., & Hopkins, W. (2007). The association of objectively determined physical activity behavior among adolescent female friends. *Research Quarterly for Exercise and Sport*, 78(2), 9-15.
- Scott, M. M., Cohen, D. A., Evenson, K. R., Elder, J., Catellier, D., Ashwood, J. S., & Overton, A. (2007). Weekend schoolyard accessibility, physical activity, and obesity: the Trial of Activity in Adolescent Girls (TAAG) study. *Preventive Medicine*, 44(5), 398-403.
- Sirard, J. R., Bruening, M., Wall, M. M., Eisenberg, M. E., Kim, S. K., & Neumark-Sztainer, D. (2013). Physical activity and screen time in adolescents and their friends. *American Journal of Preventive Medicine*, 44(1), 48-55.
- Smetana, J. G., Campione-Barr, N., & Metzger, A. (2006). Adolescent development in interpersonal and societal contexts. *Annual Review of Psychology*, 57, 255-284.
- Steinberg, L., & Monahan, K. C. (2007). Age differences in resistance to peer influence. *Developmental Psychology*, 43(6), 1531.
- Stewart, S. D., & Menning, C. L. (2009). Family structure, nonresident father involvement, and adolescent eating patterns. *Journal of Adolescent Health*, 45(2), 193-201.
- Story, M., Nannery, M. S., & Schwartz, M. B. (2009). Schools and obesity prevention: creating school environments and policies to promote healthy eating and physical activity. *Milbank Quarterly*, 87(1), 71-100.
- Terry-McElrath, Y. M., O'Malley, P. M., & Johnston, L. D. (2013). School soft drink availability and consumption among US secondary students. *American Journal of Preventive Medicine*, 44(6), 573-582.
- United States Department of Agriculture. (2015). School meals: Child nutrition programs. Retrieved March, 2015, from <http://www.fns.usda.gov/school-meals/child-nutrition-programs>
- Van der Horst, K., Kremers, S., Ferreira, I., Singh, A., Oenema, A., & Brug, J. (2007). Perceived parenting style and practices and the consumption of sugar-sweetened beverages by adolescents. *Health Education Research*, 22(2), 295-304.
- Voorhees, C. C., Murray, D., Welk, G., Birnbaum, A., Ribisl, K. M., Johnson, C. C., . . . Jobe, J. B. (2005). The role of peer social network factors and physical activity in adolescent girls. *American Journal of Health Behavior*, 29(2), 183.

- Wang, Y., & Lim, H. (2012). The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *International Review of Psychiatry*, 24(3), 176-188.
- Weiss, R., Dziura, J., Burgert, T. S., Tamborlane, W. V., Taksali, S. E., Yeckel, C. W., . . . Morrison, J. (2004). Obesity and the metabolic syndrome in children and adolescents. *New England Journal of Medicine*, 350(23), 2362-2374.
- Wiecha, J. L., Finkelstein, D., Tropic, P. J., Fragala, M., & Peterson, K. E. (2006). School vending machine use and fast-food restaurant use are associated with sugar-sweetened beverage intake in youth. *Journal of the American Dietetic Association*, 106(10), 1624-1630.
- World Health Organization. (n.d.). Health Behaviour in School-Aged Children: World Health Organization Collaborative Cross-National Survey. Retrieved March, 2014, from <http://www.hbsc.org>
- Wouters, E. J., Larsen, J. K., Kremers, S. P., Dagnelie, P. C., & Geenen, R. (2010). Peer influence on snacking behavior in adolescence. *Appetite*, 55(1), 11-17.



## CHAPTER IV.

## DIET AND EXERCISE OF KOREAN FEMALE ADOLESCENTS

## IN THEIR PEER NETWORK

## Abstract

**Purpose:** In Western countries with high rates of adolescent obesity, peers influence adolescents' diet and exercise behaviors, which contribute to obesity. Increasing rates of adolescent obesity are seen in non-Western countries, such as Korea; however, few studies have been conducted in these countries, despite differences in culture, which may affect adolescents' diet and exercise. Because most school activities are conducted within one classroom in Korea, high school students spend most of the school day in one classroom with their peers, engaging in school activities with these peers. Examining the influence of classroom-based peers on diet and exercise could provide more information about those relationships, which could be evidence for developing culturally-appropriate interventions. This study examined the diet and exercise of female adolescents within classroom-based peer networks in Korea.

**Method:** Complete social network analysis was used to examine the influence of classroom-based peers on adolescents' diet and exercise. Data were collected by self-report from 104 female adolescents in three classrooms.

**Results:** Most participants were normal-weight, 18-year-old adolescents. Across three classrooms, adolescents' dietary behaviors were connected with their classroom-based peer networks. However, few friends in the classrooms were nominated by female adolescents for exercise behaviors.

Conclusion: Using classroom-based peer networks in interventions to improve diet behaviors could be effective. However, more studies are necessary to explore potential barriers for Korean female adolescents and their classroom-based peers to spend time on exercise.

## Introduction

Many Western countries have high rates of adolescent obesity, leading to concern about the increased risks for current and future physical and mental health problems (Falkstedt, Hemmingsson, Rasmussen, & Lundberg, 2006; Ford, Nonnemaker, & Wirth, 2008; Suchindran, North, Popkin, & Gordon-Larsen, 2010; Weiss et al., 2004). Adolescent obesity can also lead to difficulties with social interactions, as obese adolescents are more likely to be targets for teasing or bullying from their peers (Janssen, Craig, Boyce, & Pickett, 2004; Lumeng et al., 2010; Puhl, Luedicke, & Heuer, 2011). Although stable since 2003, the prevalence of adolescent overweight and obesity in the United States is over 30% (Ogden, Carroll, Kit, & Flegal, 2014). In contrast, in countries from South East Asia, 10 - 20 % of adolescents are either overweight or obese, although trends are increasing (Wang & Lim, 2012). In order to decrease adolescent obesity, many studies in Western countries have focused on diet and exercise (Boone-Heinonen, Gordon-Larsen, & Adair, 2008; Janssen et al., 2005; McNaughton, Ball, Mishra, & Crawford, 2008), which are known contributors to obesity (Barlow & Committee, 2007). Modification of unhealthy diet and exercise behaviors necessitates identification of factors that contribute to these behaviors (Bauer, Neumark-Sztainer, Fulkerson, Hannan, & Story, 2011; Graham, Wall, Larson, & Neumark-Sztainer, 2014).

Studies conducted in Western countries have identified peers as an important factor influencing diet and exercise in adolescents. The influence of peers strengthens during adolescence, as adolescents tend to become less dependent on their parents during this developmental period, and also develop similar behaviors to their friends (Brown & Larson, 2009; Collins & Steinberg, 2006). Previous studies found that adolescents' diet and exercise are similar to those of their peers (Ali, Amialchuk, & Heiland, 2011; Bruening et al., 2014; Page,

Ihasz, Simonek, Klarova, & Hantiu, 2006; Wouters, Larsen, Kremers, Dagnelie, & Geenen, 2010), with some indicating differences according to gender, as well (Page et al., 2006; Sirard et al., 2013).

Social network analysis has been applied in an effort to learn more about the relationships between the diet and exercise of adolescents and their friends (Koehly & Loscalzo, 2009). Studies assessing peer networks found similar patterns of diet and exercise behaviors among adolescents and their peers (De la Haye, Robins, Mohr, & Wilson, 2010; Shoham et al., 2012; Voorhees et al., 2005). However, De la Haye et al. indicated that same-sex and opposite-sex friendship should be examined separately because the friendship selection process could differ depending on gender. In addition, network characteristics (e.g. popularity, reciprocity) have also been studied to assess the influence of peers on diet and exercise in adolescents (De la Haye et al., 2010; Simpkins, Schaefer, Price, & Vest, 2013). Popular adolescents were more likely to engage in physical activity and the influence of their behaviors was greater than that of less popular adolescents (De la Haye et al., 2010). These relational data could improve understanding of the influence of peers on adolescents' diet and exercise, and help develop peer network based interventions to promote healthier diet and exercise.

In contrast to the many studies of adolescent obesity in Western countries, studies of adolescent obesity in countries with relatively lower rates of adolescent obesity are limited. However, with increasing prevalence in many of these countries (Wang & Lim, 2012), identifying ways of reducing or preventing these increases may prevent problems observed in countries with higher rates. In Korea, for example, rates of adolescent obesity are relatively low, but have been increasing, similar to trends observed in Western countries. In 1997, the prevalence of overweight or obese adolescents in Korea was approximately 10% (K. Oh et al.,

2008). Since then, the prevalence of overweight or obese adolescents in Korea has steadily increased (K, Oh et al., 2008), with about 15% of adolescents ages 13 to 19 in Korea overweight or obese in 2013 (*Statistics for 2013 Korea Youth Risk Behaviors Web-Based Survey*, 2013). Although about 40% of Korean adolescent still adhere to Korean traditional dietary patterns focused on rice, kimchi, fish and seaweed, their diets have become more Westernized, with increasing consumption of flour, bread, pizza, sugar, and sweets (Song, Park, Paik, & Joung, 2010). In addition, the rate of physical inactivity in Korea adolescence has been increasing (*Statistics for 2013 Korea Youth Risk Behaviors Web-Based Survey*, 2014). These behavioral changes could contribute to increasing adolescent obesity rates in Korea.

Because of this, the Korean government and educational system have made reducing and preventing adolescent obesity in Korea a priority (Noh, 2013). Studies have identified contributing factors to obesity among Korean adolescents, such as unhealthy diet and decreasing exercise (Heo, Nam, Lee, & Chung, 2012; H. M. Kim, Park, Kim, Kim, & Park, 2006; Song, Park, Paik, & Joung, 2010). However, the effect of peers on diet and exercise has not been studied in Korea, although peers can influence adolescents' diet and exercise, potentially contributing to adolescent obesity. Because the adolescent obesity rate is gradually increasing in Korea, it is essential to understand the associations between diet and exercise of Korean adolescents and their peers. Identification of these associations will provide targets for modification of diet and exercise in order to prevent or reduce adolescent obesity. In addition, due to cultural differences, results from studies conducted in Western countries cannot be directly applied in Korea. Studies examining associations between Korean adolescents' diet and behaviors and that of their peers could extend the evidence for what is known from studies in

Western countries, as well as optimize the development of different culturally-appropriate interventions for healthy diet and exercise in Korea.

The unique Korean classroom environment should be considered when assessing diet and exercise of adolescents and their peers. In Korea, approximately 30 adolescents are in each classroom, regardless of whether it is in a mixed-gender, a girls-only, or a boys-only school (*2014 Pocket book for key indicators of Korean Educational Statistics 2014*). Adolescents in the same classroom are stationary throughout the day, and have classes, breaks, and lunch together (H. M. Kim et al., 2006; T.-Y. Kim, 2010), while teachers move from classroom to classroom. Relationships with classmates could influence adolescents' diet and exercise and, ultimately, obesity. In addition, established classroom environments in Korea facilitate collection of complete social network data on diet and exercise of all adolescents in a classroom. Using a complete network approach, the diet and exercise of all adolescents within a particular boundary, a classroom in this study, can be obtained. This provides an accurate measure of the classroom social network structure (e.g. number of friends nominated) as well as the relationships (e.g., closeness) formed within the classroom-based peer network (Hanneman & Riddle, 2005).

In sum, peers could influence the diet and exercise of their adolescent classmates in Korea, potentially affecting adolescent obesity. Examining the diet and exercise of adolescents and their peers will provide data to support interventions designed to reduce or prevent adolescent obesity. Social network analysis provides information about the relationships between adolescents and their peers, which can be targeted in interventions designed to improve diet and exercise. Classroom environments in Korea are ideal for collecting these data, using the complete social network approach. The purpose of this study was to examine the diet and exercise behaviors of Korean female adolescents within classroom-based peer networks. Because some studies from

Western countries indicated gender differences in the associations of diet and exercise between adolescents and their peers, only same-sex friendships were considered in this study.

### Method

Complete social network analysis was used to examine the relationships of diet and exercise behaviors among Korean female adolescents in a classroom setting. Table 4.1 provides the definitions of network terms and characteristics used in this study. The definitions for this study are also summarized in Table 4.1.

### *Sample and Settings*

The population for this study was female adolescents in Korea. The convenience sample was female adolescents who attend a girls-only high school in Seoul, Korea. Seoul is the capital of Korea where about 16.6% of all Korean high school students attended schools in 2013 (*2013 Statistic of Education*, 2015). With the consultation from the vice principal, three classrooms at the 11<sup>th</sup>-grade-level were selected from a girls' high school, to minimize the possible variability between classrooms (e.g. participants' grade, classroom location). Adolescents 16 - 18 years of age were recruited. Additional inclusion criteria were adolescents:

- i) whose parents agreed to their participation in this study
- ii) who assented to participate in the study; and
- iii) who could read and write Korean

Social network nodes in this study were adolescents who met the above criteria; lines connecting these nodes were existing peer ties among adolescents and the network boundary was each classroom. Peers in this study were defined as classmates in the same classroom; and friends were classmates nominated by an adolescent.

A total of 110 questionnaires were distributed in the three classrooms. While 106 were returned, 2 were incomplete and were excluded from analysis, leaving 104 adolescents across 3 classrooms: 31 for classroom A, 34 for classroom B, and 39 for classroom C. Six of these adolescents were excluded for network data analysis because they did not respond to all network data, or they nominated friends who did not participate in this study. Thus, information from 104 adolescents was analyzed for the sample characteristics, while network data were obtained from 98 adolescents.

### *Procedures*

Approval from the University of Iowa Institutional Review Board (IRB) was obtained. Permission to conduct the study at the school identified for this study was obtained from the vice principal, who also helped select the three classrooms. After a presentation about the study, consent and assent documents were provided to adolescents and their parents.

After obtaining signed consent documents from parents and assent documents from adolescents, study packets were given to adolescents in their classrooms. Adolescents were informed that they could stop participating at any time. Study packets contained questionnaires for demographic data, dietary habits, exercise, and classroom-based social network data. Adolescents were asked to return the completed questionnaires in an enclosed envelope to the researcher when the researcher visited the classrooms later.

### *Instruments*

Demographic: Adolescents were asked their age and grade. They were also asked to fill out height and weight as measured at the annual health screening. Every academic year, a health



screening is performed for every elementary, middle and high school students in Korea, including standardized measurement of both weight and height.

Diet: Eating habits were measured using the Adolescent Food Habits Checklist (AFHC) (Johnson, Wardle, & Griffith, 2002). This self-report checklist contains 23 true/false questions. The possible range of scores is 0-23, with higher scores reflecting healthier eating habits. The AFHC was translated into Korea by a translator who speaks both Korean and English and then reverse translation was done by a different Korean-English translator. If students missed any of the 23 questions, a total score was calculated as per the following equation: number of healthy responses  $\times$  (23/number of items completed). Cronbach's  $\alpha$  was .83, and test-retest reliability was  $r = 0.90$  ( $p < .001$ ) for adolescents aged 13 to 16 years (Johnson et al., 2002). Cronbach's  $\alpha$  for this study was .80.

The food frequency questions from the 2013 Korean Youth Risk Behavior Web-based Survey were used to examine how frequently adolescents in this study consumed selected foods during a recent week. The Ministry of Education, Ministry of Health and Welfare, and Korean Centers for Disease Control and Prevention (KCDC) have administered this survey to students in middle and high schools in Korea annually since 2005 (KCDC, 2013). Adolescents were asked to report how frequently they had fast food, ramyun (Korean instant noodles), fruits and vegetables and how many times they drank milk during a recent week. Possible answers are less than once a week, 1-2 times, 3-4 times, 5-6 times, everyday, twice a day, and 3 or more times a day. More servings of fruits, vegetables, and milk indicate a healthier diet; while more servings of fast food or Korean instant noodles indicated an unhealthier one.

Exercise: The International Physical Activity Questionnaire (IPAQ) was used to measure physical activity. The IPAQ was developed by the World Health Organization (WHO) to

examine habitual physical activity of populations from different countries (The IPAQ group, 2015). Long and short versions of the IPAQ are available in various languages, including Korean. The self-administered short version in Korean was used in this study. The short version consists of seven questions that assess the frequency and duration of walking, moderate, and vigorous physical activity and sitting during a recent week. The reliability and validity of the short IPAQ form was tested in 12 countries, and reported test-retest reliability was .76 and criterion validity was .30 (Craig et al., 2003). The reliability and validity of the Korean version of the IPAQ short form was also conducted with adults ages 15 to 69, and reliability and validity were .54 and .27, respectively (J. Y. Oh, Yang, Kim, & Kang, 2007). The validity of the IPAQ in other languages is comparable to that of the original IPAQ (Deng et al., 2008; Hagströmer et al., 2008; Vandelanotte, De Bourdeaudhuij, Philippaerts, Sjöström, Sallis, 2005). Using an accelerometer as the criterion for validity could lead to the lower values, due to underestimation of certain activities such as carrying heavy loads, riding a bike, or swimming (Hagströmer et al., 2008). Despite low validity, the IPAQ was used in this study to facilitate comparison of physical activity of Korean female adolescents with those from other countries (The IPAQ group, 2015).

Peer network: Classroom-based peer-network data were collected using friendship nomination: adolescents were asked to list their close friends in the same classroom. The number of friends to nominate was not specified, but nominated friends needed to be students in the same classroom because the classroom is the boundary for the peer networks. They also responded to whether they engaged in physical activity with and had lunch or snack with each classroom-based friend during or after school within a recent week. Because nominated friends also participated, data on level of physical activity and eating habits could be compared between friend-pairs and reciprocity of the relationship(s) could be determined.

### *Data analysis*

Demographic and behavioral data were analyzed using SAS Enterprise Guide® version 5.1 (SAS institute, Inc. Cary, North Carolina, USA). Descriptive statistics of the adolescents' characteristics, eating habits and level of physical activity were generated.

UCINET 6 for Windows (Borgatti & Freeman, 2002) was used to analyze network data. Sociograms, which are graphic displays of nodes and the lines connecting them (Hanneman & Riddle, 2005), were created to represent peer networks in each of the three classrooms. Node colors, shapes, and sizes were altered to identify specific diet, exercise, and weight status characteristics (e.g. BMI). Lines represent shared experiences of diet and thicker lines indicate reciprocity. In this study, the network analysis was based on the nominated friends within three classrooms. Sociograms for exercise data were not generated due to a lack of lines between adolescents and their peers for exercise-related variables.

### Results

Demographic, diet and exercise characteristics are described in Table 4.2. Based on self-reported height and weight, the majority of the sample was normal-weight (77.3%), 18-year-old adolescents (81.6%). 9.7% of adolescents were classified as overweight or obese, using BMI-for-age percentiles and z-scores based on the KCDC growth charts (*2007 KCDC Growth charts for Korean children and adolescents*, 2007). More than half of participants were classified as moderately or highly physically active (68.4%). Despite this, adolescents were less likely to spend time on moderate activity, vigorous activity, or walking, compared to time sitting (all  $p$ -values  $<.001$ ). In this study, 67.3% and 55.9% of adolescents consumed fruits and vegetables five or more times a week, while most had fast food or ramyun (Korean instant noodles) less than twice a week (87.6%, and 86.4%, respectively).

Friendships characteristics of the three classrooms are summarized in Table 4.3. Across classes, an average of 4 to 5 friends was nominated. Female adolescents nominated fewer friends with whom they engaged in physical activity during or after school, compared to the number nominated for having lunch or snacks together. More than half of the friendship nominations for having lunch together were reciprocated (73% for class A; 70% for class B; and 50% for class C). About 40% of nominations for having a snack together during school days were reciprocated in classrooms A and C, while only 20% were reciprocated in classroom B. Reciprocity of nominations for having a snack together after school in classroom C was approximately twice that observed in classrooms A and B.

Figure 4.1 contains network data for shared dietary events, either having lunch or snacks together. The number of clustered networks differs across classrooms. Several adolescents, indicated by orange arrows in sociograms, functioned as bridges or connectors, between networks in each classroom. Classroom A had four cliques and several bridge adolescents, and one of the cliques was not connected with any other cliques in this classroom. However, everybody in classroom B was connected. More bridge adolescents could be observed in classroom B, in contrast to classroom A or C. Fewer cliques and bridge adolescents were found in classroom C. Across all three classrooms, each adolescent was connected to at least one peer. An obese girl in classroom C was connected to only one peer; while obese adolescents in classroom A were the most nominated students in their classroom. All 12 underweight female adolescents across the three classrooms were embedded in at least one classroom-based peer network.

## Discussion

This study examined diet and exercise of Korean female adolescents within classroom-based peer networks. Dietary behaviors of Korean female adolescents were connected with friends within these networks, but exercise behaviors were not. Across the three classrooms, higher rates of reciprocity were found for having lunch together, compared to having snack together during or after school. However, regarding exercise behaviors, participants in this study nominated fewer friends from their classroom-based peer networks.

In this study, 9.7% of female adolescents were either overweight or obese and 11.7% were underweight. According to Statistics for 2013 Korean Youth Risk Behaviors Web-Based survey (2013), about 12% of female adolescents in grades 10 through 12 were either overweight or obese in 2013. In this survey, approximately 7% of female adolescents were classified as underweight, using BMI-for-age percentiles and z-scores based on the KCDC growth charts (*2007 KCDC Growth charts for Korean children and adolescents, 2007*). Compared to the prevalence of overweight or obese female adolescents in the United States (33.4%) (Ogden, Carroll, Kit, & Flegal, 2014), adolescent obesity in Korea is less common. Because the sample size in this study was small, the distribution of female adolescents' weight status was not equivalent to the national data. Another possible reason for the different distribution is the participants' socio-economic status (SES). From the studies in the United States (Singh, Kogan, Van Dyck, & Siahpush, 2008; Skelton, Cook, Auinger, Klein, & Barlow, 2009), adolescents from the households with higher income were less likely to become obese. Because adolescents living in Seoul were more likely to be from higher SES household than those in other areas in Korea, the percentage of overweight or obese adolescents in this study could be different from the rates from national data.

In this study, participants' dietary behaviors were compared to others' at two levels: international and domestic. At international level, Korean female adolescents in this study had unhealthier food habits compared to adolescents from the studies using the AFHC in Australia, Italy, and the United Kingdom (Morton, Wilson, Perlmutter, & Beauchamp, 2012; Viggiano, et al., 2014; Williams & Mummery, 2012). However, using the food frequency questions and comparing to domestic data, food intake of participants in this study was similar to that of Korean female adolescents from the Korean Youth Risk Behavior Web-based Survey in 2013 (KCDC, 2013). This nationally representative survey shows that Korean female adolescents consumed more fruit and milk and less Korean instant noodles since 2011 (KCDC, 2013). These within-country changes suggest that their food intake has become healthier over time. Future work should identify what influenced their food choices to improve their diet and to evaluate possible interventions for improving diet.

Dietary behaviors were clustered within Korean female adolescents' classroom-based peer networks. Previous studies indicated that by sharing food with friends and discussing dietary behaviors (Waqa & Mavoia, 2006; Voorend et al., 2013), female adolescents influenced their friends' dietary behaviors. By including friends in intervention development, peer norms about food choice or eating habits could be changed, and potentially spread among peer networks. Because female adolescents in this study were clustered into cliques, interventions targeting the unhealthy dietary behaviors of particular cliques could be effective. In this study, some adolescents have the role of bridge, connecting one network to another network (Hanneman & Riddle, 2005), while others nominated frequently are popular in the classrooms. However, this study did not measure the effects of the structure of relationships within a classroom (e.g. cliques)

on dietary behaviors. More studies would be helpful to design interventions considering influential peer leaders or “bridge” peers to promote healthier diets.

Depending on the classroom, the reciprocity of dietary behaviors was different. In classroom C, 50% of the nominated friendships for having lunch together were reciprocated and this proportion was similar to those for having snacks during or after school. In contrast, the reciprocity for having lunch together was higher than having snacks together in classroom A and B. There could be specific behaviors spread among friendships within classroom C. In figure 4.1, an adolescent marked with blue arrow had a lower AFHC score, indicating that she had unhealthier food habits. She might be one of the popular girls in this classroom, and her unhealthier behaviors could influence the other friends’ dietary behaviors. Because the influences of network characteristics on adolescents’ diet were not examined in this study, the further studies are necessary for understanding Korean female adolescents’ dietary behaviors.

The participants in this study were less likely to engage in exercise, compared to the time they spent sitting. Adolescents from countries in Europe (Duncan, Duncan, Strycker, & Chaumeton, 2007; Hagströmer et al, 2008; Lopes, Gabbard, & Rodrigues, 2013) and Australia (Rachele, et al., 2014) all have higher levels of physical activity compared to the Korean female adolescents in this study. However, Chinese female adolescents spent less time on both sedentary behaviors and vigorous physical activity, compared to the adolescents in this study (Wang, Chen, & Zhuang, 2013). Shan et al. (2013) indicated that, because of the traditional Asian drive to achieve higher grades, Chinese adolescents spend less time on physical activity. Similar to China, Korean adolescents spend more time studying than teens in Western countries, and thus, there might be little time for exercise.

In the current study, Korean female adolescents did not engage in exercise within their classroom-based peer networks. Further studies are needed to examine the associations of exercise between adolescents and their peers. Korean female adolescents generally spend most of their school time with their friends in their classroom (H. M. Kim et al., 2006; T.-Y. Kim, 2010), but did not, in this study, exercise with those friends. Whether this is due to low rates of exercise, or to unmeasured peer network factors, is not known. Identifying why Korean female adolescents are not physically active is necessary, as there might be some attitudes or social norms among peer networks toward exercise behaviors. Investigations assessing the spread of attitudes among peer networks could identify associations to help improve their exercise behaviors. Because some researchers found particular influence from popular peers (De la Haye et al., 2010; Shoham et al., 2012; Simpkins et al., 2013), it is also important to examine relationship effects on exercise among adolescents and their peer network.

There are also several limitations. First, this is a cross-sectional study to describe the diet and exercise of adolescents within their classroom-based peer networks. That is, causality cannot be ascertained. More investigations are needed to examine cause-effect associations between adolescents' and friends' diet and exercise. Next, data were collected using self-report questionnaires. There could be a social desirability bias; adolescents in this study might over-report healthier behaviors, while under-reporting unhealthier behaviors. There could also be recall bias, as female adolescents self-reported their weight and height, based on their memory of the annual health assessment. Another limitation is low validity of the IPAQ. That is, this instrument might not accurately measure physical activity of adolescents. In addition, although the response rate is high, data of several adolescents in three classrooms were missing. Information from missing data might influence the results of this study. Last, the results from



this study may not be generalized to all female adolescents in Korea because the sample was recruited from a selected school in Seoul, Korea.

Based on the findings from this study, several directions for future studies were suggested. First, it will be necessary to examine peer relationships in other contexts. For example, interaction with friends can and does occur outside of school (e.g. online friends). These interactions could also influence the diet or exercise of adolescents. Next, more studies examining the effect of relational or network characteristics on Korean female adolescents' diet and exercise are needed. These studies could be used to design friendship-based interventions for promoting healthier diet and exercise of Korean female adolescents.

#### Conclusion

This is the first study to examine diet and exercise of Korean female adolescents within their classroom-based peer networks, using complete social network analysis. Korean female adolescents in this study were less likely to engage in exercise but had healthier diets, compared to adolescents in other countries. Dietary behaviors among female adolescents were clustered within classroom-based peer networks. Peer involvement in the interventions for healthier diet, especially considering particular cliques, could be effective to promote healthier diet. However, little is known about what impedes Korean female adolescents from engaging in exercise and how to motivate them effectively within their friendships. More studies examining factors influencing the exercise of Korean female adolescents are necessary.

Table 4.1. Definitions of network terms and network characteristics

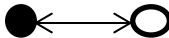
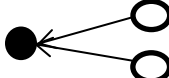
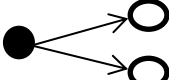
Configuration	Definition and examples	Definitions for this study	
Actors	“discrete individual, corporate, or collective social units” (Wasserman & Faust, 1994, p. 17); people in a group, departments within a corporation, public service agencies in a city, or nation-states in the world	Every classmate in the selected classrooms.	
Tie	“A linkage between a pair of actors” (Wasserman & Faust, 1994, p. 18); kinship, friendship, material transactions, behavioral interaction	Friendships; if two classmates were tied together, they had shared experience of diet or exercise.	
Reciprocity		Consisted of two actors and the possible set of relationships between them (Wasserman & Faust, 1994); Both actors named each other (Shoham et al., 2012)	The relationship of two classmates who nominated each other.
In-degree		A measure of popularity; the total number of connections from others to the actor ;  With a large in-degree: nominated by many people; with a small in-degree: nominated by few people (Wasserman & Faust, 1994)	How many classmates nominated an adolescent in the classroom
Out-degree		A measure of expansiveness; the total number of lines that connected from the actor to others (Hanneman & Riddle, 2005)	How many classmates <i>were</i> nominated <i>by</i> an adolescent in the classroom

Table 4.2. Demographic characteristics, and diet and exercise variables (N=104)

Variables		n (%) or M ± SD				
Age <sup>§</sup>	16	6 (5.8)				
	17	13 (12.6)				
	18	84 (81.6)				
Weight status <sup>§</sup>	Underweight	12 (11.7)				
	Normal	81 (78.6)				
	Overweight	6 (5.8)				
	Obesity	4 (3.9)				
Total minutes during a week						
	Vigorous activity	88.4 ± 205.5 (0.0-1350.0)				
	Moderate activity	87.4 ± 217.1 (0.0-1200.0)				
	Walking	272.4 ± 252.94 (0.0-1800.0)				
	Sitting	780.9 ± 137.9 (540.0-1140.0)				
Level of Physical Activity	Low	32 (30.8)				
	Moderate	50 (48.1)				
	High	22 (21.2)				
Food frequency <sup>⋆</sup>	Food item	Fast food	Ramyun	Milk	Fruit	Vegetable
	Never	35 (33.7)	38 (36.9)	6 (5.8)	2 (1.9)	6 (5.9)
	1-2 times/week	56 (53.9)	51 (49.5)	45 (43.3)	9 (8.7)	13 (12.8)
	3-4 times/ week	11 (10.6)	11 (10.7)	21 (20.2)	23 (22.1)	26 (25.5)
	5-6 times/ week	2 (1.9)	3 (2.9)	6 (5.8)	14 (13.5)	11 (10.8)
	Every day	0 (0.0)	0 (0.0)	17 (16.4)	21 (20.2)	20 (19.6)
	1-2 times/day	0 (0.0)	0 (0.0)	6 (5.8)	28 (26.9)	14 (13.7)
3-4 times/day	0 (0.0)	0 (0.0)	3 (2.9)	7 (6.7)	12 (11.8)	
Adolescent Food Habit Checklist (0-23)		10.6 ± 4.7 (1.0-20.8)				

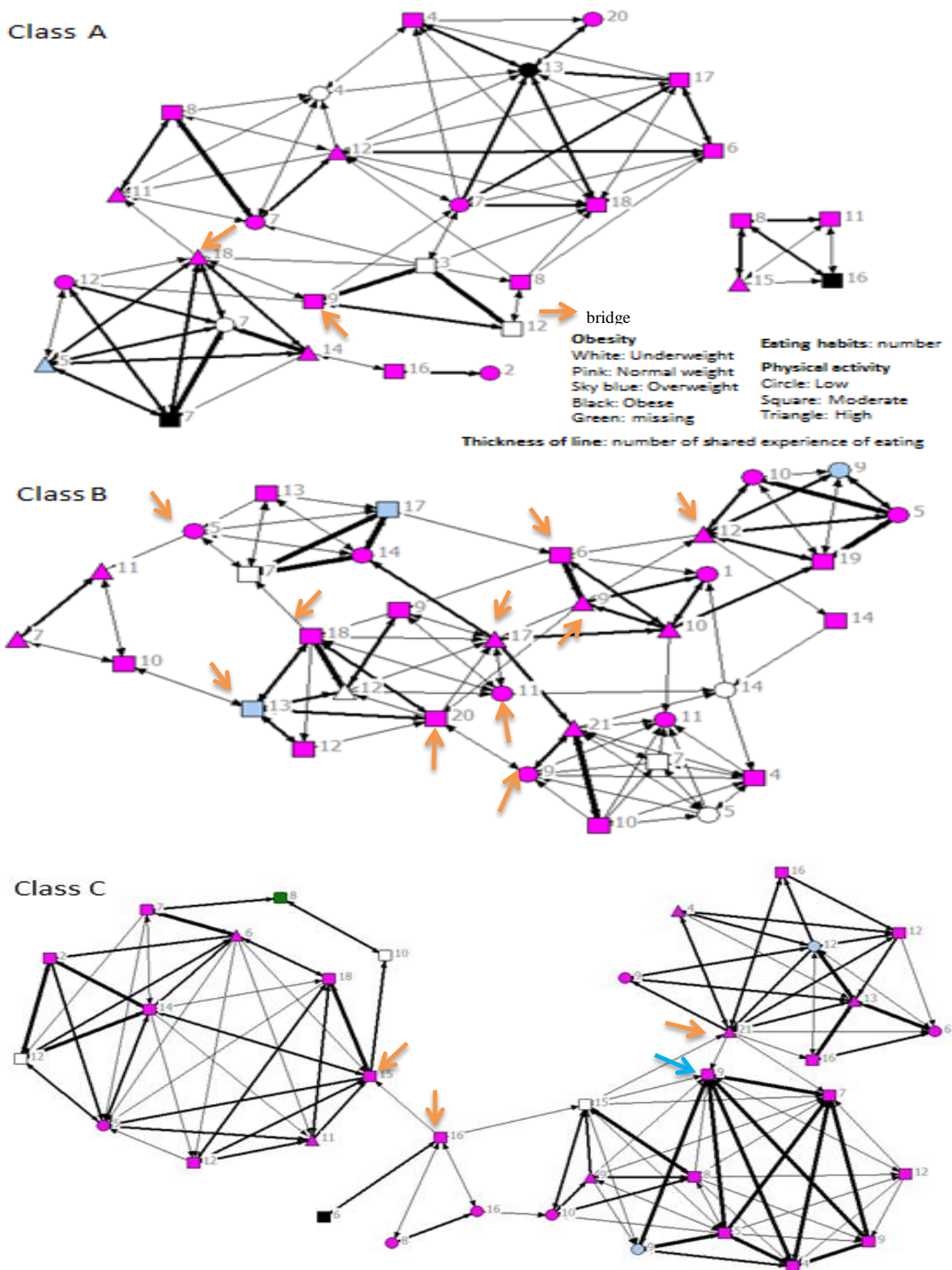
Note: <sup>§</sup> n=103, Weight status was categorized based on the BMI percentile: underweight (<5<sup>th</sup> percentile), normal weight (5<sup>th</sup> to <85<sup>th</sup> percentile), overweight (85<sup>th</sup> to <95<sup>th</sup> percentile), and obese (95<sup>th</sup> percentile ≤). <sup>⋆</sup> n=103 for food frequency of Korean instant noodles, and n=102 for vegetable.

Table 4.3. Friendship network descriptive statistics (N=99)

Characteristics	Class A n=29					Class B n=34					Class C n=36				
	PA school	PA after	lunch	Snack	Snack after	PA school	PA after	lunch	Snack	Snack after	PA school	PA after	lunch	Snack	Snack after
Friends nominated (M ± SD)	4.89 ± 1.91					4.26 ± 1.73					4.97 ± 2.59				
	.31 ± .47		4.45 ± 1.64			.83 ± .86		4.21 ± 1.55			.58 ± 1.57		4.56 ± 2.48		
Reciprocity index	1.00	0.67	0.73	0.43	0.25	0.17	0.29	0.70	0.20	0.27	0.11	.	0.50	0.40	0.50
Out-degree <sup>§</sup>	.	0.03	0.16	0.16	0.15	0.08	0.09	0.08	0.20	0.16	0.14	.	0.11	0.16	0.11
In-degree <sup>§</sup>	.	0.03	0.12	0.09	0.05	0.05	0.05	0.08	0.11	0.07	0.04	.	0.14	0.16	0.14

Note: <sup>§</sup> As proportion, not percentage.

Figure 4.1. Sociograms of peer networks within each classroom



## REFERENCES

- . 2007 *KCDC Growth charts for Korean children and adolescents*. (2007). Osong, Chungchungbooko.
- . 2014 *Pocket book for key indicators of Korean educational statistics* (2014). Seoul, Republic of Korea: Department of Education, Korean Educational Development Institute.
- .2013 *Statistic of Education: Number of students by city/province size*. (2015). Retrieved March 2015, from <http://kess.kedi.re.kr/eng/index>.
- Ali, M. M., Amialchuk, A., & Heiland, F. W. (2011). Weight-related behavior among adolescents: The role of peer effects. *PLoS ONE*, 6(6), e21179.
- Barlow, S. E., & Committee, T. E. (2007). Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: Summary Report. *Pediatrics*, 120, 164. doi: doi:10.1542/peds.2007-2329C
- Bauer, K. W., Neumark-Sztainer, D., Fulkerson, J. A., Hannan, P. J., & Story, M. (2011). Familial correlates of adolescent girls' physical activity, television use, dietary intake, weight, and body composition. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 25.
- Boone-Heinonen, J., Gordon-Larsen, P., & Adair, L. S. (2008). Obesogenic clusters: multidimensional adolescent obesity-related behaviors in the US. *Annals of Behavioral Medicine*, 36(3), 217-230.
- Borgatti, S. P., & Freeman, L. C. (2002). Ucinet for windows: Software for social network analysis. Harvard, MA: Analytic Technologies.
- Brown, B. B., & Larson, J. (2009). Adolescents' relationships with peers. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (3 ed., Vol. 2, pp. 74-103). Hoboken, NJ: John Wiley & Sons.
- Bruening, M., MacLehose, R., Eisenberg, M. E., Nannery, M. S., Story, M., & Neumark-Sztainer, D. (2014). Associations between sugar-sweetened beverage consumption and fast-food restaurant frequency among adolescents and their friends. *Journal of Nutrition Education and Behavior*, 46(4), 277-285.
- Collins, W. A., & Steinberg, L. (2006). Adolescent development in interpersonal context. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology* (6 ed., pp. 1003-1069). Hoboken, NJ: Wiley.
- Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F., & Oja, P. (2003). International Physical Activity Questionnaire: 12-Country reliability and validity. *Medicine & Science in Sports & Exercise*, 195(9131/03), 3508-1381.
- De la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2010). Obesity-related behaviors in adolescent friendship networks. *Social networks*, 32(3), 161-167.
- Deng, H., Macfarlane, D., Thomas, G., Lao, X., Jiang, C., Cheng, K., & Lam, T. (2008). Reliability and validity of the IPAQ-Chinese: the Guangzhou Biobank Cohort study. *Medicine & Science in Sports & Exercise*, 40(2), 303.
- Drake, K. M., Beach, M. L., Longacre, M. R., MacKenzie, T., Titus, L. J., Rundle, A. G., & Dalton, M. A. (2012). Influence of sports, physical education, and active commuting to school on adolescent weight status. *Pediatrics*, 130(2), e296-e304.
- 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(1), 80-89.
- Falkstedt, D., Hemmingsson, T., Rasmussen, F., & Lundberg, I. (2006). Body mass index in late adolescence and its association with coronary heart disease and stroke in middle age among Swedish men. *International Journal of Obesity*, 31(5), 777-783.

- Ford, C. A., Nonnemaker, J. M., & Wirth, K. E. (2008). The influence of adolescent body mass index, physical activity, and tobacco use on blood pressure and cholesterol in young adulthood. *Journal of Adolescent Health, 43*(6), 576-583.
- Graham, D. J., Wall, M. M., Larson, N., & Neumark-Sztainer, D. (2014). Multicontextual correlates of adolescent leisure-time physical activity. *American Journal of Preventive Medicine, 46*(6), 605-616.
- Haerens, L., Craeynest, M., Deforche, B., Maes, L., Cardon, G., & De Bourdeaudhuij, I. (2009). The contribution of home, neighbourhood and school environmental factors in explaining physical activity among adolescents. *Journal of Environmental and Public Health, 2009*.
- Hagströmer, M., Bergman, P., De Bourdeaudhuij, I., Ortega, F. B., Ruiz, J. R., Manios, Y., ... & Sjöström, M. (2008). Concurrent validity of a modified version of the International Physical Activity Questionnaire (IPAQ-A) in European adolescents: The HELENA Study. *International Journal of Obesity, 32*, S42-S48.
- Hanneman, R. A., & Riddle, M. (2005). Introduction to social network methods: University of California Riverside.
- Heo, G. J., Nam, S.-Y., Lee, S.-K., & Chung, S.-J. (2012). The relationship between high energy/low nutrient food consumption and obesity among Korean children and adolescents. *Korean Journal of Community Nutrition, 17*(2), 226-242.
- Janssen, I., Craig, W. M., Boyce, W. F., & Pickett, W. (2004). Associations between overweight and obesity with bullying behaviors in school-aged children. *Pediatrics, 113*(5), 1187-1194.
- Janssen, I., Katzmarzyk, P. T., Boyce, W. F., Vereecken, C., Mulvihill, C., Roberts, C., . . . Pickett, W. (2005). Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity Reviews, 6*(2), 123-132.
- Johnson, F., Wardle, J., & Griffith, I. (2002). The Adolescent Food Habits Checklist: Reliability and validity of a measure of healthy eating behaviour in adolescents. *European Journal of Clinical Nutrition, 56*(7), 644-649.
- KCDC. (2013). *The statistics for the 9th Korean Youth Risk Behavior Web-based Survey*. Chungchungbookdo, Korea: The Korean Centers for Disease Control and Prevention.
- Kim, H. M., Park, J., Kim, H.-S., Kim, D. H., & Park, S. H. (2006). Obesity and cardiovascular risk factors in Korean children and adolescents aged 10–18 years from the Korean National Health and Nutrition Examination Survey, 1998 and 2001. *American Journal of Epidemiology, 164*(8), 787-793.
- Kim, T.-Y. (2010). Socio-political influences on EFL motivation and attitudes: Comparative surveys of Korean high school students. *Asia Pacific Education Review, 11*(2), 211-222.
- Kirby, J., Levin, K. A., & Inchley, J. (2012). Associations between the school environment and adolescent girls' physical activity. *Health Education Research, 27*(1), 101-114.
- Koehly, L. M., & Loscalzo, A. (2009). Adolescent obesity and social networks. *Preventing Chronic Disease, 6*(3).
- Lopes, V. P., Gabbard, C., & Rodrigues, L. P. (2013). Physical activity in adolescents: examining Influence of the best friend dyad. *Journal of Adolescent Health, 52*(6), 752-756.
- Lumeng, J. C., Forrest, P., Appugliese, D. P., Kaciroti, N., Corwyn, R. F., & Bradley, R. H. (2010). Weight status as a predictor of being bullied in third through sixth grades. *Pediatrics, 125*(6), e1301-e1307.
- McNaughton, S. A., Ball, K., Mishra, G. D., & Crawford, D. A. (2008). Dietary patterns of adolescents and risk of obesity and hypertension. *The Journal of Nutrition, 138*(2), 364-370.
- Morton, K. L., Wilson, A. H., Perlmutter, L. S., & Beauchamp, M. R. (2012). Family leadership styles and adolescent dietary and physical activity behaviors: a cross-sectional study. *The International Journal of Behavioral Nutrition and Physical Activity, 9*, 48.

- Noh, E. E. (2013). The policy support plans of obesity prevention and management for childhood and adolescent. [아동·청소년 비만예방을 위한 정책적 지원방안]. *Policy Report*, 142, 1-24.
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *The Journal of American Medical Association*, 311(8), 806-814.
- Oh, J. Y., Yang, Y. J., Kim, B. S., & Kang, J. H. (2007). Validity and reliability of Korean version of International Physical Activity Questionnaire (IPAQ) short form. *Journal of the Korean Academy of Family Medicine*, 28(7), 532-541.
- Oh, K., Jang, M. J., Lee, N. Y., Moon, J. S., Lee, C. G., Yoo, M. H., & Kim, Y. T. (2008). Prevalence and trends in obesity among Korean children and adolescents in 1997 and 2005. *Korean Journal of Pediatrics*, 51(9), 950-955.
- Page, R., Ihasz, F., Simonek, J., Klarova, R., & Hantiu, I. (2006). Friendships and physical activity: Investigating the connection in Central-Eastern European adolescents. *International Journal of Adolescent Medicine and Health*, 19(2), 187-198.
- Puhl, R. M., Luedicke, J., & Heuer, C. (2011). Weight-based victimization toward overweight adolescents: Observations and reactions of peers. *Journal of School Health*, 81(11), 696-703.
- Rachele, J. N., Cuddihy, T. F., Washington, T. L., & McPhail, S.M. (2014). The Association Between Adolescent Self-Reported Physical Activity and Wellness: The Missing Piece for Youth Wellness Programs. *Journal of Adolescent Health*, 55(2), 281-286.
- Shan, Z., Deng, G., Li, J., Li, Y., Zhang, Y., & Zhao, Q. (2013). Correlational analysis of neck/shoulder pain and low back pain with the use of digital products, physical activity and psychological status among adolescents in Shanghai. *PLoS ONE*, 8(10), e78109.
- Shoham, D. A., Tong, L., Lamberson, P. J., Auchincloss, A. H., Zhang, J., Dugas, L., . . . Luke, A. (2012). An actor-based model of social network influence on adolescent body size, screen time, and playing sports. *PLoS ONE*, 7(6), e39795.
- Singh, G. K., Kogan, M. D., VanDyck, P. D., & Siahpush, M. (2008). Racial/ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: analyzing independent and joint associations. *Journal of Epidemiology*, 18(9), 682-695.
- Simpkins, S. D., Schaefer, D. R., Price, C. D., & Vest, A. E. (2013). Adolescent friendships, BMI, and physical activity: untangling selection and influence through longitudinal social network analysis. *Journal of Research on Adolescence*, 23(3), 537-549.
- Sirard, J. R., Bruening, M., Wall, M. M., Eisenberg, M. E., Kim, S. K., & Neumark-Sztainer, D. (2013). Physical activity and screen time in adolescents and their friends. *American Journal of Preventive Medicine*, 44(1), 48-55.
- 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(5), 322-329.
- Song, Y., Park, M. J., Paik, H.-Y., & Joung, H. (2010). Secular trends in dietary patterns and obesity-related risk factors in Korean adolescents aged 10–19 years. *International Journal of Obesity*, 34(1), 48-56.
- . *Statistics for 2013 Korea Youth Risk Behaviors Web-Based Survey*. (2014). Osong, Chungchungbookdo: Korea Center for Disease Control and Prevention Retrieved from <http://yhs.cdc.go.kr>.
- Suchindran, C., North, K. E., Popkin, B. M., & Gordon-Larsen, P. (2010). Association of adolescent obesity with risk of severe obesity in adulthood. *The Journal of American Medical Association*, 304(18), 2042-2047.
- The IPAQ Group. (2015). Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ): Short and long forms. Retrived May 2014, from <https://sites.google.com/site/theipaq/>



- Vandelanotte, C., De Bourdeaudhuij, I., Philippaerts, R., Sjöström, M., & Sallis, J. (2005). Reliability and validity of a computerized and Dutch version of the International Physical Activity Questionnaire (IPAQ). *Journal of Physical and Activity Health*, 2(1), 63.
- Viggiano, A., Viggiano, E., Di Costanzo, A., Viggiano, A., Andreozzi, E., Romano, V., ... & Amaro, S. (2014). Kaledo, a board game for nutrition education of children and adolescents at school: cluster randomized controlled trial of healthy lifestyle promotion. *European Journal of Pediatrics*, 174(2), 217-228.
- Voorend, C. G., Norris, S. A., Griffiths, P. L., Sedibe, M. H., Westerman, M. J., & Doak, C. M. (2013). 'We eat together; today she buys, tomorrow I will buy the food': Adolescent best friends' food choices and dietary practices in Soweto, South Africa. *Public Health Nutrition*, 16(03), 559-567.
- Voorhees, C. C., Murray, D., Welk, G., Birnbaum, A., Ribisl, K. M., Johnson, C. C., . . . Jobe, J. B. (2005). The role of peer social network factors and physical activity in adolescent girls. *American Journal of Health Behavior*, 29(2), 183.
- Wang, C., Chen, P., & Zhuang, J. (2013). Validity and Reliability of International Physical Activity Questionnaire-Short Form in Chinese Youth. *Research Quarterly for Exercise and Sport*, 84(sup2), S80-S86.
- Wang, Y., & Lim, H. (2012). The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *International Review of Psychiatry*, 24(3), 176-188.
- Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. New York, NY: Cambridge University Press.
- Waq, G., & Mavo, H. (2006). Sociocultural factors influencing the food choices of 16-18 year-old indigenous Fijian females at school. *Pacific Public Health*, 13(2), 57-64.
- Weiss, R., Dziura, J., Burgert, T. S., Tamborlane, W. V., Taksali, S. E., Yeckel, C. W., . . . Morrison, J. (2004). Obesity and the metabolic syndrome in children and adolescents. *New England Journal of Medicine*, 350(23), 2362-2374.
- Williams, S. L., & Mummery, W. K. (2012). Associations between adolescent nutrition behaviours and adolescent and parent characteristics. *Nutrition & Dietetics*, 69(2), 95-101.
- WorldHealthOrganization. Global Strategy on Diet, Physical Activity and Health. Retrieved January, 2015, from [http://www.who.int/dietphysicalactivity/childhood\\_what\\_can\\_be\\_done/en/](http://www.who.int/dietphysicalactivity/childhood_what_can_be_done/en/)
- Wouters, E. J., Larsen, J. K., Kremers, S. P., Dagnelie, P. C., & Geenen, R. (2010). Peer influence on snacking behavior in adolescence. *Appetite*, 55(1), 11-17.

## CHAPTER V.

### CONCLUSION

Adolescent obesity is a significant public health problem, with rapidly increasing rates affecting populations worldwide. Because adolescent obesity is critically important to the present and future physical and psychological health of individuals, many countries have developed and applied interventions to prevent and reduce rates of adolescent obesity. Adolescents' diet and exercise behaviors are primary targets of these interventions, because they are modifiable factors impacting obesity. Adolescents could model their diet and exercise on their parents' behaviors, or by receiving support for particular behaviors from their parents. Their behaviors could also be influenced by the availability of certain food items in schools, or access to school physical activity facilities. These contextual factors have been examined as potential intervention targets, to shift diet and exercise behaviors into healthier forms. Peer relationships should also be considered as a potential contributing factor to diet and exercise of adolescents; because adolescents become less dependent on their parents and spend more time with friends, they might be more susceptible to peers' influences than when they were younger children.

However, compared to multiple studies of parents and school factors, few studies have examined peer factors associated with adolescents' diet and exercise as a potential mechanism for reducing or preventing adolescent obesity. It is important to investigate the influence of peers on diet and exercise of adolescents, to extend future development of interventions designed to improve adolescents' diet and exercise behaviors. In addition, most current studies of peer factors influencing adolescent obesity have been conducted in Western countries, where levels of adolescent obesity are high. The influence of peer factors on adolescents' diet and exercise might be different in other countries with different cultures, where it might not be appropriate to apply

interventions developed in Western countries. Studies examining peer factors in countries with non-Western cultures will facilitate development of culturally-appropriate interventions to reverse or prevent increasing rates of adolescent obesity.

Thus, this set of three studies explored diet and exercise of adolescents in the context of peer factors. The first study is a systematic review of current studies on the influence of peers on adolescents' diet and exercise. The second study was a secondary data analysis designed to identify contextual factors, including peer factors, contributing to US adolescents' dietary and exercise behaviors. Finally, in the third study, social network analysis was used to examine the diet and exercise behaviors of Korean female adolescents and their classroom-based peers.

#### Summary of the findings

The first study was a systematic review of studies on the influence of peers on diet and exercise behaviors of adolescents. Searches of electronic databases, including PubMed, CINAHL, Web of Science, and SCOPUS, identified the studies that met inclusion and exclusion criteria. A total of 24 studies were included for analysis: seven studies were related to diet only, fourteen examined exercise only, and three focused on both diet and exercise. Two studies of diet only used qualitative methods; the remaining studies were quantitative, and included seven longitudinal studies. In most, friendship nomination was used to measure peer-related factors. Diet and exercise were assessed using self-administered questionnaires and activity monitors such as pedometers.

Findings from this review indicated that the diet and exercise behaviors of adolescents and their peers were significantly associated. Positive associations were found for food consumption: increasing consumption of certain food items was associated with increases in peers' intake of those foods. Adolescents were also more likely to engage in exercise if their friends spent more

time on exercise. However, some of these associations differed depending on gender. For example, no association was found between female adolescents' and their same-sex friends' participation in muscle-strengthening exercises, while a significant association was found for male adolescents and their same-sex friends' participation in this type of exercise. Some studies found that opposite-sex friends (e.g., male friends of female adolescents) influenced exercise behaviors, although other studies did not. The closeness of friends was identified as a potential moderator of these associations. Some dietary and exercise behaviors of adolescents were positively related to those of closer friends, but not to those of their more casual friends. From the findings in this review, peer factors could be important in promoting healthier diet and exercise among adolescents.

The second study used existing data to examine the influence of contextual factors on adolescents' diet and exercise. The aim of the second study was to examine associations of parent-, school-, and peer-related factors with diet and exercise of adolescents in the United States, using data from the World Health Organization's 2009/2010 Health Behaviours of School-aged Children study. After selection of potentially predictive variables, logistic regression analyses were used to create multiple regression models. Final models were selected based on the Akaike information criterion.

In this secondary analysis, parent and peer factors were associated with US adolescents' diet and exercise. Adolescents living with both their father and mother had healthier diet and exercise than those living with a single parent. If adolescents perceived higher parental control, they were also likely to have healthier diet and exercise behaviors. Adolescents' exercise behaviors were also associated with how frequently they spend time with their friends. Findings from this analysis indicated that adolescents who spent more time with their friends tended to

have breakfast daily and engage in more exercise. However, at the same time, they were more likely to consume soft drinks and watch television. Among school factors, the kind of lunch program provided was associated with diet, but no school factors were associated with exercise. This analysis of the diet and exercise of adolescents in the US, a Western country with a higher prevalence of adolescent obesity, identified contextual factors contributing to their diet and exercise. Based on the findings, effective methods incorporating peer factors to reduce the prevalence of adolescent obesity could be developed. In addition, these findings could be used to guide studies of adolescent obesity in other countries with different cultures.

Thus, the third study examined the diet and exercise of Korean female adolescents within classroom-based peer networks, using complete social network analysis. Korea is a country with a lower rate of adolescent obesity, compared to Western countries, but the prevalence is steadily increasing. Studies in Western countries determined that adolescents' diet and exercise behaviors contributed to obesity, and those behaviors were developed in the context of various factors, including peers. During adolescence, the importance of peers increases; thus, many studies have focused on the influence of peers on adolescents' diet and exercise in Western countries. However, few studies have been conducted in non-Western countries, including Korea. Due to cultural differences between Western and non-Western countries, there could be other considerations when examining Korean adolescents' and their peers' diet and exercise. Studies of relationships between Korean female adolescents' and their peers' diet and exercise could provide a better understanding of dietary and exercise behaviors during adolescence, and how they might contribute to adolescent obesity. In Korea, adolescents assigned to the same classroom spend almost all of the time they are in school together in the classroom, making these environments ideal for collecting data using a complete social network approach.

In this study, a total of 104 Korean female adolescents from three classrooms in a girls-only high school participated. Most of them were normal-weight, 18-year-old 11<sup>th</sup> graders. Female adolescents' dietary behaviors were connected with at least one person from their classroom-based peer networks. In two of three classrooms, about 70% of friendship nominations for having lunch together were reciprocated, and 50% were reciprocated in the other classroom. Reciprocal friendship nominations for having snacks together during or after school ranged from 20 to 50%, depending on the classroom. There were several bridging adolescents who connected two or more disconnected sub-peer networks. Nine out of 10 obese female adolescents' dietary behaviors were embedded in peer networks in classrooms. Findings for associations of exercise between adolescents and their peers, in comparison, were not as evident. Study participants nominated few friends from their classroom-based peer networks when asked about their exercise behaviors during or after school.

This set of studies supports current evidence of the influence of peer factors for diet and exercise behaviors in adolescents. From the review, adolescents' diet and exercise were likely to be similar to and influenced by their peers' diet and exercise. Studies using two different approaches in two different countries indicated that either diet or exercise of adolescents was related to the context of peers factors or relationships. Although the association might differ depending on the type of diet and exercise, considering peer factors or relationships will help extend interventions designed to modify adolescents' diet and exercise into healthier forms.

#### Clinical implications

This set of studies has implications for nursing clinical care and research. First, findings from the three studies provide evidence that peers are important to promoting healthy diet and exercise behaviors. Because diet and exercise are modifiable, contributing factors to obesity,

these behaviors should be examined when intervening to prevent or reduce adolescent obesity. Understanding peer factors may help nurses improve diet and exercise of all adolescents. For example, nurses could consider involving entire peer groups in interventions to modify unhealthier diet and exercise. One effective intervention could be a nurse providing education to adolescents and their friends together when discussing diet and exercise. To better target education content, the nurse could first assess the dietary and exercise behaviors of adolescents in a group setting, and where they usually perform those behaviors. Based on the assessments, a nurse could identify behaviors to be modified and provide appropriate interventions to adolescents and their peers. For example, adolescents and their peers might spend more time on exercise, but consume lots of soft drinks and fast food. Then, a nurse could emphasize the importance of diet to prevent adolescents from being obese. Because school is where adolescents and their peers spend the most time together, school nurses might play an important role in providing peer-based interventions in these settings.

In this set of studies, characteristics of friendships, such as gender and closeness, were associated with adolescents' diet and exercise. For example, associations of adolescents' and their peers' diets could differ depending on the gender composition of their friendship. While positive associations of vigorous exercise were found among male adolescents and their same-sex friends, no associations were found among female adolescents and their same-sex friends. However, vigorous activities of female adolescents were positively associated with those of their male friends. To improve female adolescents' exercise, a nurse could consider involvement of opposite-sex friends, if they have mixed-sex friendships. Relational characteristics among friends such as reciprocity and popularity should also be considered. Adolescents and their reciprocal friends might form cliques, within which certain dietary and exercise behaviors might be more

common. Unhealthy behaviors spreading within cliques could be targets for nursing interventions. For Korean female adolescents, it could be especially effective to design interventions for classroom-based cliques, given the classroom structure in Korea.

#### Directions for future research

Findings from this set of studies also suggest future research directions. First, more studies are needed regarding peer-related variables potentially contributing to adolescents' diet and exercise. Gender or closeness of friends appears to influence the associations of adolescents' diet and exercise and that of their peers. Although the effects of gender or closeness on those associations were not considered in the second study, the systematic review identified some evidence for the importance of gender. Few studies examined the specific influence of close friends on diet and exercise of adolescents, however, all indicated greater impact of closer friends compared to more casual friends. Only classroom-based peers were considered in the third study; however, there could be important interactions with friends outside of the school environment (e.g. online friends, friends in neighborhood) that should be included in future studies.

Next, studies examining diet and exercise of adolescents and their peers should be conducted in other non-Western countries, to identify other factors, unique to those cultures, that should be considered for prevention of adolescent obesity. For example, Korean female adolescents and their peers' dietary behaviors were associated in this study, like findings from other Western countries, although only peers in classrooms were considered due to the different classroom environments. However, Korean adolescents might interact with peers not assigned to the same classrooms, whose influence might be greater than peers in the same classroom. Depending on culture, there could be unique factors or specific conditions that contribute to diet



and exercise of adolescents. Identification of these factors could provide evidence to develop more culturally-sensitive interventions for prevention of adolescent obesity.

In addition, more information about the relationships between adolescents and their peers is needed. Because adolescents and their peers were clustered, interventions for particular cliques could be helpful to promote healthier diet and exercise. More information on how dietary and exercise behaviors spread through friendships would improve understanding of the mechanisms leading to similar behaviors among adolescents and their peers. With this information, what should be emphasized to promote adolescents' diet and exercise can be decided. Using social network analysis, adolescents who bridge different groups and those who are popular could be identified. Designing interventions that involve influential peers could be effective to spread healthier diet and exercise among the networks. Thus, it is necessary to examine adolescents' diet and exercise within their peer networks.

### Conclusion

This set of studies found peer factors could contribute to adolescents' diet and exercise. Positive associations between adolescents' and their peers' diet and exercise behaviors suggest the potential value of peer-based interventions to promote healthier diet and exercise. To improve diet and exercise behaviors of adolescents, nurses need to understand their diet and exercise in the context of peer factors. This set of studies adds to evidence supporting the importance of peers on diet and exercise of adolescents.

Appendix. PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	23
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	23
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	24-26
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	26
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	29-30
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	27
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	27
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	27
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	27-28
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	27-28
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	26-27

Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	NA
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	NA
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	NA
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	29-30
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	41-47 (tables)
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	NA
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	31-36
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	36

Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	40
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	40
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	NA

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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