ABSTRACT


Sibling relationships have been overshadowed in family leisure research by other close family relationships. Yet, most people in the United States have at least one sibling and sibling relationships are likely to be the longest-lasting and most stable across the lifespan. Previous research has shown family leisure to be positively related to family outcomes such as family functioning and satisfaction with family life. These conclusions, however, are based almost exclusively on examinations of parent-child relationships. Likewise, much of family leisure research has been limited to cross-sectional and individual level analyses. Scholars have called for longitudinal study designs and models accounting for family grouping effects.

Family members, including siblings, can affect individual family members’ obesity and physical activity through social modeling and providing support. Siblings’ effects on individual physical activity and obesity may be contingent upon relationship quality, with higher quality relationships having a greater effect on behaviors. Therefore, the purpose of this dissertation is to examine the longitudinal association between recreation behaviors, sibling relationship quality, and physical activity and obesity.

To provide context, an integrative review of family leisure research is conducted. Of the more than 2,000 published articles in four selected journals, 183 (approximately 6%) relate to family leisure. Quantitative and qualitative methods are used almost equally, while individual-level analyses are used more frequently than dyadic or system-level analyses. Examination of sample characteristics reveals White, married, middle class, families with a
child or adolescent samples are most common. Three major thematic trends emerge: Theme one (promoting family well-being through leisure) encompasses the positive outcomes individuals, dyads, and groups perceived related to family leisure. Theme two (the costs and constraints to family leisure) examines family or family roles as constraints to leisure as well as constraints to family leisure. Finally, theme three (family leisure in the margins) includes research identifying and examining diverse family structures and characteristics.

Additionally, the relationship between adolescent recreation and adult sibling relationship quality is assessed using multilevel models and sibling pairs data from Waves 1 and 3 of The National Longitudinal Study of Adolescent Health (Add Health). Playing an active sport and rollerblading or cycling in adolescence are positively related to adult perceptions of sibling relationship quality. Exercising is negatively related to adult perceptions of sibling relationship quality. Hours spent watching videos in adolescence are positively related to adult perceptions of sibling relationship quality while hours spent watching TV approach significance and are negatively related to adult perceptions of sibling relationship quality.

Finally, the relationships between adolescent recreation and adult physical activity and BMI are examined, and birth order and sibling relationship quality interaction effects are assessed. Using Add Health sibling pairs data and multilevel models, frequency of watching television and videos in adolescence is negatively related to adult physical activity, and playing an active sport in adolescence is positively related to adult physical activity. Frequency of watching television and frequency of rollerblading or bicycling in adolescence are negatively related to adult obesity. Hours watching TV in adolescence is positively related to adult obesity. Adult physical activity is lower for firstborn siblings than for later-
born siblings when hours of video or computer game playing are constant. Playing sports in adolescence is a predictor of higher adult BMI for firstborns. Firstborns are likely to have lower adult BMIs than later-born siblings when exercising is held constant. Perceptions of sibling relationship quality appear to moderate the relationship between adult physical activity and hours watching TV, hours watching, videos, and hours playing video or computer games. These findings partially support tenets of the social learning theory.
“Oh Brother Where Art Thou?” An Examination of Family Leisure, Sibling Relationships, and Physical Health

by
Camilla Jennifer Hodge

A dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Parks, Recreation and Tourism Management

Raleigh, North Carolina

2014

APPROVED BY:

__________________________________________
Michael Kanters
Committee Chair

__________________________________________
Jason Bocarro

__________________________________________
Karla A. Henderson

__________________________________________
Toby L. Parcel
DEDICATION

To my dear family: Mom and Dad; Ben, Angie, Abby, Katelyn, and Hailey; Chris and Matt.

“Other things may change us, but we start and end with family.”
BIOGRAPHY

Camilla J. Hodge is an assistant professor in the Department of Recreation, Park, and Tourism Management at The Pennsylvania State University. Camilla earned a bachelor’s degree in communications with an emphasis in print journalism and a master’s degree in youth and family recreation from Brigham Young University. She earned her Ph.D. in the Department of Parks, Recreation and Tourism Management, College of Natural Resources at North Carolina State University.
ACKNOWLEDGMENTS

I would like to firstly acknowledge the incredible faculty members who have served on my dissertation committee. To my chair, Dr. Michael Kanters, I am exceedingly grateful for the research and teaching opportunities that shaped me professionally, and his investment of time and resources into my progression. His ability to engage in and successfully manage large, impactful translational research is a skill I admire and hope to develop. I am equally indebted to Dr. Jason Bocarro for his invaluable professional advice and guidance, teaching mentorship, and support. I have greatly appreciated his genuine interest in and enthusiasm for my research topic and progress as a professional. To Dr. Karla Henderson, I owe a great deal. It was conversations with her that brought me to NCSU, and her continued mentoring that helped me finish. Dr. Henderson’s concise writing style and ability to ask and answer evocative research questions are two qualities I aspire to as a developing scholar. And to Dr. Toby Parcel, I owe a great deal of my interest in and knowledge of family structures, processes, and the research addressing both. I hope to achieve the articulate verbal and written expression of research questions, methods, analyses, and implications Dr. Parcel has achieved. I would also like to acknowledge Dr. Joshua Hendrix for his statistical consultation, and Dr. Michael Edwards and Dr. Jordan Smith for their informal consultations. Finally, I would like to thank Dr. Dorothy Anderson for the research support and funds to invest in Add Health Data without which this study would not have been possible.

According to distance runner Dean Karnazes, “pain and suffering are often the catalysts for life’s most profound lessons.” Though writing a dissertation and completing a Ph.D. is relatively low on the universal pain and suffering scale, I have been profoundly
touched by the following individuals who have supported and uplifted me through this process. My dear parents, brothers, sister-in-law, and nieces who let me cry and made me laugh over a distance of several thousand miles. Megan, who reminded me I was braver than I believed and stronger than I seemed. Jennica who cheered me on in every way. To my roommates Kristi and Jenny: I am more grateful than I can say to you both for making the last two years livable. You talked (or yelled) me out of the vortex more than once and never hesitated to give midnight statistical consults following a froyo run. Karen who watched me struggle through a master’s degree and who could empathize completely with the Ph.D. experience. My fellow PRTM Ph.D./M.S. friends and officemates: Candice, Chantell, Rob, Gareth, and Tian. It’s been a pleasure and an honor sharing part of my Ph.D. experience with you all. Finally, I would like to acknowledge Dr. Ken Rogerson, Jesse and Elaine Wood, and Dr. Ramon Zabriskie. Dr. Rogerson, thank you for your faith in me, your friendship, and your endless encouragement. I hope to be as excellent an educator and person as you. Jesse and Elaine, thank you for making me feel at home and for your faith and support. My Monday nights won’t be the same without you, the Palmers, and the puzzles! Ramon, I don’t know how to wrap up five years into a few sentences, but thank you for being my advisor, my colleague, and my friend. God bless you all.
TABLE OF CONTENTS

LIST OF TABLES .................................................................................................................. viii
LIST OF FIGURES ................................................................................................................ ix
CHAPTER 1: INTRODUCTION ............................................................................................... 1
  Background ......................................................................................................................... 4
  Summary, Research Questions, and Hypotheses ............................................................... 22
  Methods ............................................................................................................................... 25
  Data Collection Procedures ............................................................................................... 25
  Sample ................................................................................................................................. 27
  Measures ............................................................................................................................. 29
  Analyses ............................................................................................................................. 32
  References .......................................................................................................................... 35

CHAPTER 2: FAMILY LEISURE: AN INTEGRATIVE REVIEW OF RESEARCH FROM SELECT JOURNALS .................................................................................................................. 44
  Abstract ............................................................................................................................. 44
  Background ......................................................................................................................... 46
  Methods ............................................................................................................................... 49
  Findings ............................................................................................................................... 52
  Discussion ........................................................................................................................... 65
  References .......................................................................................................................... 72
  Table 1.1. Comparison of the Number of Family Leisure Articles as a Percentage of the Total Number of Articles Published Listed by Journal in Systematic Increments (1990-2012) ............................................................... 87
  Table 1.2. Methods Used in Family Leisure Research from Four Selected Journals from 1990 to 2012 .................................................................................................................. 88
  Table 1.3. Levels of Analyses Included in Family Research from Four Selected Journals from 1990 to 2012 .................................................................................................................. 89

CHAPTER 3: THE EFFECT OF ADOLESCENT RECREATION ON ADULT PERCEPTIONS OF SIBLING RELATIONSHIP QUALITY .......................................................................................... 90
  Abstract ............................................................................................................................. 90
  Literature Review ............................................................................................................ 92
  Data and Methods ........................................................................................................... 100
   Sample ............................................................................................................................. 101
   Instrumentation ............................................................................................................... 101
   Missing Data .................................................................................................................. 103
   Analyses .......................................................................................................................... 103
  Results ............................................................................................................................... 105
   Gender Interactions ........................................................................................................ 108
  Discussion .......................................................................................................................... 109
  References .......................................................................................................................... 117
  Table 2.1 Descriptive Statistics of Sample Characteristics ............................................... 125
  Table 2.2 Individual and Family Variables Predicting Sibling Relationship Quality ... 126
Figure 2.1 Mean Technology-based Recreation ................................................... 127
Table 2.3 Recreation Variables Predicting Sibling Relationship Quality ............... 128
CHAPTER 4: SIBLING RELATIONSHIPS AS A MODERATOR OF THE
RELATIONSHIP BETWEEN ADOLESCENT RECREATION AND ADULT HEALTH
OUTCOMES ............................................................................................................ 129
Abstract ............................................................................................................. 129
Review of Literature .......................................................................................... 131
Methods .............................................................................................................. 138
Data and Sample ............................................................................................... 138
Instrumentation ................................................................................................. 140
Missing Data ...................................................................................................... 143
Analyses .............................................................................................................. 143
Results .................................................................................................................. 145
Discussion .......................................................................................................... 150
References .......................................................................................................... 160
Table 3.1 Descriptive Statistics of Sample Characteristics ...................................... 168
Figure 3.1 Percentage BMI-Weight Categories .................................................... 168
Table 3.2 Summary of Parameter Estimates, Standard Errors, and Significance of
Individual- and Family-Level Effects by Physical Activity and Obesity .............. 169
Table 3.3 Summary of Parameter Estimates, Standard Errors, and Significance of
Individual- and Family-Level Effects with Recreation by Physical Activity and Obesity
................................................................................................................................. 170
Table 3.4 Summary of Parameter Estimates, Standard Errors, and Significance of
Individual- and Family-Level Effects and Birth Order Interactions .................... 171
Table 3.5 Summary of Parameter Estimates, Standard Errors, and Significance of
Individual- and Family-Level Effects and Sibling Relationship Quality Interactions .. 173
CHAPTER 5: CONCLUSION .................................................................................. 175
Brief Summary of Findings and Contributions .................................................... 175
Research Implications ........................................................................................ 179
Theoretical Implications ..................................................................................... 185
Benefits and Limitations of Secondary Data: An Assessment of Add Health Data ...... 189
Conclusions ........................................................................................................ 195
References .......................................................................................................... 198
APPENDICES ....................................................................................................... 204
Appendix A: IRB Approval .................................................................................. 205
Appendix B: Add Health Use Agreement ............................................................. 207
LIST OF TABLES

Table 1.1 Comparison of the number of family leisure articles as a percentage of the total number articles published by journal in systematic increments .......................... 87

Table 1.2 Methods used in family leisure research from four selected journals from 1990 to 2012.................................................................................................................................................. 88

Table 1.3 Levels of Analyses included in family research from four selected journals from 1990 to 2012.................................................................................................................................................. 89

Table 2.1 Descriptive Statistics of Sample Characteristics .................................................. 125

Table 2.2 Individual and Family Variables Predicting Sibling Relationship Quality........................................................................................................................................................................ 126

Table 2.3 Recreation Variables Predicting Sibling Relationship Quality........................................ 127

Table 3.1 Descriptive Statistics of Sample Characteristics .................................................. 168

Table 3.2 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects by Physical Activity and Obesity ................................................................. 169

Table 3.3 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects with Recreation by Physical Activity and Obesity ....................... 170

Table 3.4 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects and Birth Order Interactions ................................................................. 171

Table 3.5 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects and Sibling Relationship Quality Interactions ......................................... 173
LIST OF FIGURES

Figure 2.1 Mean Technology-based Recreation ............................................................. 127

Figure 3.1 Percentage BMI Weight Categories ................................................................... 168
CHAPTER 1: INTRODUCTION

Most people in the United States have at least one sibling and sibling relationships have the potential to be the longest-lasting across the lifespan (Cicirelli, 1994; Whiteman, McHale, & Soli, 2011). Even as birthrates and overall family size in the U. S. decline, children are “more likely to live in a household with a sibling than with a father” (Feinberg, Sakuma, Hostetler, & McHale, 2013, p. 97). Still, sibling relationships have not received the same level of research attention as other close family relationships such as parent-child and committed couple relationships (McHale, Updegraff, & Whiteman, 2012).

Family leisure research has also largely overlooked sibling relationships. While researchers have demonstrated a positive relationship between family leisure and family functioning, satisfaction with family life, family cohesion, family adaptability, and overall quality of family life (e.g., Holman & Epperson, 1984; Mactavish & Schleien, 2004; Orthner & Mancini, 1990; Poff, Zabriskie, & Townsend, 2010; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003), these conclusions are largely based on individual-level analyses of cross-sectional parent-child data in which the child is an adolescent. While there is some indication that “family’s shared leisure events—the extent that siblings and parents engage in activities together—are linked to positive sibling relationship qualities” (Updegraff, Thayer, Whiteman, Denning, & McHale, 2005, p. 383), whether recreation enhances sibling relationship quality is largely unknown. Therefore, sibling perspectives in family leisure research are greatly needed as are longitudinal examinations that address life stages other than adolescence. Similarly, family leisure scholars have noted the need to
expand research beyond cross-sectional data and individual level analyses and have called for models that account for family-level variance and grouping effects (Poff et al., 2010).

In addition to expanding analytical methods, there is a need to expand research to include sibling perspectives in family leisure scholarship. Siblings can support recreation behaviors that promote positive health behaviors like physical activity (Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2007). Sibling support can even deter risk taking behaviors such as substance use (Samek & Rueter, 2011a). These effects may be contingent upon relationship quality, with higher quality sibling relationships having a greater influence and effect on health behaviors and subsequent outcomes. Accounting for grouping effects is especially important when examining the effect of recreation on physical health behaviors and outcomes in families since shared genetics, environments, and even family relationships, can affect individual family members’ physical activity and obesity (Sørensen, Price, Stunkard, & Schulsinger, 1989; Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001).

Several scholars have called for increased research examining sibling relationship dynamics as fundamental parts of family processes and family socializing systems that can be used to inform policy and practitioner interventions (R. Edwards, Hadfield, Lucey, & Mauthner, 2006; McHale et al., 2012). More specifically, “practitioners often operate with underexplored assumptions about ‘normal’ sibling relationships and their implications” (R. Edwards et al., 2006, p. 4). Such unexplored assumptions may especially affect family leisure research, theory, and programming. Similarly, scholars have recommended the use of longitudinal study designs to better examine the multidimensionality of sibling relationships.
across the lifespan (Whiteman et al., 2011), and longitudinal research will also contribute to better understanding of the effects of recreation on families over time.

Overall, examining recreation in siblings is needed because recreation is considered a means for relationship development and maintenance in families (Orthner, Barnett-Morris, & Mancini, 1994) and sibling relationships may be the longest-lasting and most stable of family relationships (Cicirelli, 1994; Whiteman et al., 2011). Therefore, the purpose of this dissertation was to examine the longitudinal association between recreation behavior, sibling relationship quality, and health outcomes. Specifically, the effect of adolescent recreation on adult sibling relationship quality was examined. The effect of adolescent recreation on adult health behaviors and outcomes, and the moderating effect of sibling relationship quality on those relationships were also assessed. This dissertation addressed gaps in family leisure and recreation research by examining recreation from a sibling perspective and by using a longitudinal study design and conducting multilevel analyses. The specific aims of this dissertation were:

**Specific aim 1.** To systematically review and describe existing family leisure research and examine the methods and analyses used by family leisure scholars, the demographic characteristics of families included in family leisure research, and major thematic trends in the literature.

**1.1.** To review existing family leisure research for the presence of siblings and recommend future research directions.
Specific aim 2. To examine the relationship between adolescent recreation behaviors (technology-based recreation and active recreation) and adult perceptions of sibling relationship quality.

Specific aim 3. To examine the relationship between adolescent recreation patterns (technology-based vs. active recreation) and adult physical activity and obesity.

3.1. To determine whether sibling relationship quality and birth order moderate the relationships between adolescent recreation activities (technology-based vs. active recreation) and adult physical activity and obesity.

Background

To frame this dissertation, the following section will synthesize previous research related to (a) family systems theory and sibling research, (b) sibling relationships, (c) siblings in family leisure literature, (d) sibling health behaviors and outcomes, and (e) factors affecting sibling relationships. This section will conclude with a summary including specific research questions and hypotheses.

Family Systems Theory and Siblings

The family systems theory was used to frame this dissertation. Family leisure and recreation research has used family systems theory to understand family interactions and outcomes, and evidence of family systems theory at work in family recreation has been demonstrated. For example, leisure researchers have noted that verbal and non-verbal interaction between individual family members influences other family members’ leisure choices and preferences (Siegenthaler & O’Dell, 2000).
Broadly, family systems theory suggests all parts of a family system are interconnected, and therefore understanding any individual member or relationship within the family is contingent upon “viewing the whole” (White & Klein, 2008, p. 156). The critical components of systems framework include: (a) the system that is distinguishable from and simultaneously affects its environment; (b) boundaries, or borders that affect the flow of information and energy between the system and its environment; (c) rules of transformation, which represent relationships between elements of a system; (d) feedback, or circular loop that makes some system output a source of system input; (e) variety, or the ability of a system to adapt to a changing environment; (f) equilibrium, or how a system achieves balance between input and output; (g) system levels, the varying degrees of prioritized goals; and (h) subsystems which in family systems theory would include marital subsystems and sibling subsystems (White & Klein, 2008). Overall the components of the family systems perspective suggest “families are best understood when studied holistically,” (Whiteman et al., 2011, p. 133).

Potential applications of family systems theory include studying individuals, dyads (such as siblings), and triads (parent-siblings) research (Whiteman et al., 2011). Similarly, scholars have suggested family dynamics can be understood in terms of interactions between various subsystems (Cicirelli, 1980). These subsystems include parent-parent, parent-child, and sibling-sibling interactions that operate as “semi-independent” units that influence and are influenced by the other subsystems (Cicirelli, 1980, p. 111). Therefore, family systems theory suggests sibling relationships reciprocally influence and are influenced by the larger family system because “sibling experiences are intricately linked with family context”
(McGuire & Shanahan, 2010, p. 72). In essence, then, sibling relationships should also be considered as an important factor in shaping the entire family system (Cox, 2010; McGuire & Shanahan, 2010).

Cox (2010) applied family systems theory to sibling relationships, suggesting “individual family members are necessarily interdependent, exerting a continuous and reciprocal influence on one another” (p. 95). Thus, when applied to this study, family systems theory suggests one sibling’s recreation participation may influence another sibling’s recreation participation and health behaviors and outcomes. Furthermore, the reciprocal nature of sibling relationships suggests sibling relationship quality and health behaviors and outcomes may vary systemically across families. Therefore, family systems theory was used to frame the specific aims and research questions of this dissertation.

**Sibling Relationships**

As alluded to in the previous section, sibling relationships are increasingly recognized as a predominant part of individual and family life across the life span (Whiteman et al., 2011). Longevity makes sibling relationships unique when compared to all other close relationships (Whiteman et al., 2011). The predominance and importance of sibling relationships appears to be consistent for individuals and families in several countries, though more cross-cultural sibling research and comparisons are needed (McHale et al., 2012). In addition to the long-lasting nature of sibling relationships, these relationships are also “characterized by both hierarchical and reciprocal elements, which change across place and time” (Whiteman et al., 2011, p. 126). For example, during early and middle childhood, siblings are viewed as playmates, but as siblings enter adolescence, their relationships take...
on functions such as providing support during ongoing “socioemotional and cognitive change” (Yenes, Olabarrieta, Arranz, & Artamendi, 2000 as cited in Oliva & Arranz, 2005, p. 254). Thus, as children age, sibling relationships become increasingly mutually beneficial, or in other words, sibling relationships shift from hierarchical to reciprocal structures (Whiteman et al., 2011). Therefore, siblings fill a variety of roles and functions during childhood and adolescence such as “companions, confidants, and role models” (Whiteman et al., 2011, p. 124). Similarly, positive sibling relationships have been shown to be an important source of support during stressful life events in adolescence and childhood (Gass, Jenkins, & Dunn, 2007).

As siblings transition to adulthood, their relationships continue to exist as “sources of support” (Whiteman et al., 2011, p. 124). The largest gap in sibling relationship research, however, spans the transition from adolescence to adulthood (Conger & Little, 2010). Further research examining this gap is critical because the tasks associated with the transition to adulthood (i.e., establishing independence through decision-making, taking on responsibilities, and meeting financial obligations) are associated with significant life events like pursuing higher education, leaving the home, marriage (or long-term romantic relationship formation), and childbearing (Conger & Little, 2010). Such life events often create, and even necessitate, changes in sibling relationships. These changes have implications for sibling interactions and influences over time. Thus, research that opens the “window into how family relationships develop and change, as well as the…multiple processes and contexts that influence these lifelong bonds” (Whiteman et al., 2011, p. 135) is needed. Longitudinal research would provide this perspective. Furthermore, scholars have
called for research to examine sibling relationships over time using multiple levels of measurement (Cox, 2010). Longitudinal data with multiple levels of measurement would facilitate greater understanding of what “ingredients” are essential to creating strong and successful sibling relationships (Kramer, 2010, p. 80). In existing sibling relationship research, sibling conflict, sibling closeness and contact, sibling connection, sharing life goals, and seeking help from or caregiving among siblings have been among the most predominant variables of interest.

**Sibling conflict.** Sibling relationships create more opportunities for conflict than perhaps any other family relationship (Eriksen & Jensen, 2006; Kettrey & Emery, 2006). In general, the term *sibling conflict* has been applied to sibling violence, antagonism, competition, and rivalry (Kramer, 2010), though some scholars argue for the separate examination of each of these phenomena (Whiteman et al., 2011). Rivalry as a form of conflict has traditionally been associated with sibling relationships (Krienert & Walsh, 2011), and sibling conflict has been shown to change at certain stages of development (J. Kim, McHale, Osgood, & Crouter, 2006). For example, in one longitudinal study, sibling conflict levels remained stable through childhood, but began to decrease after early adolescence (J. Kim et al., 2006). Additionally, consistent with family systems theory that posits individuals and relationships in families influence other individuals and relationships, sibling conflict has been shown to be related to parenting style and marital conflict (McHale, Updegraff, Tucker, & Crouter, 2000; Stocker & Youngblade, 1999). In families where parents use more authoritarian approaches, siblings are more likely to have higher levels of conflict in their relationships (McHale et al., 2000). Egalitarian parenting may serve to reduce competition or
rivalry among siblings. Similarly, parents’ intervention in childhood sibling conflict and modeling of appropriate conflict resolution skills has been shown to positively affect sibling relationships (Whiteman et al., 2011).

To some extent, a level of conflict may be beneficial to siblings. Some research suggests conflict-free sibling relationships may deprive children of important developmental opportunities (Kramer, 2010). For example, Raffaelli (1992) noted that sibling conflict in early adolescence may serve to reinforce certain relationship and interpersonal boundaries within families. Among these siblings, conflict can facilitate individuation and differentiation as part of larger cognitive and social development (Raffaelli, 1992). Adler’s theory of individual psychology similarly suggests that family power dynamics (e.g., sibling rivalry) are central to a sense of self (Whiteman et al., 2011). Therefore, sibling differentiation (i.e., pursuing individual roles and developing different characteristics) may “support the development of more harmonious and less conflictual sibling relationships” (Whiteman et al., 2011, p. 128).

Conflict alone may not accurately represent sibling relationship quality. Specifically, focusing on conflict as a measure of sibling relationship quality and reducing conflict between siblings as the primary way to improve sibling relationships may “overshadow” additional insights and perspectives on sibling relationships (Kramer, 2010, p. 80). In fact, when examining individual adjustment in early and middle childhood, positive characteristics present in sibling relationships were more strongly related to child adjustment than sibling conflict (Pike, Coldwell, & Dunn, 2005). Therefore, examining processes and behaviors that create positive interactions between siblings is equally important.
**Sibling closeness and contact.** Sibling contact may be one process that facilitates positive interactions between siblings and increases perceived closeness. Sibling closeness is created by “participating in family functions, enduring family hardships, having common interests, and experiencing age-related issues” (Folwell, Chung, Nussbaum, Sparks-Bethea, & Grant, 1997 as cited in Rittenour, Myers, & Brann, 2007, p. 172). Emotional closeness among siblings is associated with outcomes such as increased help given between siblings, increased visits, increased communication as well as a perception of greater cohesion and less loneliness (Connidis & Campbell, 1995; K. Floyd, 1995; Rittenour et al., 2007).

Research has shown that elements of sibling relationships such as conflict, contact, and closeness are directly related to various individual developmental phases and changes (Oliva & Arranz, 2005). For example, as noted above, not only does conflict appear to decrease as siblings progress through adolescence but also closeness or intimacy appears to increase slightly or stabilize later in adolescence (Oliva & Arranz, 2005; Updegraff, McHale, & Crouter, 2002). When examining emotional closeness and commitment in siblings between the ages of 18–92 years, researchers demonstrated that sibling commitment remained stable across the emerging adult, adult, and older adult stages of the lifespan (Rittenour et al., 2007). This relationship depended on the level of affectionate communication and expression of emotional support in which siblings engaged. When observing conversations between young adult siblings, closeness was shown to be related to the levels of emotional empathy, expression of positive affect, and lower levels of power struggles (Shortt & Gottman, 1997).

Sibling closeness may act as a protective influence against negative psychosocial outcomes. Similarly, sibling closeness may also enhance individual well-being and
adjustment (Samek & Rueter, 2011b). For example, one study found that higher levels of perceived sibling closeness were associated with greater levels of psychological well-being among older adult widowed women (Cicirelli, 2008). This finding is consistent with Goetting's (1986) third stage of sibling relationship development and progress which is characterized by resolution of rivalry or conflict and intensification of emotional bonds. In earlier life stages, sibling closeness also provides a type of protective or positive influence. For example, among adolescent siblings, closeness may act as a deterrent against health risk behaviors (Samek & Rueter, 2011a). Therefore, sibling closeness and contact may have important implications for both sibling relationships quality and health behaviors and outcomes.

Sibling communication. Sibling communication promotes and facilitates contact as well as reciprocal influence (Cicirelli, 1994). In-person communication has also been shown to be related to sibling relationship quality. For example, firstborns—who were more likely to have frequent face-to-face contact with siblings—were more likely to report higher quality of sibling relationships (Pollet & Nettle, 2009). The content or message being communicated was also particularly salient to sibling relationship quality. Affectionate communication was related to higher levels of commitment and perceived emotional closeness between siblings (Rittenour et al., 2007). In adulthood, communication becomes a way for adult siblings to express their mutual support of each other as adults (Myers, 2011). Positive and enjoyable communication between adult siblings then facilitated greater levels of closeness in their relationships at a stage when relationship maintenance could be considered optional (Myers, 2011). Various mobile and Internet-based technologies, including text messages, e-mails, and
Internet instant messaging are quickly becoming an important facilitator of family communication (Pettigrew, 2009). Communication is a key factor in family functioning (Miller, Ryan, Keitner, Bishop, & Epstein, 2000), and texting in particular has been shown to be an effective communication method that increases family members’ sense of connectedness (Pettigrew, 2009). Some researchers have determined the Internet provides increased opportunities for family interaction, communication, and collaboration, thereby strengthening the family (Mesch, 2006). Thus, e-mail and instant messages are also considered as technologies that increase communication and connectedness (Pettigrew, 2009). E-mail communication however, usually entails a longer, more detailed exchange of information that does not need an immediate response, and has been characterized for less close relationships (H. Kim, Kim, Park, & Rice, 2007). For the purposes of my study, sibling communication comprises the level of contact and communication siblings engage in when physically separated and include technology facilitated communication methods.

**Sharing goals and interests.** Similar to reasons for communicating, when examining why adult siblings choose to maintain their relationships, Myers (2011) found that one of the most cited reasons was that siblings shared common interests and experiences. Having “been through everything together” or having “the same hobbies so we always have a lot to talk about” created greater opportunities and motivation for maintaining adult sibling relationships (Myers, 2011, p. 56). Moreover, sharing “interests, beliefs, and values” also served to create greater sibling relationship maintenance (Meyers, 2011, p. 56).

**Seeking help from or caregiving among siblings.** An additional element to the sibling relationship development and maintenance is that of caregiving and seeking or
providing help. Congruent with family systems theory, caretaking and help-giving are reciprocal and shared processes within families. Therefore, siblings can participate in caretaking and help-giving in the same way as other family members (Bryant, 1992). Caretaking and caregiving motivated adult siblings to maintain their relationships (Myers, 2011). When siblings had “always looked out for each other” or when one sibling had stepped in to act as a parental figure (e.g., “like a father to me”), they were more motivated to maintain their adult relationships (Myers, 2011, p. 56). Even in late adolescence, research has demonstrated that in some cases, siblings rely on each other for advice about life plans (Tucker, Barber, & Eccles, 1997). Late adolescent siblings also turn to each other for advice or help with personal problems (Tucker et al., 1997). Overall, the quality of sibling relationships is determined by several factors. Understanding sibling relationships and the factors that facilitate high quality sibling relationships may have implications for larger family systems as well as individual outcomes.

**Family Leisure Research: The Missing Sibling Perspective**

Recreation may create opportunities for siblings to develop and maintain their relationships. In general, research has demonstrated that recreation in families helps facilitate family bonding and other positive relationship outcomes (Orthner & Mancini, 1990). Family recreation and leisure research has consistently demonstrated a positive relationship between family recreation, family cohesion, family health and well-being, and family life satisfaction—all of which contribute to higher levels of family functioning (Agate, Zabriskie, Agate, & Poff, 2009; Holman & Epperson, 1984; Mactavish & Schleien, 2004; Orthner & Mancini, 1990; Poff et al., 2010; Zabriskie & McCormick, 2001; Zabriskie & McCormick,
From these studies, family recreation appears to play a key role in the quality of and satisfaction with family life. These conclusions, however, have historically been based on studies of leisure outcomes among committed couples or from the perspective of mothers and fathers. Freysinger (1997) noted the glaring absence of children’s perspectives in family leisure research, and scholars responded by examining parent-child relationships relative to leisure and recreation. The majority of these responding studies, however, continued to overlook sibling relationships in favor of focusing on or parent-child relationships. This oversight is significant since “lifelong bonds between siblings develop because of the time siblings spend together, the support and guidance they provide, and the family identity and experiences they share” (Feinberg et al., 2013, p. 98). Therefore, more research attention needs to be given to sibling-specific recreation.

The limited sibling recreation research that does exist is largely descriptive and originates from fields other than leisure studies. For example, scholars found Dutch youth between the ages of 10 and 12 years from higher social classes spent a substantial part of their leisure time with parents and siblings (Zeijl, Te Poel, Du Bois-Reymond, Ravesloot, & Meulman, 2000). Zeijl and colleagues did not, however, analyze any specific outcomes associated with sibling leisure time, even though siblings appeared in the article. Here again, the researchers focused on the influence of parents on adolescent free time activities. Two similar studies examined the role of daily activities (e.g., eating a meal, doing chores, caregiving, playing, going somewhere, and watching TV) in sibling and family experiences (McHale & Crouter, 1996). Both studies focused on children with younger siblings in middle childhood. One specifically focused on sibling pairs in which one child had a disability.
Mactavish and Schleien (2004) also examined family recreation perspectives in families that included children with developmental disabilities, but little focus was dedicated to siblings. While these authors reported some findings on sibling recreation patterns, the conclusions were largely descriptive and grounded in parents’ perspectives, not siblings’.

Another study described and analyzed the everyday talk, activity, and care between siblings to better understand how siblings built and ascribed meaning to their relationships (R. Edwards et al., 2006). Scholars observed that siblings created meaning through repetitive and mundane activities. They also observed power dynamics being played out as siblings undertook activities together. In terms of building relationships, girls (sisters) considered talking together to be an important aspect of their relationships while boys (brothers) emphasized shared activities. Across mixed gender sibships, activities were the preferred method of creating closeness, which suggested a gender-specific imbalance of power. The authors noted that in general it was through general everyday practices that “sisters and brothers experience[d] material and embodied aspects of their identity and their relationships” (R. Edwards et al., 2006). In other words, everyday activities and conversations were the fundamental building blocks for successful sibling relationships. This finding was consistent with the perspective that shared family recreation facilitates important aspects of family functioning such as “communication, interaction, and problem solving” (Wells, Widmer, & McCoy, 2004, p. 328). Therefore, consistent with the family systems framework, sibling recreation may create opportunities for communication, interaction, and problem solving—all of which are relevant to overall sibling relationship quality.
Recreation, Sibling Relationships, and Health Behaviors and Outcomes

Recreation may also create opportunities for siblings to engage in behaviors that enhance their physical health and well-being. Moreover, sibling relationship quality may also affect individual health behaviors and outcomes. The social learning theory suggests individuals are more likely to model a family member’s behavior if they perceive their relationship quality to be positive (Whiteman et al., 2011). Therefore, the quality of sibling relationships may facilitate socialization to specific recreation behaviors such as participation in sports and physical activity. While parents are predominantly influential in teaching children social behaviors, siblings also act as mechanisms of social learning through their social exchanges “by reciprocally reinforcing positive or negative behaviors and by observing and imitating one another” (Whiteman et al., 2011, p. 131). The saliency of a specific family member model (i.e., a sibling) depends on the quality of the relationship between family members; siblings who are perceived as competent, powerful, and loving are more likely to be models for behavior (Whiteman et al., 2011). Siblings who perceive their relationships to be positive may be more likely to model each other’s’ behaviors.

Research has demonstrated some general support for the assumption that positive family relationships and family support encourage adolescents to be physically active. For example, in a cross-sectional examination of family support for adolescent physical activity, parental support was a significant predictor of increased physical activity after school and at lunchtime during the school year (Hohepa et al., 2007). Sibling support was also influential in determining after school physical activity among students in years 9–11 of high school, with higher levels of sibling support predicting higher levels of physical activity (Hohepa et
This type of social support may become more important as siblings age. For example, among older adults, the existence of siblings contributes positively to health and wellbeing (Campbell, Connidis, & Davies, 1999). The importance of sibling relationships and their effect on individual health behaviors and outcomes during early adulthood, however, have not been examined. Similarly, the effects of sibling relationship quality on physical activity and health outcomes have not been examined from a longitudinal perspective.

**Individual and Family Factors Influencing Sibling Relationships**

To provide a clear understanding of the relationships between recreation behaviors, sibling relationship quality, and physical health behaviors and outcomes, several individual and family variables that affect these variables must also be examined. These variables include birth order, other family relationships, social class, ethnicity, gender, and age, and will be reviewed in the following sections.

**Birth order.** General differences in perceived closeness to parents and other siblings are explained in part by birth order. As noted earlier, firstborns tend to report higher quality relationships with their siblings and greater levels of contact than do laterborns (Pollet & Nettle, 2009). Therefore, birth order apparently has at least some impact on sibling relationship quality and contact. Pollet and Nettle (2009) also found that middleborns reported lower quality relationships with parents and lower levels of overall family contact. Thus, birth order appears to also account for some variance in parental relationships across siblings. Research has also demonstrated parenting styles, parents’ expectations of children, and developmental and adult outcomes are in some instances and situations associated with
birth order. For example, firstborn children generally adhered to established rules set by parents whereas later born children tended to rebel against established behavioral expectations (Sulloway, 1996).

Relationships between siblings also depend somewhat on birth order. For example, the presence of an older sibling was found to have effects on the level of locomotor exploration children 23 months old; children explored more, displayed greater independence, ventured further from the immediate proximity of their mothers, and engaged in greater inspection and manipulation of objects when their older sibling was present (Samuels, 1980). This type of attachment between siblings is specific in this case to birth order. Additionally, birth order affects the types of roles siblings play in each other’s lives. For example, older siblings often act as a companion or source of comfort in distressing situations when a parent or other caregiver is unavailable (McHale et al., 2000; Whiteman et al., 2011). Overall, caretaking responsibilities appear to follow a fairly strict age hierarchy with older siblings taking on a greater level of caretaking than younger siblings (R. Edwards et al., 2006). Interestingly, middle siblings see themselves both as care receivers and care providers (Edwards et al., 2006).

Other family relationships. As indicated by family systems theory, sibling relationships do not form and function in isolation; they influence and are influenced by other family relationships. Overall, other family relationships such as relationships between parents, and relationships between parents and their children, affect the ways siblings interact and can be important in understanding differences between siblings as they age (R. Edwards et al., 2006). Direct parent-child relationships have been examined to understand the impact
they have on sibling relationships. For example, sibling relationship quality was more likely to be lower among children and adolescents who perceived their parents were engaging in unequal treatment or differential treatment relative to their siblings (Shanahan & McHale, 2008). Decreased relationship quality was also evident among adult siblings who perceived parent differential treatment of children (Boll, Ferring, & Filipp, 2003). Scholars have also examined the impact of marital conflict and parental hostility on sibling relationships using observations and self-report. According to one study, children between 7 and 10 years who experienced marital conflict were more likely to exhibit problematic tendencies in sibling relationships like increased levels of sibling rivalry (Stocker & Youngblade, 1999). In this case, authors found maternal and paternal hostility and children’s self-blame for parental conflict mediated the negative relationship between marital conflict and sibling relationship quality. Conversely, some research has demonstrated that when marital conflict is intense, some siblings will turn to each other for emotional support and thereby develop closer relationships (Jenkins, 1992).

Attachment theory has been used to understand the effect of parent-child relationships on sibling relationships. For example, research has demonstrated that insecure-resistant attachment between an infant (one year old) and its mother is associated with higher rates of hostility and sibling conflict among four-year-olds (Volling, 2001). This increased rate of hostility and sibling conflict was present even though these same children with insecure maternal attachment were also more likely to seek comfort from their younger siblings. Likewise, another study found that two siblings who were securely attached to their mother
were more likely to form positive relationships with each other than siblings with insecure maternal attachment (Teti & Ablard, 1989).

**Family size.** Because parental resources (e.g., time, finances, and energy) are limited or finite, there emerges an element of competition for resources among family members (such as siblings) as family size increases (Downey, 2001). According to this model, even one sibling threatens the access another child will have to his or her parents’ resources. Researchers have linked this model to lower levels of intellectual development, academic achievement, and cognitive skills among children from large families (Downey, 2001). At its most fundamental level, the resource dilution model posits that if parents save $100 every month for one child’s education, that sum would be reduced on a per-child basis as more children enter the family. Subsequently, the educational and other opportunities available to each child may be increasingly constrained as family size increases. By extension, perhaps as family size increases, resource dilution also impacts sibling recreation opportunities and behaviors.

While the resource dilution perspective primarily views multiple children as a drain on parental resources, some researchers believe siblings can become a resource in some contexts (Downey & Condron, 2004). Indeed, in terms of adjustment and wellbeing, siblings may create more resources than they deplete (Downey & Condron, 2004). Still, family size and any subsequent resource dilution may be an important consideration in understanding the relationship between sibling recreation activities, relationship quality, and health outcomes.

**Social class.** Lareau’s (2011) study of social class and family life revealed interesting differences in sibling relationships across social classes. Among the working and poor
classes, siblings expressed annoyance with each other, but displays of open hostility, conflict, or competition were not evident. Hostility and competition were common occurrences, however, among siblings in middle class households (Lareau, 2011). Siblings in working and poor class households also tended to resolve their conflicts independent of adult intervention while sibling conflict in middle class households was commonly moderated by adults. Therefore, social class may affect overall quality of sibling relationships.

Social class may also influence the types of recreation activities in which youth participate. As Lareau (2011) observed, middle class children were involved in a high volume of planned or structured activities. This concerted cultivation approach to childrearing common in the middle class dictated the types of recreation activities in which youth participated. Middle class children were commonly enrolled in organized sports, choirs, and participated in formal play dates. Conversely, youth in working or poor class families were in charge of their own recreation and free time activities. They participated less frequently in organized sports and spent more time with siblings or other family members, more time watching television, and more time engaged in unstructured or creative play.

**Gender.** As noted earlier, gender plays a role in the everyday relationship building activities that siblings engage in (R. Edwards et al., 2006) with sisters valuing conversation and brother valuing activities. Some evidence suggested that “siblings in same gender dyads may be more sensitive to issues of rivalry and competition” (Whiteman et al., 2011, p. 126). Among adult siblings, however, issues of conflict and rivalry appear to have dissipated, and most adults report engaging in high levels of contact with their siblings and feelings of closeness (Spitze & Trent, 2006). This finding seems to depend on gender to some degree as
sisters tend to engage in the highest levels of contact (e.g., exchanging phone calls and sharing advice). Positive perspectives on sibling relationships were also more common among women than men. Gender differences in relationship quality were also present among adolescents. For girls between the ages of 13 and 19 years, good sibling relationships were associated with higher quality peer and parental relationships as well as greater psychological wellbeing and life satisfaction (Oliva & Arranz, 2005). This same relationship was not present for boys.

Age. As noted in other sections of this paper, age can impact sibling relationships in several ways. In general, sibling relationships evolve across the lifespan (Whiteman et al., 2011). Overall, several individual and family variables may affect sibling relationship quality and physical health behaviors and outcomes. Therefore, these were accounted for in this dissertation.

Summary, Research Questions, and Hypotheses

In summary, families use leisure and recreation to develop and maintain their relationships (Orthner et al., 1994). Continued family leisure research has helped grow a body of literature that examines recreation in various populations, using a variety of methodologies and analyses. In the body of family leisure research, family systems theory has been commonly used; however, family leisure research has largely ignored the sibling subsystem. This is a significant oversight since sibling relationships are potentially the longest-lasting family relationships across the lifespan (Whiteman et al., 2011) and one of the most stable (Feinberg et al., 2013). Family leisure research has demonstrated a positive relationship between family leisure and recreation, and family outcomes (see Agate et al.,
However, these conclusions have been based almost exclusively on parent-child relationships. Therefore, more research is needed to understand the effect of recreation on sibling relationship quality.

Likewise, much of family leisure research has been limited to cross-sectional and individual level analyses. Scholars have called for models that account for family-level variance and grouping effects (Poff et al., 2010). Similarly, longitudinal study designs are extremely limited in family leisure research, and scholars have noted the need to expand understanding of the directionality of relationships between family leisure and family outcomes by using data collected over time (Poff et al., 2010).

Therefore, the purpose of this dissertation was to examine the longitudinal association between recreation behavior, sibling relationship quality, and physical activity and obesity. To provide context for the examination of sibling relationships in family leisure, an integrative review was conducted. Integrative reviews are an essential part of research activity because they frame ongoing and future research (Jackson, 1980). They can be used to provide an objective account and description of the state of a particular body of literature by assessing the quantity of articles published, and identifying predominant themes or gaps in existing research and methodologies used to examine specific phenomenon (Floyd, Bocarro, & Thompson, 2008). Two research questions addressed the first specific aim and drove the integrative review:

**Research question 1.** What is the status of family leisure research in terms of topics being addressed, populations being studied, and types of methodologies and analyses being used?
**Research question 2.** To what extent are siblings an active focus of family leisure research?

The literature and theory reviewed in this section suggested different types of adolescent recreation may have varied effects on adolescent and adult sibling relationship quality. Specifically, extant research suggested that perceptions of sibling relationship quality from an individual perspective would be significantly related to different types of recreation:

**Hypothesis 1.** Technology-based recreation in adolescence will be negatively related to sibling relationship quality in adulthood.

**Hypothesis 2.** Active recreation in adolescence will be positively related to sibling relationship quality in adulthood.

Physical health behaviors and outcomes literature also suggested different types of adolescent recreation have different effects on adult physical activity and obesity. Additionally, the literature reviewed in this section suggested sibling behaviors and outcomes may be interdependent. Therefore:

**Hypothesis 3.** Technology-based recreation in adolescence will be negatively related to adult physical activity and be positively related to adult obesity.

**Hypothesis 4.** Active recreation in adolescence will be positively related to adult physical activity and negatively related to adult obesity.

**Hypothesis 5.** Sibling relationship quality and birth order will moderate the relationship between adolescent recreation and adult health outcomes.
Methods

The purpose of this dissertation was to systematically review extant family leisure research and to examine the longitudinal association between recreation, sibling relationship quality, and physical activity and obesity. Specifically, the effects of adolescent recreation on adult sibling relationship quality were assessed and the moderating effect of birth order and sibling relationship quality was also tested. This research addressed gaps in family leisure literature by examining recreation from a sibling perspective, and by using a longitudinal study design and multilevel analyses. This section will outline (a) data collection procedures and sample, (b) instrumentation, (c) data collection procedures, and (d) analyses.

Data Collection Procedures

My dissertation used two types of data: family leisure publications and data from the National Longitudinal Study of Adolescent Health (Add Health).

Family leisure publications. To address my first specific aim with its two related research questions, data collection consisted of gathering published family leisure literature. This literature was collected systematically following established procedures for integrative literature reviews (see Bocarro, Greenwood, & Henderson, 2008; M. Edwards & Matarrita-Cascante, 2011; Floyd et al., 2008). We first identified specific journals within a designated time period and provided rationale for the journal selection and time frame. Articles were selected from these journals using systematic search protocol and procedures including keyword searches of selected words and phrases in article titles, abstracts, and keywords.

Add Health data. To address my second and third specific aims and test their related hypotheses, data from the Add Health study were used. Add Health is a nationally
representative longitudinal study of adolescents in the United States (Harris et al., 2009). The primary sampling frame for the Add Health study was a database collected by Quality Education Data, Inc. (Harris et al., 2009). A stratified random sample of 80 nationally representative high schools in the United States was selected. High schools with at least 30 enrolled students and an 11th grade were eligible for participation. More than 70% of the originally sample high schools participated, and each school that did not participate was replaced by a similar school from the same strata. Thus, Wave 1 In-School Questionnaires rendered a sample of 90,118 responses. In stage two of Wave 1, an in-home sample of 20,745 adolescents was drawn consisting of a core sample from each community plus selected oversamples. Adolescents could qualify for more than one sample. In addition to adolescent responses, parents were asked to complete a questionnaire about family context and relationships. Written consent was obtained from the adolescent participants and their parents or legal guardians. A Computer-Assisted Personal Interview (CAPI)/Audio Computer-Assisted Self Interview (ACASI) was administered in which the more sensitive questions on the questionnaire were self-administered.

Follow-up waves of data collection consisted of samples drawn from Wave 1 in-school respondents, including the in-home samples and sibling samples. Wave 2 data were collected in 1996—one year after baseline; Wave 3 data were collected in 2002—seven years after baseline; and Wave 4 data were collected in 2007-2009—12 to 14 years after baseline. Interviewers administered the In-Home Interviews (CAPI).
Sample

This dissertation included three samples: family leisure publications, sibling pairs data from in-home interviews in Waves 1 and 3, and sibling pairs from in-home interviews in Waves 1 and 3 in which one sibling was a firstborn child.

Family leisure publications. Four journals were selected for this review: *Journal of Leisure Research (JLR)*, *Leisure Sciences (LS)*, *Leisure Studies (LStd)*, and *Family Relations (FR)*. While other journals could have been included, these four represented the principal publication outlets for family leisure research. Three of the four journals (*JLR, LS, and LStd*) were also primary publications for leisure and recreation scholars, and therefore provided the widest lens for assessing research across the field. Journals focused on therapeutic recreation such as *Therapeutic Recreation Journal (TRJ)* were excluded to maintain a focus on family and sibling leisure from a general perspective rather than an intervention or treatment perspective.

Articles were also limited to a 23-year span (1990 – 2012). This time span was selected for two reasons. First, in 1991, a review of nearly a century of family leisure research was included as a chapter in *Family Research: A Sixty Year Review*. In this review, Hawks (1991) collected examples of family leisure research published from the early 1900s to 1990 and systematically analyzed the trends and findings in the literature. Therefore, this integrative review would essentially continue that work. Second, families exist in continuing social and cultural revolutions that affect family life processes, including family leisure. Therefore, evaluation of methods, analyses, sample characteristics, and themes in family
leisure research are necessary to ensure accurate representation of recreation in families as their contexts, functions, and structures change.

Articles included for review were identified using two methods: key word searches and manual review. Ultimately, article inclusion was contingent upon examination of title, key words, abstract, and content review. Articles were delimited to those with content focusing on family leisure as a process, family as a context for leisure, and family leisure outcomes.

**Sibling pairs in-home interviews.** I used the sibling pairs subsample Add Health data which are considered restricted access, and therefore required an application and approval before use. The sibling pairs subsample included twins, full siblings, half-siblings, and non-related siblings. The sample was delimited to full siblings only (n = 2,502). Sibling pairs were matched by a unique pair identifier and by a family identifier. These identifiers plus the unique respondent identifiers enabled extraction of the Wave 1 and Wave 3 in-home interview data for full sibling pairs only.

**Sibling pairs in-home interviews with firstborn.** For the third specific aim, we further delimited the sibling pairs data discussed previously to pairs in which one sibling was a firstborn child (n = 1,122). Responses were matched by a unique pair identifier and a family identifier. These identifiers plus the unique respondent identifiers enabled us to extract the Wave 1 and Wave 3 in-home interview data for full sibling pairs only in which one sibling was a firstborn child.
Measures

The dependent variables of interest were sibling relationship quality and health behaviors (physical activity) and outcomes (obesity). The independent variables of interest were daily recreation activities, parental support and relationships, and demographic and contextual data such as birth order, social class, gender, income, and age.

Sibling relationship quality. To measure sibling relationship quality, items from the Wave 3 in-home interviews addressed several aspects of sibling relationships. These items were

(a) “How often do you feel love for [your sibling]?” with responses ranging from “never” to “very often”.
(b) “How much time do you and [your sibling] spend together?” with responses ranging from “none” to “a lot”.
(c) “How many interests or goals do you and [your sibling] share?” with responses ranging from “none” to “all”.
(d) “How close do you feel to [your sibling]?” with responses ranging from “not at all close” to “very close.”
(e) “How often do you turn to [your sibling] for help when you have personal problems or problems at work or school?” with responses ranging from “never” to “very often”.
(f) “How often do you and [your sibling] quarrel or fight?” with responses ranging from “never” to “very often”.
(g) “How often do you see [your sibling]?” with responses ranging from “never” to “almost every day”.
(h) “How often do you and [your sibling] talk on the phone?” with responses ranging from “never” to “almost every day”.

(i) “How often do you send letters or email or receive them from [your sibling]?” with responses ranging from “never” to “almost every day”.

(j) “Do you wish you had more contact with [your sibling]?” with responses being “yes” or “no”.

Items were examined using maximum likelihood factor analyses and reliability tests before a scale was constructed.

**Physical activity.** Adult (Wave 3) physical activity was assessed using items from the in-home interview data. Respondents provide data on (a) “in the past seven days, how many times did you go to an exercise or fitness center to work out?” (b) “in the past seven days, how many times did you walk for exercise?” (c) “in the past seven days, how many times did you bicycle, skateboard, dance, hike, hunt, or do yard work?” Responses ranged from 0 (“not at all”) to 7 (“7 or more times”). Items were examined using maximum likelihood factor analyses and reliability tests before a scale was constructed.

**Obesity.** Additionally, measures of height in feet and inches, and weight in pounds were included in Wave 3 in-home interview data. Height and weight were used to calculate BMI which was used as an indicator of obesity.

**Technology-based recreation.** Wave 1 in-home interview data assessing daily activities included items specific to technology-based recreation. These items included

(a) “In the past seven days, how many times did you watch television or videos?” with responses ranging from 0 (“not at all”) to 7 (“7 or more times”).
(b) “On average, how many hours a week do you spend watching videos?”

(c) “On average, how many hours a week do you spend playing video or computer games, or using a computer for something other than school work?”

(d) “On the average, how many hours a week do you spend watching television?”

(e) “On the average, how many hours a week do you spend listening to the radio?”

Items were examined using maximum likelihood factor analyses and reliability tests. A scale was not constructed and instead items were assessed individually.

**Active recreation.** Wave 1 in-home interview data also include items assessing active forms of recreation. These items included (a) “In the past seven days, how many times did you rollerblade or bicycle?” (b) “in the past seven days, how many times did you play an active sport?”, and (c) “In the past seven days, how many times did you exercise?”. These items were coded from 0 (“not at all”) to 3 (“5 or more times”). Items were examined using maximum likelihood factor analyses and reliability tests. A scale was not constructed and instead items were assessed individually.

**Parental support and relationships.** Wave 1 in-home interviews also included items assessing relationships with parents. Items included (a) “how close do you feel to your mom?” (b) “how much do you think she cares about you?” (c) “how close do you feel to your dad?” and (d) “how much do you think he cares about you?”. Responses to these items ranged from “not at all” to “very much”. Items were examined using maximum likelihood factor analyses and reliability tests before constructing a scale for mother relationship quality and father relationship quality. A scale was not constructed and instead items were assessed individually.
**Individual- and family-level factors.** The following variables were included in the analyses to provide potential controlling factors and identify primary characteristics of the sample: birth order (firstborn vs. laterborn), household income, mother’s education, family size, gender, and age.

**Analyses**

Data were analyzed using SPSS 19.0 and SAS 9.3. Because various populations were oversampled in the Wave I In-Home Interview, we also used data weights in the analyses to compensate for oversampling effects. Data were examined for normality and descriptive statistics were calculated. Maximum likelihood factor analyses and reliability tests were used to construct scales where appropriate. Significance of all analyses was assessed at the $p < .05$ level.

Guidelines established in similar integrative reviews (Bocarro et al., 2008; M. Edwards & Matarrita-Cascante, 2011; Floyd et al., 2008), Jackson’s (1980) recommendations for effective integrative reviews, and steps for content analyses (Babbie, 2013) were used guide the analyses of family leisure publications. First, total number of articles published in each of the four journals was counted. Similarly, the total number of family leisure-specific articles in each journal was counted and amassed in five-year increments. Article content was analyzed by sample characteristics (i.e., race or ethnicity, social class, and family structure) methods, and level of analysis (individual, dyadic, or family-level analysis). Guidelines for content analyses (Babbie, 2013) facilitated the examination of major trends in research. Articles were coded according to article title, key words, and content. Preliminary coding categories were reviewed and condensed into non-exclusive thematic categories. The non-
exclusivity in category assignment best reflected the content, findings, and focus of each article by allowing each article to represent various aspects of family leisure (Bocarro et al., 2008; Floyd et al., 2008).

Multilevel models assessed relationships between recreation and sibling relationship quality. Multilevel models accounted for the shared variance of responses from individuals in the same families. Controls for parental relationships, birth order (firstborn vs. laterborn), social class, gender, household income, family size, and age were also included. Finally, interaction effects of gender and birth order on sibling relationship quality were also tested using multilevel models. Similarly, because the sibling pairs represented in this data set were not independent (i.e., they shared unmeasured family effects such as genetic predisposition and shared environment), multilevel models were most effective in understanding the relationship between adolescent recreation behaviors, sibling relationship quality, and subsequent adult physical activity and obesity. Additionally, interaction effects between technology-based recreation, active recreation, and sibling relationship quality were tested to examine the potential moderating effect of sibling relationship quality on relationships between adolescent recreation and adult physical activity and obesity.

**Conclusion**

Family leisure research has overlooked the increasingly important sibling relationship. The effects of recreation on sibling relationships are unknown even though recreation has been shown to facilitate positive outcomes in other family relationships (Agate et al., 2009; Orthner & Mancini, 1990; Zabriskie & McCormick, 2003). Similarly, the effect of recreation on health outcomes and behaviors over time among sibling pairs is unknown.
Therefore, the purpose of this dissertation was to examine the longitudinal association between recreation behavior, sibling relationship quality, and health outcomes. This dissertation will augment existing knowledge on the state of family leisure research as a body of scholarship, and fill gaps in existing research by examining recreation from a sibling perspective, and by using a longitudinal study design and multilevel analyses.
References


Myers, S. (2011). I have to love her, even if sometimes I may not like her”: The reasons why adults maintain their sibling relationships. *North American Journal of Psychology, 13*(1), 51–62.


*Journal of Leisure Research, 22*(2), 125–137.


CHAPTER 2: FAMILY LEISURE: AN INTEGRATIVE REVIEW OF RESEARCH
FROM SELECT JOURNALS

Abstract

Understanding the relationship between leisure and families has been and will continue to be an important area of study. The purpose of the study is to systematically review existing family leisure research from four prominent journals over the past 23 years. Articles are assessed in terms of sample characteristics, methods, analytical approaches, and major thematic trends. Overall, 183 articles regarding family leisure, leisure in context of family life or roles, and individual experiences of family leisure are identified. Findings suggested that the sample characteristics are fairly homogenous. Survey research and individual-level analyses are most common. Three major research themes are present: promoting family well-being through leisure, the costs and constraints to family leisure, and family leisure in the margins.

Keywords: family recreation, systematic review, single-parent families, siblings, sample characteristics
Over the past several decades, leisure scholars have learned much about how leisure affects families in positive and negative ways. Outside the immediate field of leisure research, sociology, family studies, and other disciplines have examined the effect of daily activities and free time on families. On a broader social scale, family togetherness and family time have become cultural watchwords (Mintz & Kellog, 1988) as scholars, politicians, practitioners, and families themselves have sought to enhance family life and well-being through what has been identified as family leisure. Within the leisure field, family leisure has been defined as the “time that parents and children spend together in free time or recreational activities” (Shaw, 1997, p. 98). In many cases researchers have demonstrated how family leisure contributes to overall family well-being (Agate, Zabriskie, Agate, & Poff, 2009; Zabriskie & McCormick, 2001). Other studies, however, have outlined how family leisure can constrain and challenge families (Shaw & Dawson, 2001). The benefits, constraints, and challenges associated with family leisure may largely depend on family structures, functions, and social contexts. Leisure scholars need to assess from time to time the research that has been conducted to ensure appropriate methods and analyses are being used, and that appropriate and relevant questions are being asked.

Integrative or systematic reviews of research can be used to examine trends in existing literature, including methods, analytical approaches, and thematic trends in research (Jackson, 1980). Such integrative reviews of existing literature are an essential part of framing future research (Jackson, 1980). An integrative review of family leisure research that documents its methods, analyses, and trends could determine where scholars have kept pace with changing structures, functions, and social contexts of family life, and where future
research could augment the field’s knowledge base. Moreover, in time of budget cuts and increased competition for research funds, researchers can maintain and strengthen their relevancy as a field by tying to larger social contexts. Therefore, the purpose of this paper was to systematically review existing family leisure research from four prominent and relevant journals over the past 23 years (1990–2012).

More than identifying authors and articles addressing family leisure research, this paper examined the who, what, and how of family leisure research, or in other words, the methods and analyses used by scholars, demographic characteristics of families included in research, and major thematic trends in the literature. The term family was applied broadly to encompass multiple family structures (e.g., two- and single-parent families) and life stages (e.g., families with young children and adult children caring for aging parents). Such a broad application of family represents an inclusive approach that better reflects the dynamic sociocultural status of contemporary families. Research trends and themes were identified and used to frame recommendations for future research.

**Background**

Kelly (1997) advocated that “what people do together is central to life” (p. 34). For couples, parents, children, siblings, and other family members, what families do together may be one of the most meaningful parts of individual and family life, and a nontrivial amount of what families do together constitutes leisure or recreation. Research suggests family leisure increases perceptions of family functioning, family cohesion, family bonding, family adaptability, family life satisfaction, and family communication (Holman & Epperson, 1984; Orthner & Mancini, 1990; Poff, Zabriskie, & Townsend, 2010; Smith, Freeman, &
Zabriskie, 2009; Zabriskie & McCormick, 2003). At the same time, however, tensions in family leisure research have also emerged as scholars have critically examined leisure in family life. Shaw and Dawson (2001) noted that parents generally valued family leisure because of the beneficial outcomes it produced while simultaneously acknowledging it was less likely to be enjoyed by all family members (Shaw & Dawson, 2001). They deemed this type of outcome-oriented leisure *purposive leisure* as it conflicted with traditional leisure definitions which emphasize intrinsic motivation, enjoyment, and free choice. Other tensions have surfaced as scholars have examined women’s roles in family leisure from a feminist perspective.

Overwhelmingly, scholars have demonstrated that traditional definitions of and outcomes associated with leisure frequently do not accommodate the position of women as caregivers, decision-makers, and mothers (Henderson, 1990; Khan, 1997; Shaw, 1992, 1997). Consequently, Shaw (1997) called for greater examination of gender and gender related power differentials within family leisure to facilitate greater understanding of both positive and negative aspects of family leisure through deliberate exploration of contradictions and conflict. Shaw (1997) also called for inclusive research addressing diverse family structures to help a greater number of families and individual family members use their leisure opportunities “to bond with each other, problem solve, and strengthen their relationships” (Agate et al., 2009, p. 206).

Changing social contexts, and family structures and functions are evident in examinations of population trends in the United States. For example, overall family size in the U.S. is decreasing as couples marry at older ages and have fewer children (Cherlin,
Between 1990 and 2010, age of first marriage for men and women increased by more than two years from 26.1 to 28.2 years and from 23.9 to 26.1 years respectively (Elliott, Krivickas, Brault, & Kreider, 2012). Marriages frequently experience disruption (Cherlin, 2010), and a growing number of single-parent households in the United States create new family dynamics as children and nonresident parents must navigate their relationships (Laosa, 2009). Similarly, more people are living longer, and a growing older population introduces new family dynamics between grandparents and grandchildren, adults caring for aging parents, and intergenerational relationship development (Hebblethwaite & Norris, 2011). Changing workforce patterns also affect family structure and function. Specifically, more women are delaying marriage and childbearing to engage in work outside the home and earn advanced degrees (Cherlin, 2010).

From a broader perspective, ongoing demographic changes also have implications for family leisure research. For example, the Latino population in the United States has more than doubled since 1990 (Rodriguez, Larsen, Latkova, & Mertel, 2012; U.S. Census Bureau, 2012a), and in 2012, Asians were the fastest growing ethnic group in the United States (U.S. Census Bureau, 2013). Slightly more than half of all children younger than one year in the United States in 2011 were considered minorities (U.S. Census Bureau, 2012b).

These changes in family structure and function, and changing social contexts will have important implications for family leisure research. Therefore, research methods, analytical approaches, and trends must be evaluated to demonstrate that even as “our conceptualizations of family and leisure are constantly being reconstructed” family leisure scholars achieve “continuity” and “consistency” in their research (Freysinger, 1997, p. 3).
Hawk’s (1991) review of family leisure research from 1930 to 1990 is one example of an evaluation of the body of literature. To our knowledge, no systematic review of trends in family leisure research has been published in more than 20 years. Therefore, the purpose of this paper was to systematically review existing family leisure research from four prominent and relevant journals over the past 23 years (1990–2012). This systematic review of family leisure research could be used to frame future research regarding important and emerging social issues.

**Methods**

Integrative or systematic reviews are an essential part of research activity because they frame ongoing and future research (Jackson, 1980). They can be used to provide an objective account of the state of a particular body of literature by assessing the quantity of articles published, and identifying predominant themes or gaps in existing research and methodologies (e.g., Floyd, Bocarro, & Thompson, 2008). Thus, quantities, methodologies, and thematic patterns were the focus of this integrative review of family leisure research.

**Article Selection**

Similar to integrative reviews in the leisure field (see Bocarro, Greenwood, & Henderson, 2008; Edwards & Matarrita-Cascante, 2011; Floyd et al., 2008), four journals were selected for review: *Journal of Leisure Research (JLR)*, *Leisure Sciences (LS)*, *Leisure Studies (LStd)*, and *Family Relations (FR)*. Article selection was limited to these four journals because they were among the principal publication outlets for family leisure research. Moreover, three of the four journals (*JLR, LS*, and *LStd*) were primary publication outlets for leisure research providing the widest lens for assessing research across the field. Journals
specifically addressing intervention or treatment-based research such as *Therapeutic Recreation Journal* were not included to maintain the focus on leisure as a family process rather than a treatment modality.

Articles were limited to a 23-year span (1990 – 2012) for two reasons. First, in 1991, a review that synthesized and systematically analyzed trends in family leisure research from the early 1900s to 1990 was published (Hawks, 1991). Hawks’ (1991) review identified key themes, and methodological, analytical, and theoretical contributions in research by decade. A concluding and cumulative synthesis of his findings provided important directions for future research. Therefore, this integrative review built upon that review by addressing research published in the last 23 years. Second, as discussed earlier, families exist in continuing social and cultural revolutions that affect family processes, including family leisure. Therefore, an updated examination of family leisure research relative to changes in social climates over the last 23 years may provide direction for future research.

Articles included for review were identified using key word searches and manual review (Edwards & Matarrita-Cascante, 2011). Key word searches were used when online journal access was available. Key word searches in leisure journals included *family, parent, child, adolescent, mother, father, sibling, grandparent*, and their derivatives. Key word searches in *Family Relations* included *leisure, recreation, family time, family togetherness, quality time, family fun*, and *family recreation*. In addition to key word searches, we manually reviewed each issue of each journal either electronically or in print (Edwards & Matarrita-Cascante, 2011). Article inclusion was based on title, key words, abstract, and content (Bocarro et al., 2008; Floyd et al., 2008). Articles were included in the review if their
primary focus was: (a) multipoint examinations of family leisure processes or outcomes, (b) individual leisure in context of family life or family role, or (c) effects of family leisure on individuals. Articles including only peripheral references to family structure, marital status, or family size (e.g., in describing the sample of a study) were not included.

Analyses

Following similar integrative reviews (see Bocarro et al., 2008; Edwards & Matarrita-Cascante, 2011; Floyd et al., 2008), Jackson’s (1980) guidelines for effective integrative reviews, and steps for content analyses (Babbie, 2013), total number of articles published in each of the four journals were counted by year. Similarly, the number of family leisure-specific articles in each journal was also counted by year. These counts were amassed in five-year increments. After counts were completed, article content, methodologies, analyses, and sample characteristics (e.g., race or ethnicity, social class, family structure, etc.), were examined and counted.

The primary goal of the review was to identify key research themes. To facilitate thematic analysis, articles were listed in spreadsheet software for coding and theme development. Similarly, articles were entered into online reference software, and coded according to article title, key words, and content, and tagged using the online software. Preliminary coding of individual articles facilitated the development of broader coding categories: (1) impacting family, couple/marital, individual outcomes positively; (2) impacting family, couple/marital, individual outcomes negatively; (3) identifying emerging family structures/composition; (4) socializing through leisure; (5) identifying constraints to family leisure; (6) identifying family as a leisure constraint; (7) focusing on specific family
relationships or members; and (8) examining family or parenting ideologies. These preliminary categories were reviewed and condensed into three non-exclusive thematic categories. The non-exclusivity in themes best reflected the articles by allowing them to represent various aspects of family leisure.

**Findings**

Of the total 2,948 articles published in these four journals from 1990–2012, 183, or 6.2%, focused on family leisure processes or outcomes, individual leisure in context of family life or family roles, or effects of family leisure on individuals (see Table 1). *LStd* had the most family leisure related publications (*n* = 61), which may be partly attributable to a special issue on fatherhood and leisure in 2006. *LStd* also had the highest percentage of publications related to family leisure of the four journals (11.8%). *JLR* had the second highest number of articles (*n* = 60) and percentage (9.5%). When the four journals were considered together, the total number of family leisure publications increased from 4.1% in 1990–1994 to 7.1% in 2008–2012. When examined individually, *LS*, *LStd*, and *FR* reported increases in the percentage of family leisure related articles, with the greatest increase occurring in *LStd* (7.8% in 1990–1994 to 11.7% in 2008–2012). *JLR* however, saw a decrease in the percentage of family leisure related articles (from 9.3% in 1990–1994 to 7.8% in 2008–2012).

**Methods in Family Leisure Research**

Survey research was the most common method used by researchers (*n* = 85; 46%; see Table 2). A small number of those studies used secondary data (*n* = 14, 7.7%; e.g., Craig & Mullan, 2012; Hodge et al., 2012; Voorpostel, van der Lippe, & Gershuny, 2010; Warner-
Qualitative methods were almost equally present in research \((n = 84, 45\%)\) when including mixed methods approaches. Qualitative approaches spanned phenomenology (e.g., Shannon & Shaw, 2005; Thompson, Rehman, & Humbert, 2005), ethnography (Dempsey, 1990; MacPhail & Kirk, 2006), auto-ethnography (Havitz, 2007; Hultsman, 2012), photo elicitation (Kyle & Chick, 2004; Lincoln, 2005; Quinn & Stacey, 2010), video elicitation (Beck & Arnold, 2009), hermeneutic inquiry (e.g., Hebblethwaite & Norris, 2010; Trussell & Shaw, 2012), and case studies (Anderson & Doherty, 2005; Peterson, Hull, Mertig, & Liu, 2008). One article reported using an experimental design (Wells, Widmer, & McCoy, 2004), and another reported using ex post facto experimental design (West & Merriam, 2009).

**Levels of Analyses in Family Leisure Research**

Family systems theory and ecological systems theory emphasize understanding the various subsystems or levels of influence that interact to produce behavior (e.g., Caldwell & Darling, 1999; Davies & Gentile, 2012; Zabriskie & McCormick, 2003). The tenets of each of these theories suggest multiple levels of data are beneficial and even necessary to understanding social processes and phenomenon like those that occur in families (White & Klein, 2008). Within the last decade, family leisure scholars have called for more robust quantitative analyses that address systems and levels within family leisure processes (Agate et al., 2009; Poff et al., 2010). Overall, in quantitative or survey-based research \((n = 84)\), scholars relied primarily on individual level analyses when examining family leisure research \((n = 59, 70\%)\). Examinations of family dyads like committed couples, mothers and fathers, parents and children, and in a few cases, siblings occurred in slightly more than one-fourth of
all quantitative or survey-based research \( (n = 23; 27\%) \). A limited number \( (n = 7; 8.3\%) \) included multiple data points or a system level analyses (see Table 3). Five studies used multiple levels of analyses and therefore are listed in more than one category.

**Sample Characteristics of Families in Leisure Research**

Factors such as race or ethnicity, marital status and family structure, life stage, and social class play significant roles in family processes and well-being, and may have important implications for family leisure research. Therefore, this integrative review assessed the sample characteristics of families included in existing literature. While the sample characteristics included in this review are not comprehensive, they do provide insight into who family leisure scholars are studying. When examining family leisure publications reporting empirical data \( (n = 169) \), 101 articles identified a specific race or ethnicity as part of reporting their research \( (60\%) \). Of those 101 articles, White or ethnic majority families were featured more than any other group \( (n = 66, 65\%) \). Black families were the focus of five studies \( (6\%; \text{e.g.,} \text{ Hibbler \& Shinew, 2002; Outley \& Floyd, 2002; Thomas, 1990}) \), and three additional studies included almost equal sample sizes of White and Black families \( (3\%; \text{e.g.,} \text{ McMeeking, 2002; Philipp, 1999}) \). Hispanic families were also the focus of six studies \( (6\%; \text{e.g.,} \text{ Christenson, Zabriskie, Egget, \& Freeman, 2006; Coltrane, Parke, \& Adams, 2013; Shaull \& Gramann, 1998}) \). Other ethnicities and nationalities were the focus of 21 \( (21\%) \) additional studies, and included Asian families and women \( (\text{e.g.,} \text{ Tsai, 2010; Yu \& Berryman, 1996}) \), South Asian women \( (\text{Scraton \& Watson, 1998}) \), Afghan families \( (\text{Stack \& Iwasaki, 2009}) \), Australian women and families \( (\text{e.g.,} \text{ Dempsey, 1990; Warner-Smith \& Brown, 2002}) \), Canadian families and women \( (\text{e.g.,} \text{ Shaw, 1992; Trussell \& Shaw, 2007}) \),
Indo-Canadian women and their families (Tirone & Shaw, 1997), Iranian families (Arab-moghaddam, Henderson, & Sheikholeslami, 2007), Israeli women (Nimrod, 2007), Turkish families (Aslan, 2009), and several Western European countries (e.g., Craig & Mullan, 2012; Dilley & Scraton, 2010; Harinen, Honkasalo, Ronkainen, & Suurpaa, 2012; Kitterød & Lappegård, 2012).

When reporting family structure, 109 (64%) articles reported marital status of participants, 64 (38%) reported the sexual orientation of participants, and 129 (76%) provided data related to the life stages of participants. In general, research appeared to focus primarily on married (n = 90, 83%), heterosexual (n = 62, 97%) families with a child or adolescent (n = 69, 53%). Leisure in single-parent families was the focus of 10 articles (9%; e.g., Hornberger, Zabriskie, & Freeman, 2010; Irving & Giles, 2011; Jenkins, 2009). Three articles (3%) included samples with equal numbers of two- and single-parent households. The remaining seven studies (7%) reported samples with various marital statuses or unspecified ratios of respondents’ marital status. For example, Dilley and Scraton’s (2010) examination of women climbers included married, partnered, dating, and single respondents, and Roberson’s (1999) examination of family leisure among delinquent male adolescents included both single- and two-parent households in unspecified ratios. Same-sex couples, their families, and their leisure were the focus of two (3%) studies (Bialeschki & Pearce, 1997; Pritchard, Morgan, Sedgley, Khan, & Jenkins, 2000). Same-sex couples were mentioned in three (5%) additional studies; however, this population was generally less present in research. Life stage, specifically age of children, was sometimes difficult to discern as samples including children or adolescents were commonly described in terms of
school grade rather than numerical age. Moreover, researchers often did not theoretically
distinguish between development stages of children, and there was overlap in several of the
categories such as adolescence to emerging adulthood. Therefore, matching developmental
stages categories such as child, adolescent, and emerging adult across studies was a
significant challenge. As noted earlier, samples of families with a child or adolescent were
most common \((n = 69, 53\%)\). Other samples included families with an emerging adult or
adult child \((n = 12, 9\%)\). Middle age and older adults or grandparents were the focus of 17
studies \((13\%)\). Thirty-one studies \((24\%)\) referenced various life stages. For example, Stack
and Iwasaki’s \((2009)\) study of leisure and adaptation among Afghan refugees included men
and women ranging from 19 to 60 years, some adult children living with siblings and parents,
and some parents with children ranging from 1 to 13 years.

Eighty articles \((47\%)\) described their participants in terms of social class. Research
examining leisure in middle class families accounted for slightly more than half of all studies
\((n = 42; 53\%)\). Leisure in low-income and working class families were the primary focus of
14 studies \((18\%)\). Twenty-four studies \((30\%)\) referenced a range of incomes. Finally, of the
total number of articles examining family leisure, women in the capacities of mothers,
caregivers, and decision-makers were the focus of more than three times the number of
articles \((n = 41; 22\%)\) as men in their roles of fathers \((n = 13, 7.1\%)\).

As suggested by the data reported above, sample characteristics were not consistently
reported across articles. For example, race, marital status, and social class were not included
in some articles’ sample descriptions. Whether such variables were used in analyses was up
to the scholar; however, including these basic descriptors may aid family leisure scholars in
synthesizing existing research. Thus, some sample descriptions were vague or unclear, which limited the ability to analyze and report the characteristics of study participants. Overall, the percentages represented the characteristics of the sample as reported by the original authors.

**Prominent Research Themes**

Three dominant themes emerged from this review of family leisure research. These themes were not mutually exclusive, meaning articles could be categorized under more than one theme. Theme one (*promoting family well-being through leisure*) encompassed the positive outcomes individuals, dyads, and groups perceived related to family leisure. Theme two (*the costs and constraints to family leisure*) examined family or family roles as constraints to leisure as well as constraints to family leisure. Finally, theme three (*family leisure in the margins*) included research identifying and examining diverse family structures and characteristics. Complete descriptions and examples of each theme are presented below.

**Promoting family well-being through leisure.** This theme included research demonstrating the benefits and positive effects of family leisure as perceived by families, couples, parents and children, and individuals. For families, Orthner and Mancini (1990) suggested family stability, family bonding, family interaction, and family life satisfaction could be facilitated by shared leisure. Zabriskie and McCormick (2001) used Orthner and Mancini’s (1990) framework to develop a model for studying family leisure. Zabriskie and McCormick’s (2001) Core and Balance Model of Family Leisure Functioning was introduced as a way to assess family cohesion and adaptability relative to core and balance family leisure involvement, and later expanded to include family functioning (Zabriskie & McCormick, 2003). Since then, scholars have applied the Core and Balance Model in various
contexts including families with a child with a developmental disability (Dodd, Zabriskie, Widmer, & Eggett, 2007), single-parent families (Hornberger et al., 2010), Mexican-American families (Christenson et al., 2006), and in nationally representative U.S. samples (Poff et al., 2010; Zabriskie & McCormick, 2003). Harrington (2006) also used the Core and Balance Model to examine fathering through leisure and sport in Australian families. Jenkins and Lyons (2006) used the model to frame their qualitative examination of non-resident fathers. Other studies have expanded the model to examine the relationship between family leisure and communication (Smith et al., 2009) and satisfaction with family life (Agate et al., 2009; Aslan, 2009; Poff et al.; Zabriskie & McCormick, 2003). In these studies, scholars also reported positive relationships between family leisure, communication, and satisfaction with family life.

For couples, scholars further examined the effects of individual, parallel, and joint leisure on marital satisfaction. Early research suggested joint leisure encouraged communication, interaction, and role interchange, and would therefore promote marital satisfaction more than individual or parallel leisure (Orthner, 1975). Research in the last 23 years has provided additional insight. For example, scholars demonstrated potentially negative effects of individual leisure (e.g., long-distance running) on marital satisfaction could be moderated by couple or spousal support (Baldwin, Ellis, & Baldwin, 1999; Goff, Fick, & Oppliger, 1997; Goodsell & Harris, 2011). Most recently, couples who either played Massively Multiplayer Online Role Playing Games (MMORPGs) together or supported the other’s playing did not experience the same decreased levels of marital satisfaction as
couples who reported conflict associated with online video game playing (Ahlstrom, Lundberg, Zabriskie, Eggett, & Lindsay, 2012).

For parents and children, family leisure promoted positive family relationships and interactions. Many of the studies using the Core and Balance Model of Family Leisure Functioning mentioned earlier in this section included responses from a parent and an adolescent child (Agate et al., 2009; Christenson et al., 2006; Hornberger et al., 2010; Smith et al., 2009). Overall, when parents and children shared leisure, it generally promoted positive perceptions of family functioning. Additionally, Shaw and Dawson (2001) interviewed mothers and fathers and found they highly valued family leisure, and intentionally used it to achieve goals and outcomes such as improved cohesion, communication, and family functioning. Parents also used family leisure as a way to socialize their children and teach them moral values and healthy lifestyle traits (Shaw & Dawson, 2001). For example, parents used family service expeditions to share their moral values with their children. These families experienced family deepening through leisure, or a process that defined and influenced a family and its identity for several years (Palmer, Freeman, & Zabriskie, 2007). Parents’ personal perspectives on the value of leisure shaped adolescents’ perspectives (Shannon, 2006), participation in sport (Green & Chalip, 1998; Gutiérrez, Caus, & Ruiz, 2011), nature-based recreation (Shaull & Gramann, 1998), and overall free-time use (Hutchinson, Baldwin, & Caldwell, 2003).

In many cases family leisure also had positive effects on individuals and family relationships. For example, leisure was the primary context in which fathers built relationships with their children (Kay, 2006a) even when fathers were not living with their
children (Jenkins & Lyons, 2006; Jenkins, 2009). Similarly, grandparents’ time with their grandchildren was predominantly leisure-based (Hebblethwaite & Norris, 2010) and was viewed as a way for grandparents to teach and mentor their grandchildren, and create a family legacy (Hebblethwaite & Norris, 2011). Grandparents’ leisure with grandchildren provided a sense of gratification and belonging, and contributed to increased life satisfaction among older adults (Nimrod, 2007). Siblings spent most of their shared time in leisure, and were likely to report positive outcomes related to their shared leisure (Siegenthaler & O’Dell, 2000; Zeijl, Te Poel, Du Bois-Reymond, Ravesloot, & Meulman, 2000). Family members and relationships in turn affected recreation behaviors in positive ways. For example, siblings helped create positive recreation behaviors pertaining to media. More specifically “families with siblings consistently report more healthy media habits than families with only one child” (Davies & Gentile, 2012, p. 422).

Interestingly, individual leisure also benefitted families. For example, when children from low-income families experienced individual, child-centered vacations provided by non-governmental organizations (NGOs), they and their families experienced social benefits (Quinn & Stacey, 2010). When mothers took time away from their children and engaged in a group exercise program, they reported improved feelings of well-being and increased ability to cope with their responsibilities (Currie, 2004). Overall, this theme of promoting family well-being through leisure demonstrated an increase in exploration and documentation of the benefits of family leisure from the perspectives of parents, couples, children, and less frequently, grandparents and siblings.
The costs and constraints to family leisure. Not all family leisure outcomes were positive, and several studies noted costs and constraints. This theme, therefore, examined negative cases or research in which challenges, costs, and constraints to family leisure were identified. Similarly, this theme included articles examining family leisure itself as a cost and constraint to individual family members. Costs and constraints refer to the factors that inhibit leisure, not necessarily the costs of leisure itself. In general, families experienced costs and constraints to their leisure such as poverty or low-income (Churchill, Clark, Prochaska-Cue, Creswell, & Ontai-Grzebik, 2007; Quinn & Stacey, 2010), physical disabilities (Dodd et al., 2007; Henderson, Bedini, Hecht, & Schuler, 1995; Jeanes & Magee, 2012; Mactavish, MacKay, Iwasaki, & Betteridge, 2007; Mactavish, Schleien, & Tabourne, 1997), lack of time (Zuzanek et al., 1998), lack of resources or facilities (Churchill et al., 2007; Warner-Smith & Brown, 2002), and social, gender, or ideological constraints (Currie, 2004; Kay, 1996, 2006b; Miller & Brown, 2005).

Henderson’s (1990) integrative review of women in leisure research was instrumental in expanding research on women in leisure including in family leisure. For example, women with responsibilities as caregivers and mothers “do not find the opportunities available for leisure that they would like to pursue or are not satisfied with the opportunities that are available to them” (Henderson, 1991, p. 363). Women with young children living in rural communities experienced additional constraints. For example, these women lacked access to public transportation and family leisure places or activities, and their constraints were compounded by low-income living (Churchill et al., 2007). The constraints associated with rural living were consistent across several countries including Australia, North America,
Canada, and New Zealand (Warner-Smith & Brown, 2002). Mothers of young children also reported having less time and fewer resources, and were often inadequately physically active because of these limitations (Brown, Brown, Miller, & Hansen, 2001; Miller & Brown, 2005). Interestingly, women who were unable to have children also experienced costs to their leisure. Specifically, women living with infertility reported lower access to and enjoyment of leisure because of changes in their lifestyle associated with fertility treatments, social isolation, and the time consuming experience of navigating infertility (Parry & Shinew, 2004).

Research also examined the interaction between women’s leisure, employment, and family leisure. Interestingly, mothers’ part-time involvement in the workforce did not always constrain their leisure. In fact, in one study part-time employment was related to an increase in daily recreation time (Hill, Märtinson, & Ferris, 2004). Similarly, part-time employed women derived more meaning from their leisure time than did full-time employees and homemakers (Harrington & Dawson, 1995). Lesbian mothers consciously used role and responsibility negotiations to navigate their constraints and create leisure as individuals, couples, and families (Bialeschki & Pearce, 1997).

Family leisure as a mechanism for reproducing parenting ideologies was another cost and constraint for mothers and fathers. For example, organized youth sports, was identified as a site for conspicuous or public parenting practices that pitted parents against each other (Trussell & Shaw, 2012). For mothers, the prevailing ethic of care often negatively affected their individual and family leisure (Brown et al., 2001; Miller & Brown, 2005). In fact, the work to create family leisure was more intensive for women than men (Shaw, 1992) and men
achieved greater parenting satisfaction through leisure than women (Freysinger, 1994). This disparity may be better understood by examining parenting ideologies. Changes in masculinity and family structure helped reshape fathering ideologies (Kay, 2006b) and were described in terms of leisure-based parenting whereas motherhood ideologies separated parenting from leisure (Such, 2006). Fatherhood ideologies, or being a good father, required spending time with children (Daly, 1996), and using leisure (e.g., sports) to engage in good fathering (Coakley, 2006). Non-resident fathers reported feeling constrained in leisure time with their children and expressed a perceived expectation to conform to social and cultural definitions of fatherhood (Jenkins, 2009). Grandparenting was also divided along gender lines. Grandfathers described their roles in terms of obligation and ambivalence, and expected their partners to engage in most of the work to initiate and maintain contact with grandchildren (Scraton & Holland, 2006). Grandmothers were also assumed to be the primary caregivers suggesting “a gendered division of labor and leisure” (Scraton & Holland, 2006, p. 244). Havitz (2007) noted in his autoethnography that his interactions with his paternal grandmother occurred mostly when he was on vacation but she was not.

Couples also experienced costs and constraints to their leisure such as lack of time and childcare (Dyck & Daly, 2006). The burden of negotiating these constraints largely fell to women, except in couples who adhered to relatively traditional gender roles when men took responsibility (Dyck & Daly, 2006). Parenting ideologies (i.e., children come first) were also constraining to couple leisure (Dyck & Daly, 2006).

Family leisure also constrained children and adolescents. Adolescents perceived their parents’ influence and monitoring constrained their leisure participation (Outley & Floyd,
2002), and were frequently required to rely on parents for access and transportation to leisure (McMeeking & Purkayastha, 1995). Parents were most influential in their children’s leisure and recreation participation decisions (Hultsman, 1993). Purchase decisions and consumptive leisure behaviors were more likely to be specified as a parent’s role, particularly mothers (Howard & Madrigal, 1990). In this sense, parents became gatekeepers to adolescent leisure (Caldwell & Darling, 1999; Outley & Floyd, 2002), which adolescents perceived as a constraint. Parents also socialized their children to leisure attitudes and behaviors (Shannon, 2006). For example, mothers’ body image issues increased their daughters’ perceptions of leisure constraints (Shannon & Shaw, 2008). Overall, research examining the costs and constraints to family leisure increased in breadth and depth as new perspectives on men’s and women’s roles, social ideologies, physical disabilities, and children and adolescent leisure were introduced.

**Family leisure in the margins.** Articles in the third and final theme identified and examined diversity in family structures, characteristics, or previously unexamined roles and relationships. For example, scholars studied family leisure among single-parent families (Azar, Naughton, & Joseph, 2009; Hornberger et al., 2010; Irving & Giles, 2011; Jenkins, 2009), families living with low-incomes or in poverty (Churchill et al., 2007; Dattilo, Dattilo, Samdahl, & Kleiber, 1994; Outley & Floyd, 2002; Quinn & Stacey, 2010), widows (Patterson & Carpenter, 1994), non-resident fathers (Jenkins & Lyons, 2006; Jenkins, 2009; Troilo & Coleman, 2012), Latinos (Christenson et al., 2006; Gutiérrez et al., 2011), same-sex couple families (Bialeschki & Pearce, 1997; Parry & Shinew, 2004), families in which an individual lived with a disability (Emira & Thompson, 2011; Fitzgerald & Kirk, 2009;
Mactavish et al., 1997), older adults (Kivett, 1993; Nimrod, 2007; Scraton & Holland, 2006), families with paternal alcohol abuse (Haugland, 2005), families dealing with chronic illness (Radina, 2009), and biracial couples (Hibbler & Shinew, 2002).

Overwhelmingly, these families’ leisure experiences were distinct from the more commonly studied White, middle class, two-parent family. For example, biracial couples in which one partner was African American and the other was European American often felt socially isolated, and even wary of some leisure activities and locations, and consequently engaged in a pre-leisure vetting process (Hibbler & Shinew, 2002). Similarly, sports in families with a child with a disability involved several adjustments and adaptations that created a leisure process unique to those families (Fitzgerald & Kirk, 2009). Lesbian mothers negotiated their roles according to their interests, availability, and ability to pay for household and other services. Likewise, they relied on communication and structured agreements to meet the demands of raising children and facilitate individual, couple, and family leisure time (Bialeschki & Pearce, 1997). Overall, this theme drew attention to the need for more research examining families outside the middle class ideal. Relatively few scholars sought out these minority populations. Therefore, there is a continued need for inclusivity and diversity in family leisure research. Including more diverse families in future research will further illuminate the uses, applications, benefits, and conflicts within family leisure.

**Discussion**

The purpose of this paper was to systematically review and describe family leisure research from four prominent journals over the past 23 years (1990–2012). This paper
examined the demographic characteristics of families included in family leisure research, the methods and analyses scholars used, and major thematic trends in research. Overall, relatively few articles (6%) addressed family leisure. There is no baseline comparison to determine whether the percentage of research being dedicated to family leisure is adequate; however, when compared to Hawks’ (1991) collection and assessment of family leisure research, current findings suggest family leisure research has increased. Moreover, scholars have expanded their approaches and perspectives to family leisure research. For example, Hawks (1991) found scholars were primarily using questionnaires and surveys to gather data, and he recommended that future research incorporate qualitative methods to increase scholars’ understanding of the meaning of family recreation. As noted in the current findings, studies using qualitative approaches ($n = 84$) were nearly equally as present as studies using quantitative approaches ($n = 85$). Hawks’ (1991) also encouraged scholars to use more longitudinal research, as well as research designs and analyses that can establish causality. Current findings suggest scholars have begun to do so within the past 23 years; however, these types of studies were fairly limited. Therefore, when considering the progress made since Hawks’ (1991) review and when considering the significant and rapid changes in family formation, structure, and function, family leisure as a distinct field with specialized expertise has room to grow.

More than simply increasing research quantity, however, we need to increase research relevancy. A relatively simple way to begin to increase relevancy is to improve the consistency with which sample characteristics are reported in publications. Hawks (1991) noted the ways in which scholars reported sample characteristics and sampling methods
steadily improved; however, there remained some inconsistencies regarding sample descriptions in the last 23 years of research. In some cases, key identifiers such as race, marital status, and social class were missing from sample descriptions making them inconsistent and somewhat arbitrary. Families should be described in terms of structure (including marital status), size, race or ethnicity, social class, sexual orientation, and life stage at minimum to facilitate comparing and synthesizing findings into general research trends. Hawks (1991) noted that many of these structural and sociodemographic indicators, particularly socioeconomic status, had significant effects on family recreation. Family leisure scholars should therefore build on this existing knowledge and include these important indicators when designing their studies and analyzing their data.

Hawks (1991) also recommended using more representative samples and including a wider range of family types and family sizes. Overall, families included in family leisure research in the past 23 years appeared to be predominantly White, heterosexual, intact (i.e., two-parent) families, suggesting limited progress has been made to address Hawks’ (1991) recommendation. While important progress toward diversifying family leisure research was evident, scholars can continue to build upon and increase that diversity. By studying largely homogenous samples of families, researchers may be inadvertently limiting the generalizability and applicability of what is known about family leisure. It may also be contributing to the reproduction of social ideologies such as the middle class ideal (Trussell & Shaw, 2012), motherhood or the ethic of care (Miller & Brown, 2005; Parry, 2005), and family leisure itself as an idyllic and exclusively fun activity (Shaw, 1992). Researchers should be aware of and sensitive to family structures and relationships that have been
overlooked, and continue to broaden the research scope beyond the White, intact family, middle class ideal. Future researchers could intentionally seek out the perspectives of families that have been relegated to the margins of family leisure research. In some cases, what is understood about the benefits and constraints of family leisure may apply to some family structures but not all. Scholars could consider using purposive sampling techniques to ensure inclusivity, and avoid reproducing social ideologies as they describe their study, sample, and findings. This approach will enable scholars to better understand how these families perceive family leisure, the constraints they experience, and the benefit they derive from engaging in family leisure.

As one specific example, the leisure experiences of single-parent families may be distinct from leisure experiences of two-parent families. Single-parent families have been the focus of only a few studies even though recent census data suggest that in some communities and populations such as low-income, Black, and American Indian households, more than half of all families are headed by a single parent (Shattuck, & Kreider, 2013). Research also suggests single-parent households experience greater constraints and challenges that affect, among other aspects of life, their leisure. For example, children from single-parent households were more likely to engage in health risk and socially delinquent behaviors (Cherlin, 2009) and be obese (Huffman, Kanikireddy, & Patel, 2010). Some family leisure behaviors such as regular family dinner are associated with decreased adolescent delinquent behavior (Griffin, Botvin, Scheier, Díaz, & Miller, 2000), especially when relationships between parents and children are positive (Meier & Musick, 2014), and decreasing adolescents’ sedentary leisure time may reduce the risk of obesity (Liou, Liou, & Change,
Determining how to best provide opportunities for positive family leisure or physically active leisure in households where resources may be reduced poses a significant social problem. Addressing these types of research and social problems can not only increase the leisure field’s inclusivity but also its relevancy. Other groups such as Latino and Asian families were also underrepresented even though they are two of the fastest growing populations in the United States (U.S. Census, 2012). Same-sex couples and parents, blended or step-families, and family life stages other than adult parents with adolescent children also deserve increased research attention from family leisure scholars. If research is focused on a narrow range of family structures or types, the field’s potential for growth is limited as well as the ability to stay socially and politically relevant in an era of decreasing resources.

Expanding the scope of family leisure research also applies to the family relationships scholars study. Hawks (1991) noted that future research should examine meanings of leisure and recreation for all family members and not just one or both parents. Since then, scholars have begun to expand upon the relationships and perspectives included in family leisure research; however, some important family relationships have still been overlooked. For example, sibling perspectives were included in only a few studies, and then only peripherally. Furthermore, the samples represented predominantly White, middle class or upper class, intact families. The absence of siblings in family leisure research means models and frameworks explaining the reported benefits and constraints of family leisure have been largely based on studies involving couples, and parent-child relationships, which makes such frameworks potentially incomplete. Social trends further emphasize the importance of understanding sibling relationships because children are now “more likely to live in a
household with a sibling than with a father” (Feinberg, Sakuma, Hostetler, & McHale, 2013, p. 97). Moreover, there is some indication that “family’s shared leisure events—the extent that siblings and parents engage in activities together—are linked to positive sibling relationship qualities” (Updegraff, Thayer, Whiteman, Denning, & McHale, 2005, p. 383). If sibling relationships are the longest lasting, then more research needs to examine how leisure in families can be used to promote positive, stable, and sustainable sibling relationships across life stages. This area has not been widely considered. Other relationships to consider from a wider scope are those of grandparent relationships, which were the subject of only a limited number of studies in the last 23 years.

As scholars expand their scope of research to include a broader range of family types and relationships, conceptual research will continue to be a necessary. At the same time there is a need to begin or increase translation and application of family leisure research. Scholars can use existing family leisure research and theory to address social problems such as the physical and psychological health and well-being of families. By building on existing conceptual frameworks and research to engage in social-problem focused translational research, family leisure research can strengthen its relevancy and ensure interdisciplinary contributions.

Overall, within the broader concept of leisure experiences, family leisure is a highly relevant social phenomenon. It is distinct from traditional definitions of leisure in that it is less likely to be freely chosen, and more likely to be extrinsically motivated. These differences mean family leisure comes with its own set of special considerations. These important considerations are also highly dependent upon family structures and forms, and
social and cultural shifts that affect the functions of the family. In other words, researchers should concern themselves with the “real life conditions” in which families exist that affect their leisure opportunities, constraints, and outcomes (Kelly, 1997, p. 34) to ensure continued relevancy and capacity for contribution.
References


Table 1.1. Comparison of the Number of Family Leisure Articles as a Percentage of the Total Number of Articles Published Listed by Journal in Systematic Increments (1990-2012)

<table>
<thead>
<tr>
<th>Year</th>
<th>JLR</th>
<th>LS</th>
<th>LStd</th>
<th>FR</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Family Leisure</td>
<td>Total</td>
<td>% Total</td>
<td>Family Leisure</td>
<td>Total</td>
</tr>
<tr>
<td>1990-1994</td>
<td>12</td>
<td>129</td>
<td>9.3</td>
<td>4</td>
<td>103</td>
</tr>
<tr>
<td>1995-1999</td>
<td>20</td>
<td>122</td>
<td>16.4</td>
<td>5</td>
<td>109</td>
</tr>
<tr>
<td>2000-2004</td>
<td>7</td>
<td>136</td>
<td>5.1</td>
<td>8</td>
<td>111</td>
</tr>
<tr>
<td>2005-2009</td>
<td>14</td>
<td>154</td>
<td>9.1</td>
<td>10</td>
<td>158</td>
</tr>
<tr>
<td>2010-2012</td>
<td>7</td>
<td>88</td>
<td>8.0</td>
<td>7</td>
<td>89</td>
</tr>
</tbody>
</table>
Table 1.2. Methods Used in Family Leisure Research from Four Selected Journals from 1990 to 2012.

<table>
<thead>
<tr>
<th>Method</th>
<th>JLR</th>
<th></th>
<th>LS</th>
<th></th>
<th>LStd</th>
<th></th>
<th>FR</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Survey</td>
<td>30</td>
<td>50</td>
<td>18</td>
<td>53</td>
<td>17</td>
<td>28</td>
<td>20</td>
<td>71</td>
<td>85</td>
</tr>
<tr>
<td>Secondary Data Analysis</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Literature/Integrative Review</td>
<td>8</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Experimental Design</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Mixed Methods</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>12</td>
<td>10</td>
<td>16</td>
<td>3</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Qualitative</td>
<td>21</td>
<td>35</td>
<td>20</td>
<td>59</td>
<td>34</td>
<td>56</td>
<td>9</td>
<td>32</td>
<td>84</td>
</tr>
<tr>
<td>Case Studies</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>[Auto]ethnography/Narratives</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: Articles were cross categorized when various methods were reported. This plus rounding error may render percentages that do not equal 100 and totals that do not correspond to reported sums.
Table 1.3. Levels of Analyses Included in Family Leisure Research from Four Selected Journals from 1990 to 2012.

<table>
<thead>
<tr>
<th>Level of Analyses (no. survey articles)</th>
<th>JLR(30)</th>
<th>LS(18)</th>
<th>LStd (17)</th>
<th>FR(20)</th>
<th>Total(85)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Individual</td>
<td>19</td>
<td>63</td>
<td>12</td>
<td>67</td>
<td>16</td>
</tr>
<tr>
<td>Dyad</td>
<td>8</td>
<td>27</td>
<td>6</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>System</td>
<td>4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: Articles were cross categorized in some cases. This plus rounding error may render percentages that do not equal 100 and totals that do not correspond to reported sums.
CHAPTER 3: THE EFFECT OF ADOLESCENT RECREATION ON ADULT PERCEPTIONS OF SIBLING RELATIONSHIP QUALITY

Abstract

The purpose of this study is to examine the effect of technology-based and active recreation on perceptions of sibling relationship quality. Using sibling pairs data from the National Longitudinal Study of Adolescent Health and multilevel models, findings suggest that adolescent recreation behaviors are related to adult perceptions of sibling relationship quality. When accounting for fixed and random individual and family effects, participating in rollerblading or bicycling, playing an active sport, and hours spent watching videos in adolescence are positively related to adult perceptions of sibling relationship quality. Exercising is negatively related to adult perceptions of sibling relationship quality. Hours spent watching TV approach significance and are also negatively related to adult perceptions of sibling relationship quality.

Keywords: siblings, technology, physical activity, family leisure, multilevel models
The Effect of Adolescent Recreation on Adult Perceptions of Sibling Relationship Quality

Most people in the United States have at least one sibling and their relationships are potentially the longest-lasting across the lifespan (Cicirelli, 1994; Whiteman, McHale, & Soli, 2011). Even as the birthrate and overall family size in the U. S. declines, children are more likely to grow up sharing a household with a sibling than they are with a father (Feinberg, Sakuma, Hostetler, & McHale, 2013). Little is known about the role leisure and recreation play in sibling relationships, though in middle childhood, siblings spend most of their free time together (Whiteman, McHale, & Crouter, 2007) and sibling closeness is built by sharing common interests (Folwell, Chung, Nussbaum, Sparks, & Grant, 1997).

Recreation is commonly considered to be a means of relationship development and maintenance among families (Orthner, Barnett-Morris, & Mancini, 1994) and family leisure has been shown to contribute to increased family functioning, satisfaction with family life, family cohesion, and family adaptability (Holman & Epperson, 1984; Mactavish & Schleien, 2004; Orthner & Mancini, 1990; Poff, Zabriskie, & Townsend, 2010; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). These conclusions, however, are largely based on individual-level analyses of cross-sectional couple or parent-child data in which the child is an adolescent. Understanding of the effect of recreation on sibling relationships is extremely limited. Therefore, the purpose of this study was to examine the effect of leisure and recreation on perceptions of sibling relationship quality.
Literature Review

Family Systems Theory and Sibling Research

Family systems theory was used to frame this study. Two components of family systems theory particularly salient to the current study are elements and subsystems. Elements are the individual family members, and influence subsystems as well as the overall family system (White & Klein, 2008). Subsystems consist of groups of two to three family members, and each subsystem has its own rules, boundaries, and characteristics. Thus, subsystems operate as “semi-independent” units that interact with and are influenced by the other subsystems (Cicirelli, 1980, p. 111). Each subsystem interacts, and simultaneously influences and is influenced by elements and the overall family system (White & Klein, 2008).

Family systems theory has been used to examine sibling relationships, specifically regarding how siblings shape family context and individual behavior regulation (Cox, 2010). Similarly, Folwell et al. (1997) used family systems theory to examine determinants of perceived closeness among older adult siblings. Therefore, we used systems theory to examine the relationship between individual behaviors and subsystem characteristics. Specifically, individual recreation participation may be relevant to relationship quality at the sibling subsystem. Moreover, according to family systems theory, individual behaviors (i.e., recreation) and subsystem characteristics (i.e., sibling relationship quality) may vary systemically across families. For example, verbal and non-verbal interaction between individual family members has been shown to influence other family members’ leisure
choices and preferences (Siegenthaler & O’Dell, 2000). This finding is relevant to the examination of individual recreation behaviors and sibling relationship quality.

**Recreation and Sibling Relationships**

Recreation among individuals and families has been shown to be related to family level outcomes. Many families use leisure and recreation to facilitate family bonding, and to develop and maintain their relationships (Orthner & Mancini, 1990). Family leisure and recreation contribute to family cohesion and adaptability, family functioning, and family life satisfaction (Agate, Zabriskie, Agate, & Poff, 2009; Holman & Epperson, 1984; Mactavish & Schleien, 2004; Orthner & Mancini, 1990; Poff et al., 2010; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). These effects, however, are largely based on the perspectives of parent-child or committed relationships. Sibling recreation, like family recreation, may create opportunities for shared experiences, communication, closeness, and problem solving—all of which may contribute to improved sibling relationship quality. Sibling closeness is, in part, created by sharing common interests (Folwell et al., 1997). Recreation, therefore, may serve as a foundation for creating common interests that promote sibling closeness. On the other hand, recreation may also create opportunities for conflict, and high levels of conflict (e.g., sibling violence, antagonism, competition, and rivalry) can negatively affect overall sibling relationship quality (Kramer, 2010). Longitudinal data accounting for family context would facilitate greater understanding of what ingredients are essential to creating strong and successful sibling relationships (Kramer, 2010). Overall, research examining the effects of recreation on sibling relationships is limited even though
“lifelong bonds between siblings develop because of the time siblings spend together” (Feinberg et al., 2013, p. 98), including time spent in recreation (McHale & Crouter, 1996).

The limited extant sibling recreation research is largely descriptive. For example, scholars found that Dutch youth between the ages of 10 and 12 years from higher social classes spent a substantial part of their leisure time with parents and siblings (Zeijl, Te Poel, Du Bois-Reymond, Ravesloot, & Meulman, 2000). Zeijl and colleagues (2000) did not, however, analyze any specific sibling outcomes related to leisure time, and instead focused on parents’ influence on adolescent leisure. Another study examined the relationships between social contexts of siblings’ daily activities (e.g., hobbies, sports, outdoor play, reading, television viewing, toys and games, and hanging out) and individual social adjustment (e.g., school grades, behavior, and depression) (McHale, Crouter, & Tucker, 1996). This study, however, was focused on individual social adjustment outcomes in late childhood and adolescence, and did not examine how recreation affected perceptions of sibling relationship quality. Mactavish and Schleien (2004) reported some limited findings on sibling recreation in families with a child with a developmental disability; their findings and conclusions were largely descriptive and grounded in parents’ perspectives, not siblings’.

These studies suggest leisure and recreation could serve as fundamental building blocks for successful sibling relationships, yet little research has explicitly examined those effects. One study included inferential examinations of sibling daily activities and relationship outcomes among children with younger siblings (McHale & Crouter, 1996). Their examination of relationships between individual characteristics and sibling outcomes was limited to children in middle childhood. The current study expanded on existing research
by examining the relationship between individual adolescent characteristics and behaviors and adult sibling outcomes. Siblings in these age groups, particularly adults, have not received the same level of research attention as have siblings in childhood.

The current study examined two specific types of recreation: technology-based recreation such as television and movie viewing, listening to the radio, and video game playing, and active recreation such as participation in team and individual sports, exercise activities, and unstructured physically active recreation activities.

**Technology-based recreation.** Technology claims a significant portion of leisure time in the United States, and has become a mainstay of family and youth leisure (Brock, 2002; Daly, 1996; Rideout, Foehr, & Roberts, 2010). Researchers estimated that about half of people’s free time is spent in media use. Sports and various leisure activities claim approximately 8%, social interaction about 18%, and “walking, resting and attending ‘spectacles’ the rest” (Jeffres, Neuendorf, & Atkin, 2003, p. 169).

Despite the evidence suggesting technology is a predominant part of recreation, little research has detailed the effects of technology and media on family outcomes, especially in leisure studies. In one study, individual media use was negatively related to individual perceptions of family functioning, while shared media use was positively related to perceptions of family functioning (Hodge et al., 2012). Another study found that families with multiple children were more likely than only-child families to engage in activities other than screen-based media (Davies & Gentile, 2012). Still, teenaged children with siblings were more susceptible to media effects than were only-children (Davies & Gentile, 2012). Media effects include mimicking or imitating TV characters’ behaviors or experiencing
frequent fear or anxiety as a result of media exposure (Davies & Gentile, 2012). For example, viewing or consuming violent media is associated with increases in aggressive thoughts and behavior in both short- and long-term evaluations (Anderson et al., 2003). Similarly, consuming media portraying relational aggression also increased physically and relationally aggressive behavior (Coyne et al., 2008). Thus, some media consumption may be related to increased sibling conflict, and overall, lower quality sibling relationships. Overall, however, the presence of siblings has been shown to create more positive uses and outcomes associated with screen-based media (Davies & Gentile, 2012). Understanding the effects of technology-based recreation on sibling relationship quality requires more examination.

**Active recreation.** Active recreation includes leisure time physical activity and active leisure such as exercising or playing competitive or social sports (Tsai & Coleman, 2009). Sport is pervasive, particularly among adolescents (Papacharisis et al., 2005). In the year 2000, more than half (54%) of all American youth between the ages of six and 17 years were enrolled in at least one organized sport team (American Sports Data, Inc. 2005 as cited in Woods, 2011), and in 2005 the percentage of American youth between the ages of 10 and 17 years who were enrolled in at least one organized sport team increased to 59% (National Survey of Children’s Health, 2005).

Sports, with their high levels of adolescent participation, represent a prime area for sibling-specific research. For example, in a qualitative examination of the role of family members in supporting youth sports participation, siblings provided encouragement and commitment, acted as role models, and mentored the focal child (Schinke et al., 2010). Conversely, sibling rivalry may be related to comparisons of sport performance particularly
when siblings share sports or other recreation activities (Whiteman et al., 2011). Sibling rivalry if intense or prolonged can negatively affect individual adjustment, outcomes, and well-being (Cote & Hay, 2002; East, 2009). Therefore, sports as active recreation may have a potentially negative effect on sibling relationship quality. Overall, organized activities—and sports in particular—represent a “major influence in the development of one’s identity and feelings of competence across the life span” (Danish, Petitpas, & Hale, 1993, p. 353).

**Contextual Considerations for Recreation and Sibling Relationships**

According to family systems theory and extant literature, sibling relationships operate and are affected by the larger family context as well as individual characteristics. Therefore, we included several individual- and family-level covariates affecting sibling relationships in this study. Specifically, we examined birth order, other family relationships, family size, social class, gender, and age.

**Birth order.** Birth order generally affects perceived closeness to parents and other siblings. For example, firstborns reported higher quality relationships with their siblings and greater levels of contact than did later-born siblings, and middle-born siblings reported lower quality relationships with parents and lower levels of overall family contact (Pollet & Nettle, 2009). Therefore, it would appear that birth order has at least some impact on sibling relationship quality as well as parental relationships across siblings.

**Other family relationships.** Relationships between parents, and relationships between parents and their children, also affect sibling relationships (Edwards, Hadfield, Lucey, & Mauthner, 2006). For example, sibling relationship quality was more likely to be lower among children and adolescents who perceived their parents were engaging in unequal
treatment or differential treatment of their siblings (Shanahan & McHale, 2008). This decreased relationship quality continued into adulthood among siblings who perceived parents engaged in differential treatment of children (Boll, Ferring, & Filipp, 2003). Children who experienced marital conflict were also more likely to exhibit increased sibling rivalry (Stocker & Youngblade, 1999). Conversely, some research has demonstrated that when marital conflict is intense, siblings will turn to each other for emotional support and thereby develop closer relationships (Jenkins, 1992). Therefore, other family relationships may have mixed effects on perceptions of sibling relationship quality.

**Family size.** If parental resources (e.g., like time, finances, and energy) are limited or finite, competition for resources among siblings may increase with family size (Downey, 2001). This resource dilution model suggests even one sibling threatens a child’s access to his or her parents’ resources. Decreased access to resources can negatively affect educational and academic outcomes (Downey, 2001). Conversely, siblings may also act as resources in some contexts (Downey & Condron, 2004). In terms of social adjustment and well-being, siblings may create more resources than they deplete. Thus, family size is an important part of understanding sibling relationships.

**Social class.** Sibling relationships may differ across social class. In working class and poor families, siblings expressed annoyance with each other, but displays of open hostility, conflict, or competition were not as evident as they were in middle class families where conflict, hostility and competition were common (Lareau, 2011). Siblings in working class and poor households also tended to resolve their conflicts independent of adult intervention while adults frequently intervened in sibling conflict in middle class households (Lareau,
Therefore, social class affected overall quality of sibling relationships at least during childhood and adolescence when the subjects of Lareau’s (2011) study were observed.

Social class may also influence sibling recreation. Middle class children participated in a high volume of planned or structured activities, like sports, as part of their parents’ concerted cultivation approach to childrearing (Lareau, 2011). Conversely, parents in working class or poor families approached parenting from a natural growth perspective, making youth responsible for their own recreation and free time activities (Lareau, 2011). Subsequently, social class may dictate to some extent the types of activities in which siblings engage.

**Gender.** Gender also plays a role in siblings’ relationships and preferences for different types of everyday activities (Edwards et al., 2006). Gender affects adolescent siblings’ perceptions and sensitivity to “rivalry and competition” especially among same-gender siblings (Whiteman et al., 2011, p. 126). Sisters generally engaged in the highest levels of communication, contact, and support, and their positive perceptions of sibling relationships were generally higher (Spitze & Trent, 2006). Therefore, gender may play a role in perceptions of sibling relationship quality as well as recreation behaviors.

**Age.** As noted in other sections of this paper, age can impact sibling relationships in several ways. In general, sibling relationships evolve across the lifespan affecting perceptions of conflict and rivalry, and closeness (Whiteman et al., 2011). Conflict tends to decrease as siblings age, and closeness appears to increase slightly or stabilize later in adolescence (Oliva & Arranz, 2005; Updegraff, McHale, & Crouter, 2002).
In summary, the relationship between sibling recreation (i.e., playing, watching TV, leisure time, to sports participation) has largely been examined descriptively and is often restricted to adolescent and child perspectives. Therefore, the purpose of this study was to examine the relationship between recreation and perceptions of sibling relationship quality longitudinally. Specifically, this study explored the effects of adolescent technology-based and active recreation on adult perceptions of sibling relationship quality. Based on the literature and theory reviewed in this article, we expected that higher levels of technology-based recreation would be negatively related to sibling relationship quality. We also expected that higher levels of active recreation would be positively related to sibling relationship quality.

**Data and Methods**

Data on sibling relationship and recreation were examined from the National Longitudinal Study of Adolescent Health (Add Health). Add Health data comprise a nationally representative longitudinal study of adolescents in the United States (Harris et al., 2009). This study assessed participants’ physical, social, psychological, and economic well-being at four time points beginning in adolescence and spanning into adulthood. The study also included contextual data such as family relationships, neighborhood resources, school characteristics, friend relationships, and romantic relationship outcomes. Participants were first selected from a stratified random sample of 80 nationally representative high schools in the United States and were enrolled in grades 7 through 12 at baseline \( n = 90,118 \); Harris et al., 2009). A survey questionnaire was administered to these students in the Wave 1 in-school sample. A smaller sample was drawn from the in-school sample to participate in an in-home
interview \( (n = 12,105) \). The first wave of data collection (Wave 1) occurred in 1994-5. Wave 3 data were collected in 2002—seven years after baseline—providing longitudinal data concerning recreation behaviors and sibling relationships.

**Sample**

Data for this study were taken from the in-home interview sample at Waves 1 (adolescence) and 3 (adulthood) to examine the effects of leisure and recreation on perceptions of sibling relationship quality. By study design, twins were intentionally recruited for the study whereas other sibling types (e.g., full siblings, half siblings, non-related siblings) were included at random. Sibling pairs were identified by sibling relationship type (e.g., twin, full, half, non-related) and gender (e.g., male-male, male-female, or female-female). The final sample was delimited to full sibling (FS) pairs \( n_{\text{pairs}} = 1,251 \), \( n_{\text{respondents}} = 2,502 \) of all gender compositions (i.e., female-female, male-male, and female-male). Limiting sibling type to full siblings helped contain variance in perceptions of relationship quality to one specific relationship type. The size and representativeness of the sibling subsample increased statistical power and generalizability.

**Instrumentation**

**Sibling relationship quality.** Wave 3 in-home interviews included eight items assessing sibling relationships. Maximum likelihood factor analysis of Wave 3 revealed five of the eight items addressing sibling relationships loaded on a single factor. Reliability tests of these items supported the creation of a scale or index variable \( (\alpha = .741 > .65) \). Therefore, we calculated an index of sibling relationship based on five items: (a) how close respondents felt to their siblings, (b) how often respondents asked their siblings for help, (c) how many
interest and goals they shared, (d) how often they spoke on the phone, and (e) how often they saw each other. This index served as the measure of adult sibling relationship quality.

**Technology-based recreation.** In-home interview data included items measuring respondents’ daily activities. These activities included a survey of technology use, which was used to assess frequency and duration of technology-based recreation. Wave 1 items included (a) frequency of watching television or videos, (b) duration of or hours spent watching television, (c) hours spent watching videos, and (d) hours spent playing video or computer games. Responses ranged from 0 (“not at all”) to 3 (“5 or more times”) for the frequency estimations, and were measured continuously for the hourly estimations. These items were assessed individually as predictors of sibling relationship quality.

**Active recreation.** Items assessing physically active forms of recreation also were measured. At Wave 1, these items assessed during the last week: (a) “how many times did you go roller-blading, roller-skating, skate-boarding, or bicycling?” (b) “how many times did you play an active sport, such as baseball, softball, basketball, soccer, swimming or football?” and (c) “how many times did you do exercise, such as jogging, walking, karate, jumping rope, gymnastics or dancing?” These items were coded from 0 (“not at all”) to 3 (“5 or more times”). These items were assessed individually as predictors of sibling relationship quality.

**Demographic and contextual data.** The following variables were included in the proposed analyses to provide potential controlling factors and to identify primary characteristics of the sample: birth order (firstborn vs. later-born), mother’s education,
household income, living with both mother and father, family size, race, gender, relationships with parents, and age.

**Missing Data**

Even among the specific subsample of full siblings in the Add Health data, missing data occurred for several variables. For these variables, we used a multiple imputation procedure in SAS to augment the missing data (Allison, 2002). The multiple imputation procedure completed otherwise incomplete data sets such as Add Health by using a “sequential chain of data augmentation” (Parcel, Campbell, & Zhong, 2012, p. 170). Missing data values were replaced based on sets of probable values that incorporate uncertainty about the imputed values (Rubin, 1976). These probable values were generated through iterative simulations of regression models, or imputations (Little & Rubin, 2002). In this study, five imputations were used to predict and replace missing data with appropriate estimates and standard errors. Those estimates were then pooled to create valid and generalizable statistical models and supportable conclusions (Allison, 2002; Parcel et al., 2012). These procedures were in line with those used among other large, secondary datasets (see Parcel et al., 2012).

**Analyses**

Data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 19.0 and SAS 9.3. Data were first examined to identify and select matched pairs of full-sibling cases. These data were then assessed for normality, and descriptive statistics were analyzed. After constructing scales and indices as described in the previous section, the relationships between key study variables were assessed using correlations. Specifically, we examined the relationships between (a) family context variables and sibling relationship
quality, and (b) adolescent recreation (both technology-based and physically active) and adult sibling relationship quality.

We focused on the effects of recreation activities on sibling relationships across time by using Wave 1 recreation behaviors to predict Wave 3 perceptions of sibling relationship quality. Because the data included respondents from the same family, we ran a series of multilevel models examining adolescent and adult sibling relationship quality. Multilevel models allowed responses to correlate. In other words, multilevel models allowed us to account for the variation explained by family-level influences. Fixed effects, or individual level effects, were used to explain within and between family differences (Georgiades, Boyle, Jenkins, Sanford, & Lipman, 2008). In this study, fixed effects were age, race, gender, birth order, relationship with mother, relationship with father, and recreation variables. Random effects, or family-level effects, were household income, mother’s education, and family size, and were used to explain between-family response variance.

Several models were estimated. The first was an unconditional means model that approximated a one-way ANOVA with random effects enabling the determination of how much variance in mean perceptions of sibling relationship quality was explained by family effects. The second model included only family context variables since research suggested contextual family factors significantly affect sibling relationships. The third model included the addition of the technology-based and physically active recreation items. A final model testing for gender interaction effects was estimated.
Results

At Wave 1 a slight majority of respondents in the sibling pairs subsample were female \((n = 1,276, 51\%)\). Respondents reported a mean age of 15.1 years \((SD = 1.50)\), with ages ranging between 10 to 19 years. More than half of respondents self-identified as White \((n = 1,380, 55\%)\) and 15\% \((n = 389)\) self-identified as African American. Other races accounted for 30\% of respondents \((n = 733)\). Most respondents lived with both their mother and father \((n = 2,106, 84\%)\) and mean family size was 5.0 \((SD = .87)\) with a range of 1 to 7 people per household. Twelve percent of mothers had less than a high school education \((n = 311)\), and 36\% had graduated for high school or earned a GED \((n = 892)\). Nearly one-third \((n = 720, 29\%)\) had some college and 17\% \((n = 17\%)\) had graduated from a college or university. A small percentage \((n = 147, 6\%)\) had professional training beyond a four-year college or university degree. About one-third \((n = 773, 31\%)\) of respondents self-identified as a first-born child. For a summary of sample characteristics, see Table 2.1.

When examining adolescent recreation behaviors, more than half of respondents \((n = 1,450, 58\%)\) reported watching TV or videos five or more times per week, 22\% \((n = 544)\) reported watching TV or videos three or four times per week. Respondents further reported watching an average of 15.6 \((SD = 14.7)\) hours of television and 4.5 \((SD = 7.2)\) hours of videos each week. Additionally, respondents reported spending an average of 2.9 \((SD = 6.5)\) hours playing computer or video games each week. Overall, respondents spent 23 hours a week engaged in some form of technology-based recreation (see Figure 2.1). In examining patterns of physically active recreation, nearly two-thirds of respondents \((n =1,511, 60\%)\) reported not rollerblading or cycling in the last week, and less than one-fourth had
participated in this activity once in the last week \( n = 587, 23\% \). Nearly equal number of respondents reported not playing an active sport during the week \( n = 635, 25\% \) as did the number of respondents who reported playing an active sport once in the last week \( n = 661, 26\% \). Sixteen percent of respondents \( n = 401 \) reported no exercise in the last week, 31% \( n = 780 \) reported exercising once or twice in the last week, and slightly more than half \( n = 1,321, 53\% \) reported exercising three or more times in the last week.

**Multilevel Models**

Initial correlations and subsequent multilevel models suggested recreation behaviors in adolescence were significantly related to adult perceptions of sibling relationship quality. Using the initial unconditional model, the intraclass correlation coefficient (ICC) was calculated. The ICC describes how strongly individuals from the same family resemble each other. It is based on the ratio of between-family variation and the total variation \([\text{var(family)}/\text{var(family+var(residual))}]\) (Georgiades et al., 2008). The ICC for this model was 46.6%, meaning nearly half of the variance in perceptions of adult sibling relationship quality was explained by family grouping effects when no other variables were included in the model.

In the second model some individual (fixed) effects and family (random) effects were significant predictors of sibling relationship quality. Household income, gender, relationship with mother, and race were significant. Family size, mother’s education, relationship with father, age, and living with both mother and father were not significant predictors of adult sibling relationship quality. Theory suggests, however, that family size and birth order have effects on resources available to siblings (see Downey, 2001 and Downey & Condron, 2004 for a discussion on the resource dilution model). As family size increases, available resources
decrease, and that decrease in resources could theoretically have an impact on elements of sibling relationship quality such as conflict, closeness, and caregiving. Similarly, firstborns reported higher quality relationships with their siblings than did later-born siblings (Pollet & Nettle, 2009). Therefore, family size and birth order were maintained in subsequent models. Other non-significant respondent individual and family level effects (i.e., age, mother’s education, relationship with father, and having two parents) were dropped. In this reduced model, male siblings reported significantly lower perceptions of adult sibling relationship quality than females (β = -1.73, t = -12.94, p < .001). Positive relationships with mothers contributed to increased positive perceptions of adult sibling relationships (β = .191, t = 8.47, p < .001). Income was positively associated with sibling relationship quality (β = .138, t = 3.31, p = .001). Race was also a significant predictor of sibling relationship quality with respondents who self-identified as White reporting significantly lower perceptions of adult sibling relationship quality (β = -.420, t = -2.82, p = .005). A summary of these findings was noted in Table 2.2.

In the third model, adolescent recreation variables were added. Four of the seven adolescent recreation variables were significant predictors of adult sibling relationship quality: (1) participating in rollerblading or bicycling, (2) playing an active sport, (3) exercising, and (4) hours spent watching videos. A fifth variable (hours watching TV) approached significance. Engaging in rollerblading or bicycling as an adolescent was positively related to adult perceptions of sibling relationship quality (β = .214, t = 2.96, p = .003) as was playing an active sport (β = .225, t = 3.45, p = .001). Conversely, exercising in adolescence was negatively related to adult perceptions of sibling relationship quality (β = -
related to adult perceptions sibling relationship quality ($\beta = .042, t = 3.85, p < .001$) whereas hours spent watching TV were negatively related to perceptions of adult sibling relationship quality ($\beta = -.010, t = -1.95, p = .052$). Because the p-value of hours watching TV was .052, results for the effect of this type of recreation should be interpreted with caution. Playing video games and listening to the radio as an adolescent were not significantly related to adult perceptions of sibling relationship quality. Gender effects, relationship with mother, income and race differences remained significant. Higher quality relationships with mothers were positively related to perceptions of adult sibling relationships ($\beta = .187, t = 8.34, p < .001$) and higher household income was also associated with higher perceptions of adult sibling relationship quality ($\beta = .166, t = 5.42, p < .001$). Males ($\beta = -2.00, t = -14.12, p < .001$) reported lower perceptions of adult sibling relationship quality than females, and White siblings ($\beta = -.575, t = -3.83, p < .001$) also reported lower perceptions of adult sibling relationship quality than African American and other races. Birth order and family size were not significantly related to adult perceptions of sibling relationship quality (see Table 2.3).

**Gender Interactions**

Existing literature on sibling relationships indicates gender may be highly salient in understanding facets of sibling relationships including perceived closeness and conflict, and communication (see Bowerman & Dobash, 1974; Oliva & Arranz, 2005; Whiteman et al., 2011). Gender is also relevant to understanding the types of activities that contribute to relationship building in siblings (Edwards et al., 2006). Mean comparisons of perceived sibling relationship quality and reports of recreation activities revealed there were significant
gender-based differences in all recreation behaviors. Therefore, we examined the interaction effects of gender and adolescent recreation activities on adult perceptions of sibling relationship quality. In spite of the differences in means, none of the gender-recreation interactions was significant.

**Discussion**

The purpose of this study was to examine the relationship between recreation and perceptions of sibling relationship quality. Specifically, this study explored the effects of adolescent technology-based and active recreation on adult perceptions sibling relationship quality. Based on the literature and theory reviewed in this article, we expected that higher levels of technology-based recreation would be negatively related to sibling relationship quality. We also expected that higher levels of active recreation would be positively related to sibling relationship quality.

Not all relationships between recreation variables and sibling relationship quality were as predicted. For example, we hypothesized that similar technology-based recreation behaviors would share directional relationships to sibling relationship quality, yet this was not the case. Similarly, frequency and duration of television viewing only approached statistical significance while watching videos was significantly related to adult perceptions of sibling relationship quality. The difference in statistical significance and directionality for these two behaviors was surprising given that the underlying behaviors of watching TV and watching videos appeared to be the same. The seemingly contradictory results suggested two possibilities: First, instead of being functionally the same, watching TV and watching videos may create distinct processes and outcomes in sibling relationships. The instrument used to
measure these two technology-based recreation activities did not specify with whom the respondent was sharing the activity. This was a limitation of the study and suggested a need for future research to account for differences in shared and individual technology-based recreation behaviors. Second, an index of technology-based recreation that included both behaviors may have been a beneficial analytical approach in understanding sibling relationship outcomes. Future research should consider the construction and use of indices in analyses rather than using only individual items.

Moreover, instead of being negatively associated with perceptions of adult sibling relationship quality, watching videos was related to higher perceptions of adult sibling relationship quality. This contradicted the hypothesis and existing literature that has demonstrated that individual media use (as measured by a combination of watching television and videos, playing video games, and using the Internet) was negatively related to adolescent perceptions of family functioning (Hodge et al., 2012). We expected the same type of relationship to exist for siblings, yet non-significant and opposite relationships were evident instead. Current findings may differ from Hodge et al.’s (2012) findings for three reasons. First, Hodge et al. (2012) used a composite measurement of media use while the current study examined specific behaviors. The differences in measurement and assessment of technology-based recreation behaviors may therefore be one reason for this difference in findings. Second, while both studies were longitudinal, Hodge et al.’s (2012) study spanned one year and one life stage while the current study spanned eight years and the transition from adolescence to adulthood. Therefore, the value of longitudinal research that crosses life stages may be particularly relevant to understanding the relationships between technology-
based recreation behaviors and sibling outcomes—especially since much of existing family leisure research has used cross-sectional data only. Third, the differences in findings may also be attributable to the differences between family relationships. Hodge et al.’s (2012) study examined adolescent-parent relationships while the current study examined sibling relationships. The differences in findings between the two studies may be indicative of different processes in recreation at different subsystems of the family.

The non-significant relationships between playing video or computer games, listening to the radio, and sibling relationship quality also contradicted the hypotheses. A previous study found that as time spent playing video games increased among college students, the quality of their peer and parental relationships decreased (Padilla-Walker, Nelson, Carroll, & Jensen, 2010). We hypothesized a similar relationship would exist between playing video or computer games and perceptions of sibling relationship quality. Therefore, the effect of technology-based recreation on sibling relationships may be different when compared to the effect of technology-based recreation on relationships with their parents. Differences in the sibling relationship were potentially distinct enough from other family relationships that established relationships between some technology-based recreation behaviors were not consistent. It may be that where some technology-based recreation is negatively related to relationships with parents, the same technology-based recreation is positively related to sibling relationship quality. Overall, further examination of the effect of technology-based recreation on sibling relationships is needed to understand variation in sibling relationship outcomes by technology type.
The relationships between active recreation and sibling relationship quality were also somewhat different from the hypotheses. Unstructured physically active recreation like roller-blading and bicycling in adolescence was positively related to adult sibling relationship quality. Exercise, however, was negatively related to perceptions of sibling relationship quality. The negative relationship between exercising in adolescence and adult perceptions of sibling relationship quality was also somewhat unexpected. In general, unstructured physically active recreation like roller-blading or bicycling may create opportunities for siblings to engage in supportive-type behaviors that increase positive sibling relationships attributes (Schinke et al., 2010). Therefore, in this regard, the relationships between active recreation and sibling relationships may resemble what is experienced in other family relationships. For example, parents cited using sports to teach children important moral lessons like sportsmanship, and to teach behavioral expectations (Shaw & Dawson, 2001), which could potentially improve parent-child and other family relationships. Exercising may be a more individual activity that does not contribute to sibling interaction nor does create opportunities for sibling support. Overall, additional research is needed to further address the relationship between physically active recreation and sibling relationship quality.

Limitations

This study had several limitations. A primary limitation to using any type of secondary data was that the Add Health study was not conceptualized with the specific aims of this article in mind. As is true in many cases of using secondary data, the data used in this study were developed with the intent of catering to multiple users. In the current study, the overall fit between the data and the aims was good; however, the conceptualization and
measurement of recreation variables in the data set were not grounded in recreation research or theory. Specifically, some of the categories of recreation activities were not well-defined or delimited, and measurement of physically active recreation was limited. This limitation, however, was addressed by using existing recreation research and theory to establish inclusion criteria for individual survey items. Factor analyses were also used to identify underlying recreation constructs.

Additionally, as noted above, the scope of the Add Health data did not include measure of shared vs. individual recreation. This limited somewhat the understanding of the context of both technology-based and active recreation. As noted in extant family leisure research, shared leisure is related to more positive perceptions of family cohesion, family functioning, satisfaction with family life, and marital satisfaction (Ahlstrom, Lundberg, Zabriskie, & Eggett, 2012; Orthner, 1975; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). Similarly, Hodge et al. (2012) found that while individual media use was negatively related to perceptions of family functioning, shared media use was positively related to perceptions of family functioning. This distinction was not one we were able to make in the current study and future research should endeavor to measure the relationship between both shared and individual recreation and sibling relationship outcomes.

Lack of prior research may have also been a limitation to this study. While there is a growing body of family leisure research, siblings have not been included in those studies except in a few cases. We conducted an extensive literature review encompassing bodies of family leisure and family studies research; however, the hypotheses and conceptual
framework were ultimately informed by a somewhat limited perspective. This has important implications for future research questions, hypotheses and study designs.

**Contributions and Future Research**

This study also made important research contributions. First, the size and scope of the Add Health data increased statistical power and generalizability of the findings. Second, the data were used were longitudinal, meaning we could predict adult sibling relationship quality using adolescent recreation data. This strength was particularly important since this life stage transition from adolescence to adulthood is one that is missing from much of existing research (Conger & Little, 2010), and longitudinal study designs are limited in family leisure research. Future research using longitudinal study designs that span transitions across life-stages may help scholars identify and understand long-term outcomes and impacts of recreation behaviors. Third, the statistical analyses accounted for family-level effects. Scholars have called for more robust analyses of family leisure outcomes and behaviors that account for shared family variance (Poff et al., 2010). Future research should continue to incorporate more robust analyses, especially in data where responses are clustered or grouped in families. Additionally, growth curve modeling could also be a salient analytical approach for future longitudinal research studies. Finally qualitative examinations of the meaning of recreation experiences for siblings may also be an important direction for future research.

Future research should also further examine the relationship between active recreation, specifically sport, and sibling relationships. Previous research has demonstrated that siblings can either deter continued participation in a sport (Fraser-Thomas, Cote, & Deakin, 2008), or encourage participation in afterschool physically active recreation like
sports (Hohepa et al., 2007; Schinke et al., 2010) in adolescence. This study augmented extant knowledge by examining the effect of sport participation on sibling relationships over time; however, differences in the directionality and significance of the active recreation items suggest more research is needed to better clarify the mechanisms driving the effect of sport and physically active recreation on sibling relationships.

Perhaps the most natural next step in this line of research would be to examine the effects of shared vs. individual sibling recreation on sibling. Overall, shared family leisure contributes to enhanced family cohesion, family functioning, satisfaction with family life, and marital satisfaction (Ahlstrom et al., 2012; Orthner, 1975; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). These positive relationships may not exist for siblings in some cases. For example, individual recreation has been shown to decrease perceptions of family functioning among adolescents (Hodge et al., 2012), and has been shown to decrease perceptions of marital satisfaction except when supported by a spouse (Ahlstrom et al., 2012; Orthner, 1975). The findings, however, suggest that some types of individual recreation are related to higher perceptions of sibling relationship quality and may instead support Adler’s theory of individual psychology which suggests that sibling differentiation (i.e., pursuing individual roles and developing different characteristics) may “support the development of more harmonious and less conflictual sibling relationships” (Whiteman et al., 2011, p. 128). Therefore, future research should examine the mechanisms driving the differences in these recreation outcomes across sibling and other family relationships.

Other considerations for future research include additional and continued examination of the effects of technology-based recreation on sibling relationships. For example, siblings
in this study spent an average 23 hours per week in technology-based recreation during adolescence; however, these data were collected in 1994 and 1995, a full decade before social media outlets like Facebook and YouTube were established, and more than a decade before television and videos could be delivered via online streaming. Now, more recent estimates of time adolescents spend with technology indicate that time spent consuming media is more than double the rate of data we used. In fact, adolescents spend approximately 8 hours a day, 7 days a week with some form of media (Rideout et al., 2010). These significant changes in media consumptions may have contextual implications for the relationships observed in this study, as could the media content. Essentially, the effects of technology-based recreation seen in this study could be significantly more substantial for siblings growing up in technology inundated environments.

In conclusion, more research is needed to understand the mechanisms driving the differences in recreation effects on sibling relationships. Differences in expected and actual outcomes suggested technology-based recreation and active recreation may not be related to sibling relationships in the same way they are related to other family relationships, like relationships with parents. Overall, family leisure research has overlooked the sibling relationship, and this study provides a general foundation for beginning to understand the effects of recreation on siblings over time.
References


Downey, D. B. (2001). Number of siblings and intellectual development: The resource


(Eds.), *Handbook of Adolescent Psychology: Contextual influences on adolescent


relationships to prevent adolescent problem behaviors: theory, design and feasibility

Differential accounts of closeness in older adult sibling relationships. *Journal of
Social and Personal Relationships, 14*(6), 843-849.

Fraser-Thomas, J. L., Cote, J., & Deakin, J. (2008). Examining adolescent sport dropout and
prolonged engagement from a developmental perspective. *Journal of Applied Sport

Georgiades, K., Boyle, M. H., Jenkins, J. M., Sanford, M., & Lipman, E. (2008). A
multilevel analysis of whole family functioning using the McMaster Family


Table 2.1 Descriptive Statistics of Sample Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean or %</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Female</td>
<td>51%</td>
<td></td>
</tr>
<tr>
<td>% Male</td>
<td>49%</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% White</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>% African American</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>% Other</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>15.11</td>
<td>1.64</td>
</tr>
<tr>
<td>Living with Two Parents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% living with mother and father</td>
<td>84%</td>
<td></td>
</tr>
<tr>
<td>% not living with mother and father</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>Mother’s Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% less than high school</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>% high school graduate or GED</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>% some college</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>% college graduate</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>% training beyond college</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Family Size</td>
<td>4.99</td>
<td>.869</td>
</tr>
<tr>
<td>Birth Order</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% first born</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>% later-born</td>
<td>69%</td>
<td></td>
</tr>
</tbody>
</table>

Note: n = 2,502
Table 2.2 Individual and Family Variables Predicting Sibling Relationship Quality

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Gender (Males)</td>
<td>-1.73</td>
<td>.133</td>
<td>-12.94</td>
</tr>
<tr>
<td>Birth Order</td>
<td>.128</td>
<td>.144</td>
<td>.96</td>
</tr>
<tr>
<td>Relationship with Father</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Relationship with Mother</td>
<td>.191</td>
<td>.023</td>
<td>8.47</td>
</tr>
<tr>
<td>Race (White)</td>
<td>-.420</td>
<td>.149</td>
<td>-2.82</td>
</tr>
<tr>
<td>Race (African American)</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Race (Other)</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Living with Two Parents</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Random Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>.168</td>
<td>.031</td>
<td>5.44</td>
</tr>
<tr>
<td>Family Size</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Mother’s Education</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

Note: * indicates significant at the p < .05 level; ** indicates significance at the p < .001 level; a indicates cautious interpretation of significance; n.s. = not significant.
Figure 2.1 Mean Technology-based Recreation
Table 2.3 Recreation Variables Predicting Sibling Relationship Quality

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (Males)</td>
<td>-1.94</td>
<td>.145</td>
<td>-13.38</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td>Birth Order</td>
<td>.215</td>
<td>.146</td>
<td>1.48</td>
<td>.140</td>
</tr>
<tr>
<td>Relationship with mother</td>
<td>.188</td>
<td>.022</td>
<td>8.36</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td>Race (White)</td>
<td>-.578</td>
<td>.150</td>
<td>-3.85</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td>Race (Black)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Race (Other)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Watching TV and videos</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Rollerblading or cycling</td>
<td>.214</td>
<td>.072</td>
<td>2.96</td>
<td>.003*</td>
</tr>
<tr>
<td>Active Sport</td>
<td>.225</td>
<td>.065</td>
<td>3.45</td>
<td>.001*</td>
</tr>
<tr>
<td>Exercise</td>
<td>-.143</td>
<td>.066</td>
<td>-2.17</td>
<td>.030*</td>
</tr>
<tr>
<td>Hours watching TV</td>
<td>-.010</td>
<td>.005</td>
<td>-1.95</td>
<td>.052a</td>
</tr>
<tr>
<td>Hours watching videos</td>
<td>.042</td>
<td>.011</td>
<td>3.85</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td>Hours playing video games</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours listening to the radio</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Random Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>.166</td>
<td>.031</td>
<td>5.42</td>
<td>&lt; .001**</td>
</tr>
<tr>
<td>Family Size</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

Note: *indicates significance at the $p < .05$ level; ** indicates significance at the $p < .01$ level; $^a$ indicates cautious interpretation of significance; n.s. indicates non-significance.
CHAPTER 4: SIBLING RELATIONSHIP QUALITY AND BIRTH ORDER AS MODERATORS OF RELATIONSHIPS BETWEEN ADOLESCENT RECREATION AND ADULT HEALTH OUTCOMES

Abstract

The purpose of this study is to examine the relationships between adolescent recreation patterns and adult physical activity and BMI. We also examine birth order and sibling relationship quality as moderators of the relationships between recreation and adult physical activity and BMI. Using sibling pairs data from the National Longitudinal Study of Adolescent Health, findings suggest some types of adolescent technology-based recreation and some types of active recreation are significantly related to adult physical activity and BMI. Findings also suggest birth order and sibling relationship quality moderate some relationships between adolescent recreation behaviors and adult physical activity and BMI. These findings partially support tenets of the social learning theory. Firstborn siblings may act as social models for physical activity and obesity.

Keywords: physical activity, technology, obesity, active recreation, family leisure
Sibling Relationship Quality and Birth Order as Moderators of Relationships between Adolescent Recreation and Adult Health Outcomes

Promoting behaviors that contribute to physical health and well-being is a growing social concern. Families are a primary context for learning and acquiring health behaviors, and parents especially are considered to be social learning models who transmit behaviors and attitudes about physical activity (Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2007) as well as preferences for activities and behaviors that may contribute to obesity (Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001). Likewise some research has identified siblings as social learning models and has linked sibling influences to individual social adjustment, delinquent behaviors (East, 2009), and in certain cases, physical activity (Cleland et al., 2011; Duncan, Duncan, Strycker, & Chaumeton, 2004). Research has suggested relationship warmth, perceived competence, and power of the model significantly contribute to the salience of a social model (Whiteman, McHale, & Soli, 2011). Sibling relationship quality as an indicator of relationship warmth, and birth order as an indicator of the power of a model may, therefore, influence health behaviors and outcomes such as participation in physical activity (Duncan et al., 2004; Hohepa et al., 2007) and obesity (Pachucki, Lovenheim, & Harding, 2012). These potential moderating effects of sibling relationship quality and birth order, however, have been unexamined.

Therefore, the purpose of this study was to examine the relationship between adolescent recreation patterns (i.e., technology-based vs. active recreation) and adult physical activity and BMI in sibling pairs. Second, this study examined whether birth order and sibling relationship quality moderated the relationships between adolescent recreation and
adult physical activity and BMI. Testing these interaction effects allowed for the examination of social learning theory as a mechanism for explaining sibling relationships and outcomes.

**Review of Literature**

**Social Learning Theory**

Social learning theory was used to frame this study. Social learning theory suggests that modeling behavior (i.e., learning by observing) and reinforcement are the primary mechanisms driving adoption and implementation of novel behavior (East, 2009; McHale, Updegraff, & Whiteman, 2013). While parents are generally the most influential social models and have the greatest effect on children’s adaptation of social behaviors, siblings also act as mechanisms of social learning (Whiteman et al., 2011). The saliency of a specific social model depends on the quality of the relationship between family members; family members who are perceived as competent, powerful, and loving are more likely to be models for behavior (Whiteman, McHale, & Crouter, 2007; Whiteman et al., 2011). The qualities of competency and power suggest that older siblings may be more likely to serve as models than younger siblings, and the larger the age gap, the more status or power as a model an older sibling may have (Whiteman et al., 2011). Similarly, the more loving a sibling relationship is perceived to be, the more likely a social model will be salient (Whiteman et al., 2007).

Social learning theory has been used to explain sibling relationships and outcomes in childhood and adolescent development including why siblings share a propensity for risk-taking behaviors or substance use (East, 2009). For example, second-born siblings who reported high levels of sibling influence were more likely to resemble their older siblings in
risky behaviors (Whiteman et al., 2007). Social learning theory has also been used to examine the potential for siblings to act as socializing agents in academic settings (East, 2009). For example, older siblings’ academic engagement was predictive of younger siblings’ levels of academic adjustment (Bouchey, Shoulberg, Jodl, & Eccles, 2010). Social learning theory was also used to explain similarities in sibling mental health outcomes (Vogt Yuan, 2009). It has not been used to examine specific recreation behaviors among siblings, though some research has applied social learning theory to understanding siblings’ social competencies and interests and ability levels in sports and arts (Whiteman et al., 2007). Whiteman and colleagues’ (2007) examination of interests and ability levels in various types of recreation was not, however, connected to adult outcomes such as physical activity or obesity. Therefore, the current study applied social learning theory to understanding adolescent recreation behaviors, and adult physical activity and obesity in sibling pairs.

**Sibling Health Behaviors and Outcomes**

Sibling relationships as some of the longest-lasting and most stable across the lifespan (Cicirelli, 1994; Whiteman et al., 2011), and as social models, may significantly influence individual health behaviors like physical activity and health outcomes like obesity.

**Physical activity.** Physical activity can considerably impact health outcomes and quality of life and may be influenced by sibling relationships. In their systematic review of physical activity research among children and adolescents, Janssen and LeBlanc (2010) noted physical activity was commonly used as a treatment for negative health outcomes and was associated with improved health outcomes including reduced levels of cholesterol and blood lipids, lower blood pressure, less instances of obesity or overweight, and greater bone
density. Improving childhood and adolescent health through consistent physical activity could have significant implications for adult physical health. Specifically, children and adolescents who consistently participate in sport or other types of physical activity may be more likely to maintain higher levels of physical activity as adults (Kraut, Melamed, Gofer, & Froom, 2003; Tammelin, Näyhä, Hills, & Järvelin, 2003; Telama et al., 2005).

Siblings may promote continuous or increased physical activity. For example, in a cross-sectional examination of family support for adolescent physical activity, parental and sibling support were both significant predictors of increased physical activity after-school and during lunchtime throughout the school year (Hohepa et al., 2007). Higher levels of parental and sibling support were predictive of higher levels of after-school physical activity among students in years 9-11 of high school, (Hohepa et al., 2007). This study, however, examined adolescent siblings only. Another study used multilevel analyses and found that levels of physical activity varied across families, and siblings’ levels of physical activity are similar (Duncan et al., 2004). While Duncan and colleagues did not examine the effects of sibling physical activity longitudinally, an Australian study assessed physical activity in families over time using survey and accelerometer data (Cleland et al., 2011). In that study, sibling co-participation in physical activity predicted weekend moderate-to-vigorous physical activity (MVPA) levels in young girls over time (Cleland, et al., 2011). These studies, however, examined only adolescent siblings. Physical activity patterns in adult siblings remain to be examined.

**Obesity.** Obesity is another aspect of physical health and well-being that siblings as sources of social learning and social support may influence considerably. The family
contexts and relationships that affect obesity are complex, and siblings may play a role in shaping behaviors and attitudes that contribute to or prevent obesity. Both genetic and environmental influences have been identified as major contributors to obesity patterns in families (Sørensen, Price, Stunkard, & Schulsinger, 1989). Biological siblings share genetic factors that may contribute to obesity, and siblings raised in the same household also share same environmental factors which may contribute to obesity. In a study of full siblings who had been raised separately because of adoption, the BMI of siblings increased with the overweight and obesity of the adoptees (Sørensen et al., 1989). In other words, despite being raised in different environments and by different parents, full siblings were highly similar in their levels of obesity and overweight, suggesting genetic influences are highly predictive of obesity among siblings. Another study suggested an obese sibling—especially an older, same-gender sibling—was a stronger predictor of individual obesity than parent obesity (Pachucki et al., 2012). Their findings suggested siblings models may be more predictive of individual obesity than parental models. Researchers used the social learning theory to explain this relationship; however, they did not account for the potential moderating effects of relationship quality such as warmth and perceived competence that dictate the salience of a social model. Therefore, the current study examined these potential moderating effects.

**The Interaction of Recreation, Sibling Relationships, and Physical Health**

Like family relationships and contexts, recreation and free time behaviors may also have significant effects on health behaviors. Two types of recreation were examined in this study: technology-based recreation and active recreation.
Technology-based recreation. Technology has become a mainstay of family and youth leisure and recreation (Brock, 2002; Daly, 1996; Rideout, Foehr, & Roberts, 2010), and can affect both relationship quality and physical health behaviors and outcomes. Research has examined the effects of technology use on obesity in children and adults more extensively (Boone & Gordon-Larsen, 2007; Robinson & Godbey, 1999; Tucker & Friedman, 1989). Generally a positive correlation exists between the amount of time spent watching television and being overweight or obese in various age populations (Caroli, Argentieri, Cardone, & Masi, 2004). Additional research has found that individuals who were classified as high leisure-time Internet and computer users were 1.46 times more likely to be overweight, and 2.52 times more likely to be obese when compared to individuals who reported no Internet or computer use (Vandelanotte, Sugiyama, Gardiner, & Owen, 2009). This trend held among adults who were otherwise highly active in their leisure time. Scholars have examined this trend from an individual perspective using data from the National Longitudinal Study of Adolescent Health, and suggested that reducing media use may be effective in reducing the likelihood of obesity especially among females (Boone & Gordon-Larsen, 2007). However, these outcomes were not examined from a sibling perspective.

Active recreation. In contrast to generally high participation in technology-based recreation, fewer people regularly engage in physically active recreation (Russell, 2009) even though active recreation has high social value (Tsai & Coleman, 2009) and may have substantial effects on health outcomes. Active recreation includes leisure time physical activity such as exercising or playing competitive or social sports (Tsai & Coleman, 2009). Sport is particularly pervasive among adolescents (Papacharisis, Goudas, Danish, &
Theodorakis, 2005) with more than half of American youth between the ages of 10 and 17 years enrolled in at least one organized sport team (National Survey of Children’s Health, 2005). Continuous adolescent sport participation has been linked to higher levels of physical activity in adulthood (Kraut et al., 2003; Tammelin et al., 2003; Telama et al., 2005), and social support from family was an important predictor of physical activity and sport participation among children and adolescents (Hohepa et al., 2007).

Sports, with their high levels of adolescent participation, represent a prime area for sibling research. For example, in a qualitative examination of the role of family members in supporting youth sports participation, siblings provided encouragement and commitment, and acted as role models and mentors (Schinke et al., 2010). Sport among siblings, however, may also lead to rivalry when siblings share sports or other recreation activities (Whiteman et al., 2011). Sibling rivalry if intense or prolonged can negatively affect individual adjustment, outcomes, and well-being (Cote & Hay, 2002; East, 2009). Sibling rivalry may also undermine the potential for siblings to model healthy behavior. Therefore, understanding the effect of sports and other active recreation on physical health among siblings may be contingent upon understanding the relationship between sports and sibling relationship quality. This understanding is important as practitioners, policymakers, and families themselves consider the most effective ways to promote healthy behaviors in children and adults.

Sibling relationships. Families use leisure and recreation to facilitate family bonding and develop and maintain their relationships (Orthner & Mancini, 1990). Family leisure has been shown to contribute to increased family cohesion, family life satisfaction, and family
functioning (Agate, Zabriskie, Agate, & Poff, 2009; Holman & Epperson, 1984; Mactavish & Schleien, 2004; Orthner & Mancini, 1990; Poff, Zabriskie, & Townsend, 2010; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). Research in an unpublished dissertation also showed that some types of recreation are related to higher perceptions of sibling relationship quality that may make social models more salient (Hodge, 2014). Therefore, recreation among siblings could foster positive relationships that in turn increase the potential of siblings becoming salient social models. Positive sibling relationships have also been shown to be an important source of support in childhood and adolescence (Gass, Jenkins, & Dunn, 2007). This support may promote recreation that contributes to positive health behaviors and outcomes such as physical activity and reduced obesity.

A large gap in sibling relationship research spans the transition from adolescence to adulthood (Conger & Little, 2010). Further research examining this gap is critical because the tasks associated with the transition to adulthood often create, and even necessitate, changes in sibling relationships. These changes have implications for sibling interactions and influences over time and may provide insight into what creates strong and successful sibling relationships (Kramer, 2010). Furthermore, understanding this life stage may also provide insight into understanding how siblings can support and promote healthy behavior in adulthood.

Overall, the relationship between adolescent recreation behaviors and adult physical activity and obesity among siblings needs more examination, specifically in understanding how the social learning theory and siblings as social models may play a role. Existing research examining the effects of siblings on positive health behaviors and outcomes has
focused on siblings in adolescence and older adulthood. Similarly, this research has been limited to cross-sectional examinations of specific life stages among siblings. More longitudinal research examining the importance of sibling relationships and their effect on individual health behaviors is needed, and more attention to life stages such as early adulthood and transitions between life stages is also needed.

Based on this literature, the purpose of the current study was to examine the effect of adolescent technology-based and active recreation on adult physical activity and obesity as assessed in terms of BMI. Additionally, we examined whether birth order and sibling relationship quality as part of the social learning theory moderated the relationships between adolescent recreation and adult physical activity and BMI. We hypothesized that higher levels of adolescent technology-based recreation would predict lower levels of adult physical activity and higher adult BMI. Similarly, we hypothesized that higher levels of active recreation in adolescence would predict higher levels of adult physical activity and lower levels of adult BMI. Furthermore, we hypothesized birth order and sibling relationship quality would also have a significant effect on adult physical activity and obesity. Finally, we hypothesized that birth order and sibling relationship quality would moderate the relationships between adolescent recreation and adult physical activity and BMI, changing the strength or direction of those relationships.

**Methods**

**Data and Sample**

Data from the National Longitudinal Study of Adolescent Health (Add Health) in-home interview sample (Waves 1 and 3) were used to examine the effects of adolescent
recreation and sibling relationships on adult physical activity and obesity. Add Health comprises a nationally representative longitudinal study of adolescents in the US (Harris et al., 2009). This study includes longitudinal data on respondents’ social, economic, psychological, and physical well-being and development. Researchers also gathered environmental data such as neighborhood and school characteristics, and parent, sibling, and romantic partner data were also collected. Participants were selected for the first wave, in-school sample ($n = 90,118$) from a stratified random sample of 80 nationally representative high schools in the United States and were enrolled in grades 7 through 12 at baseline (Harris et al., 2009). A smaller sample was drawn from the in-school sample to participate in the in-home interview ($n = 12,105$). The first wave of data collection (Wave 1) occurred in 1994-5. Wave 3 data were collected in 2002.

We used a sibling pairs subsample drawn from Waves 1 and 3 to examine the effect of recreation and sibling relationship quality on adult physical health behaviors and outcomes. The sibling pairs subsample consisted of respondents who were from the same family and who participated in the in-home interview. Sibling pairs were identified by sibling relationship type (e.g., full, half, non-related) and gender (e.g., male-male, male-female, or female-female). We limited the cases used in the current study to full sibling (FS) pairs, and pairs in which one of the respondents was a firstborn child ($n_{pairs} = 561$, $n_{respondents} = 1,122$). Limiting sibling type helped contain variance in perceptions of relationship quality to one specific relationship type. Furthermore, delimiting the sample to only sibling pairs in which one sibling was a firstborn allowed testing some tenets of the social learning theory, specifically the interaction effects of birth order sibling relationships on health behaviors and
outcomes. According to the social learning theory, social models are generally perceived as powerful, competent, and loving (Whiteman et al., 2011), and therefore firstborn siblings, or older siblings, are more likely to be perceived as social models than later-born siblings.

**Instrumentation**

The two dependent variables of interest were body mass index (BMI), which was used to estimate obesity in the sample, and physical activity in adulthood. Independent variables included both individual- (fixed effects) and family-level (random effects) factors including self-report of adolescent recreation, sibling relationship quality, and various demographic and socioeconomic indicators.

**Physical activity.** Eight items measuring adult physical activity were identified in the Health & Diet section and the Daily Activities section of Wave 3. These items asked participants to estimate how many times per week (a) they went to an exercise or fitness center to work out, (b) walked for exercise, (c) bicycled, skateboarded, danced, hiked, or hunted, (d) roller-bladed, roller-skated, downhill-skied, snowboarded, played racquet sports, or did aerobics, (e) played a strenuous sport, (f) played an individual sport, (g) participated in strength training, gymnastics, or weight lifting, and (h) golfed, hunted, bowled, fished, or played softball or baseball. Responses ranged from 0 (“not at all”) to 7 (“7 or more times”). Maximum likelihood factor analysis revealed seven of the eight items loaded on a single factor. Reliability tests supported the creation of a scale or index variable composed of seven items ($\alpha = .734 > .65$). This index served as the adult (Wave 3) measure of physical activity.

**Obesity.** Measures of height in feet and inches, and weight in pounds were measured at Wave 3. Height and weight were used to calculate BMI for both waves. BMI served as an
indicator of obesity in adulthood. BMI-based weight-status categories were established using the Centers for Disease Control (CDC) recommendations. These categories suggested BMI less than 18.5 was considered underweight, BMI between 18.5 and 24.9 was considered normal weight, BMI between 25.0 and 29.9 was considered overweight, and BMI greater than 30 was considered obese. These categories were used to describe the sample while the continuous-level measurement of BMI was used in the multilevel models.

Technology-based recreation. Wave 1 in-home interview data included items measuring technology-based recreation in terms of frequency and duration. These items included (a) a general estimation of frequency of technology use (e.g., “during the past week, how many times did you watch television or videos, or play video games”), (b) estimations of hours per week watching television, (c) watching video, and (d) playing video or computer games. Exploratory factor analyses showed all four items in Wave 1 loading on an individual factor; however, reliability was relatively poor ($\alpha = .573 < .65$). Therefore, individual items were used in the model rather than a scale variable.

Active recreation. Also included in the daily activities section of the Wave 1 in-home interview data were items assessing physically active forms of recreation. These items assessed during the last week: (a) “how many times did you go roller-blading, roller-skating, skate-boarding, or bicycling?” (b) “how many times did you play an active sport, such as baseball, softball, basketball, soccer, swimming or football?” and (c) “how many times did you do exercise, such as jogging, walking, karate, jumping rope, gymnastics or dancing?” These items were coded from 0 (“not at all”) to 3 (“5 or more times”). The items did not load
in an exploratory factor analysis and a reliability assessment of them was $\alpha = .411$, which is unacceptably low. Therefore, these items were assessed individually.

**Sibling relationship quality.** Wave 3 Add Health in-home interviews assessed several facets of sibling relationships including (a) how often respondents felt love for their sibling, (b) how much time they spent together, (c) how many interests and goals they shared, (d) how close they felt, (e) how often they turned to their sibling for help, (f) how often they fought or quarreled, (g) how often they saw each other, and (h) how frequently they communicated over the phone. Maximum likelihood factor analysis revealed five of the eight items addressing sibling relationships loaded on a single factor. Reliability tests of these items supported the creation of a scale or index variable ($\alpha = .741 > .65$). Therefore, we calculated an index of sibling relationship based on five items: (a) how close respondents felt to their siblings, (b) how often respondents asked their siblings for help, (c) how many interest and goals they shared, (d) how often they spoke on the phone, and (e) how often they saw each other. This index served as the Wave 3 measure of sibling relationship quality. Perceptions of sibling relationship quality was included in the models as an individual-level, or fixed effect factor.

**Individual level covariates.** Five individual level covariates were assessed. Birth order (firstborn vs. later-born), gender, race, living with mother and father, and age were included in the models as predictors of physical activity and obesity. Birth order was of particular interest to this study because it allowed testing of moderating effects.
**Family level covariates.** The following variables were included as family-level covariates in the analyses to provide potential controlling factors and identify primary characteristics of the sample: mother’s education, income, and family size.

**Missing Data**

Even among the delimited and specific subsample of full siblings pairs with one firstborn sibling, several variables had missing data. For these variables, we used a multiple imputation procedure in SAS to augment the missing data (Allison, 2002). The multiple imputation procedure completed otherwise incomplete data sets such as Add Health by using a “sequential chain of data augmentation” (Parcel, Campbell, & Zhong, 2012, p. 170). Missing data values were replaced based on sets of probable values that incorporate uncertainty about the imputed values (Rubin, 1976). These probable values were generated through iterative simulations of regression models, or imputations (Little & Rubin, 2002). In this study, five imputations were used to predict and replace missing data with appropriate estimates and standard errors. Those estimates were then pooled to create valid and generalizable statistical models and supportable conclusions (Allison, 2002; Parcel et al., 2012). These procedures were in line with those used among other large, secondary datasets (see Parcel et al., 2012).

**Analyses**

Data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 19.0 and SAS 9.3. Data were first examined to identify and select pairs of full-sibling cases in which one respondent was a firstborn child. These data were then assessed for normality, and descriptive statistics were analyzed. After constructing scale variables using factor
analyses and testing reliability as described in the previous section, we assessed relationships between key study variables using correlations. Specifically, we examined the relationships between individual- and family-level covariates, adolescent recreation behaviors, sibling relationship quality, adult BMI, and adult physical activity levels.

An underlying assumption of this study was that sibling recreation behaviors, physical activity, and BMI would correlate. We assumed that because siblings shared both observed and unobserved family contextual factors, their responses would not be independent. To account for this, we estimated a series of multilevel models. Multilevel models allow responses to correlate, and allowed isolating the variance explained by shared family-level influences as well as the individual-level influences. Therefore, a series of multilevel models were estimated. First, we estimated the unconditional means models for both adult physical activity and BMI. Unconditional means models are the most basic multilevel models and approximate a one-way ANOVA with random effects. These unconditional means models enabled the determination of how much variance in mean adult physical activity and BMI levels was explained by family grouping effects. Second, we estimated models first examining the relationship of individual- and family-level covariates on adult (Wave 3) physical activity and BMI, and then estimated models examining also the relationships between adolescent (Wave 1) recreation behaviors and adult (Wave 3) physical activity and BMI respectively. Third, we tested for birth order and sibling relationship interaction effects between adolescent recreation behaviors and adult physical activity and BMI. Testing interaction effects allowed us to estimate how the independent variable (recreation) varied with the dependent variables (i.e., physical activity and BMI) varied as a
function of additional independent variables (i.e., birth order and sibling relationship quality independently; Gravelle, 2012).

**Results**

Multilevel models suggested that some recreation behaviors in adolescence had a significant effect on adult physical activity and BMI. Moreover, results from multilevel models suggested that birth order and sibling relationship quality moderated the strength and direction of some of those relationships.

When examining the sample of full sibling at Wave 1, a slight majority of respondents in the sibling pairs subsample were female ($n = 562, 50.1\%$). Respondents reported a mean age of 15.1 years ($SD = 1.50$), with the youngest reported age being 12 years old and the oldest being 19 years old. Most respondents self-identified as White ($n = 681, 61\%$). Twelve percent ($n = 137$) self-identified as African American, and 27% ($n = 304$) self-identified as a race other than White or African American. Most lived with both their mother and father ($n = 965, 86\%$). Eighty-six mothers (8%) had less than a high school education, and nearly five times that ($n = 436, 39\%$) had graduated from high school or earned a GED. Slightly more than one-fourth of mothers ($n = 319, 28\%$) had some college and 206 (18%) had earned a college degree. A small percentage ($n = 74, 7\%$) had professional training beyond a college or university degree. Mean family size was 4.81 ($SD = .89$) people per household with a range of 1 to 7 people per household. For a summary of sample characteristics, see Table 3.1.

When examining adolescent recreation behaviors, respondents appeared to engage in technology-based recreation more frequently than physically active recreation. Specifically at
Wave 1, respondents reported watching an average of 15.3 ($SD = 14.8$) hours of television and 4.2 ($SD = 6.6$) hours of videos each week. Additionally, respondents reported spending an average of 3.1 ($SD = 6.7$) hours playing computer or video games each week. In sum, respondents spent 22.6 hours a week engaged in some form of technology-based recreation. In examining patterns of physically active recreation, 60% ($n = 675$) respondents reported not having engaged in rollerblading or cycling in the previous week, nearly one-quarter ($n = 266$, 24%) had engaged in rollerblading or cycling once or twice in the previous week, and only 16% ($n = 181$) had engaged in rollerblading or cycling more than three times in the previous week. Less than one-fourth of respondents ($n = 261$, 23%) had not played an active sport like baseball, softball, basketball, soccer, swimming, or football in the past week, 29% ($n = 320$) reported playing an active sport once or twice in the past week, and almost half ($n = 541$, 49%) reported playing an active sport more than three times in the past week. More than half of respondents ($n = 615$, 54%) reported engaging in exercise like jogging, walking, jumping rope, karate, gymnastics, or dancing three or more times in the past week, 30% ($n = 337$) reported exercising once or twice in the past week, and 15% ($n = 170$) reported no exercise in the past week.

The average adult (Wave 3) BMI for female respondents was 25.6 ($SD = 6.19$) and the average adult (Wave 3) BMI for male respondents was 26.1 ($SD = 5.53$). Frequency distributions of CDC weight categories showed nearly half ($n = 550$, 49%) of all respondents were in the normal weight range with a BMI between 18.5 and 24.9, and four percent ($n = 43$) were underweight. Slightly more than a quarter of respondents ($n = 313$, 28%) were
considered overweight with a BMI between 25.0 and 29.9, and 215 (19%) were considered obese with a BMI greater than 30 (see Figure 3.1).

**Physical activity.** We estimated initial unconditional means models to examine the intraclass correlation coefficient (ICC). The ICC describes how strongly reports of physical activity from individuals in the same family resembled each other. It is based on the ratio of between-family variation and the total variation \[ \frac{\text{var(family)}}{\text{var(family)+var(residual))}} \] (Georgiades et al., 2008). In this model, the ICC was 14.0%, meaning slightly more than one-tenth of the variance in adult physical activity levels was explained by family grouping effects.

When estimating a model containing adolescent (Wave 1) individual- and family-level covariates predicting adult (Wave 3) physical activity, gender, birth order, and sibling relationship quality were significant at the \( p = .05 \) level, while age and race were not significant. When considering gender, male siblings reported higher levels of adult physical activity (\( \beta = 3.47, t = 8.03, p < .001 \)) than female siblings and firstborn siblings reported lower levels of adult physical activity than later-borns (\( \beta = -1.05, t = -2.19, p = .03 \)). Of the family-level covariates, family size was a significant predictor of adult physical activity, while mother’s education and household income were not. Family size was positively related to adult levels of physical activity (\( \beta = .47, t = 2.17, p < .03 \)). Non-significant covariates were dropped from future models. For a complete summary of these statistics, see Table 3.2.

Adolescent recreation variables were added to the subsequent model and two of the seven variables were significant predictors of adult physical activity: (1) frequency of watching television and videos (\( \beta = -1.137, t = -4.49, p < .001 \)), and (2) playing an active
sport ($\beta = 1.37, t = 6.59, p < .001$). Other measures of technology-based recreation were not significantly related to adult physical activity. Similarly some measures of adolescent active recreation were not significantly related to adult physical activity levels (see Table 3.3).

Next, the moderating effects of birth order on the relationship between adolescent recreation and adult physical activity were tested. Significant interaction effects were found for birth order and hours playing video or computer games. For first-born siblings, there was a negative relationship between hours playing video games or computer games as an adolescent and adult physical activity ($\beta = -.210, t = -3.56, p < .001$). Adult physical activity was lower for first-born siblings than for later-born siblings when hours of video or computer game playing were held constant. No other birth order interaction effects were significant (see Table 3.4).

In the final model, we examined the moderating effects of sibling relationship quality on the relationship between adolescent recreation and adult physical activity. Perceptions of sibling relationship quality appeared to moderate the relationship between adult physical activity and three adolescent recreation variables: (1) hours watching TV, (2) hours watching videos, and (3) hours playing video or computer games. Sibling relationship quality appeared to moderate the relationship between hours watching TV in adolescence and adult physical activity ($\beta = -.011, t = -2.28, p = .02$), and appeared to reduce the size of the negative relationship between watching TV in adolescence and adult physical activity. Similarly, sibling relationship quality appeared to change the relationship between hours watching videos in adolescence and adult physical activity ($\beta = .033, t = 3.25, p = .001$). Finally, sibling relationship quality changed the relationship between hours playing video or
computer games in adolescence and adult physical activity ($\beta = .016, t = 2.27, p = .023$). For a summary of these statistics, see Table 3.5.

**Obesity.** The unconditional means model predicting adult BMI indicated the ICC was 41.3% with nearly half of the variance in adult BMI being explained by family-level grouping effects. When estimating a model containing adolescent (Wave 1) individual- and family-level covariates predicting adult (Wave 3) BMI, race was significant at the $p = .05$ level, and age, birth order, and sibling relationship quality were not significant. When considering race, respondents who self-identified as White reported significantly lower adult BMI ($\beta = -1.22, t = -3.14, p < .05$) than other races. Similarly, respondents who self-identified as African American reported significantly lower levels of adult BMI ($\beta = -1.22, t = -2.06, p < .05$) than other races. No family-level covariates were significant predictors of adult obesity (see Table 3.2). Non-significant covariates were dropped from future models with the exception of gender, birth order and sibling relationship quality, which were maintained to test for potential moderating effects.

Adolescent recreation variables were added to the subsequent model and three of the seven variables were significant predictors of adult BMI: (1) frequency of watching television and videos during the week ($\beta = -.711, t = -3.41, p < .05$), (2) frequency of rollerblading or bicycling ($\beta = -.520, t = -2.81, p < .05$), and (3) hours watching TV ($\beta = .044, t = 3.04, p < .05$). Other measures of technology-based recreation including reports of hours spent playing video games, hours watching videos, and hours listening to the radio were not significantly related to adult BMI. Similarly some measures of adolescent active
recreation such as exercising and playing an active sport were not significantly related to adult BMI (see Table 3.3).

Next, we tested the moderating effects of birth order on the relationship between adolescent recreation and adult BMI. Birth order had a significant moderating effect on the relationship between playing an active sport as an adolescent and adult BMI for firstborn siblings. This moderating effect demonstrated that for firstborn siblings, playing an active sport had a positive relationship to adult BMI ($\beta = 1.01$, $t = 3.04$, $p < .05$), meaning playing sports in adolescence was a predictor of higher adult BMI for firstborns. This relationship between playing an active sport as an adolescent and adult BMI was not evident until the moderating effect of birth order was accounted for. For later-born siblings, this same relationship was not significant. Birth order also moderated the relationship between exercising in adolescence and adult BMI. For firstborn siblings, exercising was negatively related to adult BMI ($\beta = -.765$, $t = -2.21$, $p < .05$), meaning firstborn siblings were more likely to have lower adult BMIs than later-born siblings (see Table 3.4).

Finally, we examined the moderating effects of sibling relationships quality on the relationship between adolescent recreation and adult BMI. Perceptions of sibling relationship quality did not moderate any relationships between adult BMI and two adolescent recreation variables (see Table 3.5).

**Discussion**

The purpose of this study was to first, examine effect of adolescent recreation patterns (technology-based vs. active recreation) on adult physical activity and BMI while accounting for data clustering in families. Second, we examined whether birth order and sibling
relationship quality moderated the relationships between adolescent recreation and adult physical activity and BMI. Overall, some adolescent recreation patterns were significantly related to adult physical activity and BMI, and some of those relationships were in the hypothesized direction. Similarly, birth order and sibling relationship quality acted as significant moderators of the relationships between some adolescent recreation and adult physical activity and BMI.

The hypothesis that technology-based recreation would be related to poorer lower levels of adult physical activity and higher levels of adult BMI was partially supported. Not all adolescent technology-based recreation behaviors were significantly related to adult physical activity and BMI, and only some of them followed hypothesized relationship directions. For example, frequency of watching television and videos in adolescence was related to lower levels of adult physical activity as was expected, and hours watching television in adolescence were related to higher adult BMI which also supported the hypotheses. Both findings were also supported by previous research. For example, several longitudinal studies have demonstrated a significant relationship between the time children and adolescents spend watching television and increased overweight and obesity (Caroli et al., 2004). One finding from this study was inconsistent with previous research and hypotheses. Specifically, frequency of watching television and videos in adolescence was related to lower levels of adult BMI. The difference between previous studies and current findings may be attributable to the difference in measurement of duration of TV viewing (i.e., time spent viewing) and frequency (i.e., number of days per week). More research
examining the potential nuanced differences between frequency or duration of TV watching and frequency may help better frame this finding.

The hypothesis that active recreation would predict higher levels of physical activity and lower levels of obesity was also partially supported. Only one of the active recreation items was significantly related to physical activity, and only one was related to BMI. Playing an active sport as an adolescent was related to higher levels of adult physical activity, and frequency of rollerblading or bicycling was associated with lower BMI. These findings were consistent with the hypotheses that adolescent active recreation would be related to higher physical activity and lower BMI in adulthood, and findings were also consistent with existing research. For example, researchers have demonstrated that children and adolescents who consistently participated in sport or other types of physical activity were more likely to maintain higher levels of physical activity as adults (Kraut et al., 2003; Tammelin et al., 2003; Telama et al., 2005). Similarly, previous research has demonstrated that higher levels of physical activity in adolescence and adulthood contributed to lower BMI and obesity in adulthood (Janssen & LeBlanc, 2010). Overall, these findings supported the hypotheses and previous research.

Significant interaction effects between birth order and recreation variables provide some tentative support for siblings as social models. As an independent indicator variable, birth order was negatively related to physical activity for firstborns, meaning firstborn siblings had lower overall levels of adult physical activity than later born siblings. Birth order was not related to BMI. As a moderator variable, however, birth order was significant when predicting both physical activity and BMI. When examining physical activity, significant
interaction effects between birth order and hours playing video or computer games suggested that when hours of video or computer game play were held constant, firstborn siblings were significantly less physically active than later-born siblings. As an independent indicator variable, playing video or computer games in adolescence was positively related to adult physical activity; however, for firstborn siblings this relationship was reversed. Based on the social learning theory, we hypothesized that firstborn siblings would promote healthier behaviors and outcomes among later-born or younger siblings. It would seem that in this case, firstborn siblings may not have been acting as social models, and instead, later-born siblings’ physical activity behaviors were independent of and significantly different from their firstborn siblings. Davies and Gentile (2012) found that presence of siblings increased participation in non-screen-based media activities. Current findings suggested later-born siblings may have benefitted from having a sibling whereas firstborn siblings may not be experiencing the same benefits.

Birth order also moderated the relationship between playing an active sport in adolescence and adult BMI, and the relationship between exercising in adolescence and adult BMI. When levels of playing an active sport in adolescence were held constant, firstborn siblings reported significantly higher adult BMI than later-born siblings. Interestingly, the relationship between playing an active sport as an adolescent and adult BMI was not evident until the moderating effect of birth order was added to the model. When the moderating effect of birth order was included, playing an active sport as an independent predictor of BMI was negatively related to BMI. Thus, playing an active sport in adolescence was related to lower adult BMI as suggested by existing literature and as was hypothesized in the current
study. The birth order interaction effect, however, demonstrated the relationship between playing an active sport in adolescence and adult BMI were not consistent for firstborn and later-born siblings. This change in the relationship contradicted the hypotheses and extant literature demonstrating a relationship between higher physical activity and lower levels of obesity (of which BMI is an indicator). A recent systematic review of physical activity as an obesity prevention mechanism in children, adolescent, and adults suggested that physical activity may actually have little no effect on change in adiposity, or the measure of body fat (Wilks, Besson, Lindroos, & Ekelund, 2011). Wilks and colleagues (2011) suggested that energy intake rather than energy expenditure through physical activity may be a more important driver of changes in overweight and obesity. Therefore, current findings may be somewhat limited by using only BMI as a measure of obesity. Using additional measures such as waist circumference and accounting for dietary considerations in future research may help clarify these relationships.

Like playing an active sport, the relationship between exercise in adolescence and adult BMI was also dependent on birth order. In this case, when levels of exercising in adolescence were held constant, firstborn siblings reported significantly lower levels of adult BMI than later-born siblings. This finding suggests firstborn siblings may have experienced increased benefits from exercise than did later-born siblings. This difference in birth order effects regarding exercising in adolescence and adult BMI, may support the resource dilution model rather than social learning. The resource dilution model has demonstrated that in context of academic achievement and cognitive and intellectual development, firstborn siblings are advantaged over later-born siblings (Downey, 2001). The resource dilution
model suggests that siblings act as competitors for parents’ finite resources (e.g., the necessities of life, personal attention and teaching, and opportunities; Blake, 1981). Thus, as family size increases (i.e., as more siblings enter the family), there are fewer resources to be shared, and firstborn siblings are advantaged because they spent at least some portion of time as the sole consumer of parental resources. Therefore, understanding the role of resources in sibling recreation and more broadly family recreation, may be a direction for future research, especially as scholars continue to examine health outcomes associated with recreation in families.

The mixed interaction effects of birth order as a predictor of BMI may be related to one of the limitations of this study which was using BMI as the only indicator of obesity. Waist circumference as a measure of obesity has been shown to be more sensitive than BMI and one of the best predictors of metabolic syndrome (Bener et al., 2013). Similarly, including waist circumference and BMI when assessing health risks is more predictive than BMI alone (Janssen, Katzmarzyk, & Ross, 2004). Thus, while BMI is an accepted indicator of obesity, without additional measures of obesity such as waist circumference, the current study and findings may be missing some important information since playing an active sport could increase weight because of increased muscle mass and not necessarily increased body fat. Future research could incorporate additional measure of obesity to better understand this relationship. Overall, the evident birth-order interaction effects evident in predicting adult physical activity and BMI partially supported the hypotheses. Findings suggest there were birth order differences in some of the relationships between technology-based and active recreation, and physical activity and obesity, but not all.
Finally, sibling relationship quality, while a significant predictor of physical activity, was not related to BMI as an independent indicator. When interaction effects were examined, sibling relationship quality moderated only relationships between adolescent recreation and adult physical activity, not BMI.Sibling relationship quality moderated the relationships between hours watching TV, hours watching videos, and hours playing video or computer games. Interestingly, only hours spent watching videos was independently related to physical activity as a fixed effect, and this fixed effect was only present when interaction terms were included in the model.Sibling relationship quality appeared to have a boosting effect on the positive relationship between hours spent watching videos in adolescence and adult physical activity. Similarly, the interaction between sibling relationship quality and hours spent playing video or computer games in adolescence was positively related to adult physical activity. The positive relationships between these technology-based recreation behaviors may be representative of the phenomenon Davies and Gentile (2012) observed in families with multiple children (i.e., siblings). In their study, families with multiple children reported healthier screen-based media use and increased participation in activities other than screen-based media. Findings from the current study suggested that sibling relationship quality may have promoted healthier technology-based recreation behaviors that lead to higher levels of physical activity in adulthood. Therefore, respondents with higher sibling relationship quality may have benefitted from some technology-based recreation behaviors when siblings with low-quality relationships did not. In one instance, however, the interaction of sibling relationship quality was not positively related to adult physical activity. Sibling relationship had a threshold effect on the relationship between hours spent watching TV in adolescence
and adult physical activity. Hours spent watching TV was not significantly related to adult physical activity as an independent fixed effect in previous models, therefore, it may be the combination of sibling relationship quality and various recreation behaviors that interact to promote more or less physical activity in adulthood. Future research should continue to consider the effect of sibling influences on individual health and well-being outcomes, particularly in the combination of individual and sibling effects.

**Limitations and Contributions**

This study has several limitations. A primary limitation to using any type of secondary data was that the Add Health study was not conceptualized with the specific aims of this article in mind. As is true in many cases of using secondary data, the data used in this study were developed with the intent of catering to multiple users. In the current study, the overall fit between the data and research aims was good; however, the conceptualization and measurement of recreation variables in the data set were not grounded in recreation research or theory. Additionally, as mentioned earlier, the estimation of obesity in this study was based exclusively on BMI. While BMI is a relatively well accepted indicator of obesity, other measures of obesity and fatness have been shown to be more accurate than BMI (Burkhauser, & Cawley, 2008). Future research should consider including additional items and measures of obesity to enhance the reliability of findings.

Similarly, the measures of active recreation were limited in breadth and depth, and may not have been comprehensive. This limitation was addressed by using existing recreation research and theory to establish inclusion criteria for individual survey items. Factor analyses were also used to identify underlying recreation constructs. Future research
should seek to include a broader range of active recreation based on extant leisure and recreation conceptual frameworks. Future researchers should endeavor to include greater contextual detail for both active recreation and technology-based recreation. For example, the underlying behaviors associated with watching television versus watching videos appeared on the surface to be the same. The findings suggested, however, the relationships between these measures and outcome variables often differed. Future research, and perhaps, future iterations of this article can address this limitation and assess index-based measures of technology-based recreation.

In spite of these limitations, this study made some contributions to family leisure research as well as physical health and well-being research. To my knowledge, this study is one of only a few examining the relationships between recreation and health behaviors and outcomes among siblings. One study cited earlier in this paper examined how having an obese sibling affected individual risk of obesity and found that sibling influences were in some cases more salient than parental influences (Pachucki et al., 2012). The authors cited social models as the mechanism driving this relationship; however, did not address the tenets of social learning theory that suggest that social models’ saliency is dependent upon perceived competence and warmth of relationship (Whiteman et al., 2011). Therefore, the current study expanded existing research on sibling as social models for obesity by examining the elements of competency (i.e., birth order) and warmth of relationship (i.e., sibling relationship quality). Moreover, this study examined these relationships longitudinally across an often overlooked life-stage transition. Much of the literature reviewed for this article included research on sibling support for positive health behaviors in
adolescent or mid- to late-childhood sibling populations. This study examined the relationship of adolescent recreation behaviors and adult physical health behaviors and outcomes. This transition is one that is often overlooked with respect to sibling relationships. Siblings themselves as part of family leisure have been largely overlooked, and this study makes a small contribution toward developing more understanding of the processes and outcomes associated with sibling specific leisure. Sibling relationships are formative and supportive, and siblings influence an individual’s quality of life and development (Kramer & Bank, 2005). Previous research has demonstrated in a limited capacity the potential for some daily activities or recreation to promote either sibling conflict or closeness among siblings (Edwards, Hadfield, Lucey, & Mathner, 2006; Folwell, Chung, Nussbaum, Bethea, & Grant, 1997; Kramer, 2010; Whiteman et al., 2011), and has tied sibling relationships to individual health and well-being (Cicirelli, 2008; Yeh & Lempers, 2004). Likewise research has demonstrated a connection between leisure time behaviors and physical health and well-being (citation). Low-quality sibling relationships are predictive of adverse individual developmental and behavioral outcomes (Kramer & Bank, 2005). The boosting or threshold effects of birth order and sibling relationship quality on individual recreation behaviors may be part of the mechanism driving these relationships. Therefore, recreation and sibling relationships may play an important role in protecting the health and well-being of individuals, siblings, and families across the lifespan. Obtaining a more robust perspective on the protective potential of sibling relationships may have implications for continued examination of this line of inquiry as well as practical application for obesity prevention and intervention programming.
References


Table 3.1 Descriptive Statistics of Sample Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean or %</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Female</td>
<td>50.1%</td>
<td></td>
</tr>
<tr>
<td>% Male</td>
<td>49.9%</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% White</td>
<td>61%</td>
<td></td>
</tr>
<tr>
<td>% African American</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>% Other</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>15.1</td>
<td>1.50</td>
</tr>
<tr>
<td>Living with Two Parents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% living with mother and father</td>
<td>86%</td>
<td></td>
</tr>
<tr>
<td>% not living with mother and father</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Mother’s Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% less than high school graduate</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>% high school or GED</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>% some college</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>% college or university degree</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td>% training beyond college or university</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Family Size</td>
<td>4.8</td>
<td>.89</td>
</tr>
</tbody>
</table>

Figure 3.1 Percentage BMI-Weight Categories
### Table 3.2 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects by Physical Activity and Obesity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Physical Activity</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (S.E.)</td>
<td>t-value</td>
</tr>
<tr>
<td>Fixed Effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth order (Firstborn)</td>
<td>-1.05 (.479)</td>
<td>-2.19*</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>3.47 (.433)</td>
<td>8.03**</td>
</tr>
<tr>
<td>Age</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Race (White)</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Race (African American)</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Sibling Relationship Quality (SRQ)</td>
<td>.196 (.061)</td>
<td>3.19*</td>
</tr>
</tbody>
</table>
Table 3.3 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects with Recreation by Physical Activity and Obesity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Physical Activity</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>t-value</td>
</tr>
<tr>
<td></td>
<td>(S.E.)</td>
<td></td>
</tr>
<tr>
<td><strong>Fixed Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth Order (Firstborn)</td>
<td>-1.986 (.418)</td>
<td>-2.36**</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>2.57 (.470)</td>
<td>5.46**</td>
</tr>
<tr>
<td>Race (White)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Race (African American)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sibling Relationship Quality (SRQ)</td>
<td>.155 (.059)</td>
<td>2.61**</td>
</tr>
<tr>
<td>Watch TV/Videos</td>
<td>-1.13 (.252)</td>
<td>-4.49**</td>
</tr>
<tr>
<td>Rollerblading or Cycling</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Active Sport</td>
<td>1.37 (.208)</td>
<td>6.59**</td>
</tr>
<tr>
<td>Exercise</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours TV</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours Videos</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours Video/Computer Games</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours Radio</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Random Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Model 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Size</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Mother’s Education</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 3.4 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects and Birth Order Interactions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Physical Activity</th>
<th></th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimat e (S.E.)</td>
<td>t-value</td>
<td>Estimat e (S.E.)</td>
</tr>
<tr>
<td>Fixed Effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth Order (Firstborn)</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>2.47 (.476)</td>
<td>5.19**</td>
<td>-</td>
</tr>
<tr>
<td>Race (White)</td>
<td>-</td>
<td>-</td>
<td>-1.04 (.397)</td>
</tr>
<tr>
<td>Race (African American)</td>
<td>-</td>
<td>-</td>
<td>-1.37 (.600)</td>
</tr>
<tr>
<td>Sibling Relationship Quality (SRQ)</td>
<td>.152 (.060)</td>
<td>2.55*</td>
<td>-</td>
</tr>
<tr>
<td>Watch TV/Videos</td>
<td>-.827 (.364)</td>
<td>2.55*</td>
<td>-</td>
</tr>
<tr>
<td>Rollerblading or Cycling</td>
<td>-</td>
<td>n.s.</td>
<td>-.630 (.236)</td>
</tr>
<tr>
<td>Active Sport</td>
<td>1.08 (.285)</td>
<td>3.79**</td>
<td>-.646 (.235)</td>
</tr>
<tr>
<td>Exercise</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
<tr>
<td>Hours TV</td>
<td>-</td>
<td>n.s.</td>
<td>.058 (.020)</td>
</tr>
<tr>
<td>Hours Videos</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
<tr>
<td>Hours Video/Computer Games</td>
<td>.120 (.039)</td>
<td>3.12*</td>
<td>-</td>
</tr>
<tr>
<td>Hours Radio</td>
<td>-.040 (.017)</td>
<td>-2.39*</td>
<td>-</td>
</tr>
<tr>
<td>Interaction Effects: Birth Order</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth Order * Watch TV/Videos</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
<tr>
<td>Birth Order * Rollerblading or Cycling</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
<tr>
<td>Birth Order * Active Sport</td>
<td>-</td>
<td>n.s.</td>
<td>1.01 (.334)</td>
</tr>
<tr>
<td>Birth Order * Exercise</td>
<td>-</td>
<td>n.s.</td>
<td>-.765 (.346)</td>
</tr>
<tr>
<td>Birth Order * Hours TV</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
<tr>
<td>Birth Order * Hours Videos</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
<tr>
<td>Birth Order * Hours Video/Computer Games</td>
<td>-.210 (.059)</td>
<td>-3.56**</td>
<td>-</td>
</tr>
<tr>
<td>Birth Order * Hours Radio</td>
<td>-</td>
<td>n.s.</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 3.4 Continued

<table>
<thead>
<tr>
<th>Random Effects</th>
<th>Family Size</th>
<th></th>
<th>n.s.</th>
<th></th>
<th>n.s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother’s Education (Some College)</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td>1.28 (0.591)</td>
</tr>
</tbody>
</table>
Table 3.5 Summary of Parameter Estimates, Standard Errors, and Significance of Individual- and Family-Level Effects and Sibling Relationship Quality Interactions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Physical Activity</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (S.E.)</td>
<td>t-value</td>
</tr>
<tr>
<td>Birth Order (Firstborn)</td>
<td>-1.16 (.418)</td>
<td>-2.76*</td>
</tr>
<tr>
<td>Gender (Male)</td>
<td>2.52 (.468)</td>
<td>5.39**</td>
</tr>
<tr>
<td>Race (White)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Race (African American)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sibling Relationship Quality (SRQ)</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Watch TV/Videos</td>
<td>-156 (.797)</td>
<td>.05*</td>
</tr>
<tr>
<td>Rollerblading or Cycling</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Active Sport</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Exercise</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours TV</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours Videos</td>
<td>.332 (.126)</td>
<td>2.64*</td>
</tr>
<tr>
<td>Hours Video/Computer Games</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Hours Radio</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>SRQ * Watch TV/Videos</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>SRQ * Rollerblading or Cycling</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>SRQ * Active Sport</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>SRQ * Exercise</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>SRQ * Hours TV</td>
<td>-.011 (.005)</td>
<td>-2.28*</td>
</tr>
<tr>
<td>SRQ * Hours Videos</td>
<td>.033 (.010)</td>
<td>3.25*</td>
</tr>
<tr>
<td>SRQ * Hours Video/Computer Games</td>
<td>.016 (.007)</td>
<td>2.27*</td>
</tr>
<tr>
<td>SRQ * Hours Radio</td>
<td>-</td>
<td>n.s.</td>
</tr>
<tr>
<td>Fixed Effects (Model 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction Effects: Sibling Relationship Quality (SRQ)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Random Effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother’s Education (High School)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 3.5 Continued

<table>
<thead>
<tr>
<th>Random Effects</th>
<th>Mother’s Education (Some College)</th>
<th>-</th>
<th>-</th>
<th>-1.23 (.576)</th>
<th>-2.14*</th>
</tr>
</thead>
</table>

CHAPTER 5: CONCLUSION

Although family recreation research has increased over the last 23 years, little of that research has examined siblings. Most extant research examining sibling recreation (or what scholars from fields other than family leisure may call daily activities or free time) has primarily described time expenditures (e.g., Zeijl, Te Poel, Du Bois-Reymond, Ravesloot, & Meulman, 2000), examined individual outcomes associated with recreation (e.g., McHale, Crouter, & Tucker, 2001), and in limited qualitative studies, describing what types of recreation contribute to sibling relationships (Edwards, Hadfield, Lucey, & Mauthner, 2006). This study extended previous research in three ways. First, this dissertation made a contribution to the family leisure field by conducting an integrative review of family leisure research that provided a review of major characteristics and trends in existing literature, and by providing a framework for future research. Second, this study addressed recreation and sibling relationships and examined the relationships between active and technology-based adolescent recreation and adult sibling relationship quality. Finally, this study also tested moderating effects of sibling relationships on the relationship between adolescent recreation and adult physical activity and obesity. This chapter briefly summarizes these findings and contributions, examines the benefits and limitations of using Add Health data, and discusses the theoretical and practical implications of these findings for future research.

Brief Summary of Findings and Contributions

This dissertation made several contributions to the family leisure field, and some of the findings may also be relevant to other disciplines including family studies, sociology, and physical health and well-being. Moreover, this research may help inform policies protecting
siblings and sibling relationships in practice-based fields such as social work and family law (Hasday, 2012). First, the integrative review represents a needed synthesis of existing family research that identified existing trends, methods, analyses, and sample characteristics with directions for future research. The integrative review helped identify family structures and types that have not received adequate research attention. Examples of these family structures and types were single-parent families, same-sex couples, and racial and ethnic minorities, which were included in only a small percentage of studies. However, family leisure scholars’ attention to them has been limited, rendering existing research and conceptual frameworks less accurate and specific.

Similarly, some family relationships had limited presence in extant research, specifically grandparent and sibling relationships. The importance of grandparent relationships in family leisure may be increasing as adults live longer, healthier lives. A MetLife Report on American Grandparents (2011) estimated there were approximately 56 million grandparents in the United States, and some 7 million grandparents had grandchildren younger than 18 years living with them (U. S. Census Bureau, 2011). Grandparents potentially play a significant role in child development as caregivers and playmates (Attar-Schwartz, Tan, & Buchanan, 2009). Therefore, the importance of the grandparent’s role in the lives of grandchildren is worth considering, particularly among family recreation scholars. Likewise, sibling relationships may be more important than family leisure research has recognized. Family scholars have suggested sibling relationships are potentially more long-lasting, stable, and continuous (Feinberg, Sakuma, Hostetler, & McHale, 2013). Therefore, among the recommendations for future research was a call to
carefully consider the families and family relationships included in research. By so doing, family leisure scholars can increase the meaning and applicability of their research, and better position themselves to address social problems associated with family life.

Second, in response to the call to broaden the scope of the family relationships included in family leisure research, we addressed the relationship between recreation and perceptions of sibling relationship quality. A significant amount of existing research has examined the relationship between recreation and perceptions of marital satisfaction, family cohesions, family adaptability, family functioning, family bonding, and satisfaction with family life (e.g., Agate, Zabriskie, Agate, & Poff, 2009; Orthner, 1975; Orthner & Mancini, 1990; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). Scholars have not given the same attention to the relationship between recreation and sibling outcomes, which may have important practical and conceptual implications for family leisure scholars. Understanding the relationship between recreation and sibling relationship quality may also have important implications for the applicability of conceptual frameworks to addressing social problems in families and communities by opening new avenues for family programming and treatments. We found that recreation behaviors were related to sibling relationships somewhat differently from other family relationships. For example, individual recreation has been shown to be related to lower perceptions of marital satisfaction (Orthner, 1975) and in some cases, individual adolescent technology-based recreation has contributed to lower perceptions of family functioning (Hodge et al., 2012). These findings were not the case among siblings. Instead, some types of individual recreation during adolescence were related to more positive perceptions of adult sibling relationships. This result may be because
of some of the functions of sibling relationships. For example, Adler’s theory of individual psychology suggests that adolescents need to differentiate themselves and compare themselves to their peers as they develop (Whiteman, McHale, & Soli, 2011). Therefore, individual recreation may be necessary in the adolescent life stage as a part of human development, and may detract from sibling relationship quality.

Third, as recommended in the integrative review, this dissertation also addressed some social problems—specifically physical activity and obesity—from a family perspective. Specifically, this dissertation examined the relationship between recreation, sibling relationships, and physical activity and obesity. Previous research has shown that different types of recreation (i.e., physically active vs. sedentary) can contribute to or detract from positive health outcomes (Caroli, Argentieri, Cardone, & Masi, 2004; Kraut, Melamed, Gofer, & Froom, 2003; Tammelin, Näyhä, Hills, & Järvelina, 2003; Telama, et al., 2005). Research has also demonstrated that family context is significantly related to health behaviors and outcomes (Cleland, et al., 2011; Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2007; Pachucki, Lovenheim, & Harding, 2012; Sørensen, Price, Stunkard, & Schulsinger, 1989). In families, parents socialize their children to particular behaviors, and some research supports for the hypothesis that siblings also contribute to this socialization process. Building on findings from chapter three of this dissertation, I examined sibling relationship quality and birth order as moderators of the relationships between recreation and physical activity and obesity. Chapter four demonstrated that sibling relationship quality and birth order moderated relationships between some recreation and physical activity and obesity, which extended previous research examining the contributions of familial social context and recreation to
both physical activity and obesity. Family leisure research can and should make contributions to this ongoing dialogue.

Finally, this dissertation made contributions to family leisure research by examining nationally representative, longitudinal data, and by using multilevel models that appropriately accounted for clustered data. Using multilevel models in this dissertation addressed the need for more robust approaches in family leisure research (Poff, Zabriskie, & Townsend, 2010) to facilitate a more complete and statistically accurate view of perceptions of family leisure experiences and outcomes. Additionally, the majority of existing family leisure research has been cross-sectional, which has precluded understanding the effects of family recreation over time. This dissertation began to address that gap in research by using longitudinal data and analyses that assessed relationships between adolescent behaviors and adult outcomes. In sum, this dissertation addressed the need for sibling-specific family leisure research as well as the need for more analytically robust, longitudinal research.

**Research Implications**

Based on findings from this dissertation, there are several research implications. First, careful consideration of methods and analyses used in family leisure research should continue. According to the integrative review findings, quantitative and qualitative methods were used in nearly equal measure in family leisure research between 1990 and 2013. This represented an increase in use and application of qualitative methods as was recommended by Hawks (1991) in his 60-year review of family recreation research. Hawks’ (1991) also recommended an increase in longitudinal research and research designs addressing causality. In this case, the integrative review found no evidence of an increase in those types of
methods. Survey data remained the predominant form of quantitative research. Surveys may continue to be used in research, but other types of methods, particularly longitudinal and experimental study designs, should also be considered where appropriate. Scholars should also actively consider expanding their data collection methods to include multiple data points from families. Similarly, researchers should assess whether statistical analyses are appropriately accounting for the multiple levels of influence present in families. In addition to these implications for quantitative research, new and innovative qualitative methods should also be considered. Qualitative methods will continue to enrich the conceptual understanding of and framework for family leisure.

Second, many research opportunities regarding leisure in families remain. When compared to the total number of articles published in the last 23 years, family leisure research is limited. More than simply increasing research quantity, however, family leisure researchers need also consider how to best increase research relevancy to society. Overall, families included in family leisure research in the past 23 years appeared to be predominantly White, heterosexual, two-parent families. While progress toward diversifying family leisure research was evident, more progress can be made. This research implication is important since the conclusions from previous studies that inform continued research and framework may be incomplete if they are based on fairly homogenous samples. As one specific example, the leisure experiences of single-parent families may be distinct from leisure experiences of other families. Single-parent families were the focus of only a very few studies even though recent census data suggest that in some populations, more than half of all families are headed by a single parent (Shattuck, & Kreider, 2013). Researchers should be aware of and
intentionally seek out underrepresented perspectives. Researchers have also focused on a relatively limited and homogenous subset of family relationships (e.g., parent-child relationships and couple relationships). Family leisure scholars may be able to make significant progress in developing the family leisure field by broadening the types of relationships studied. By casting a wider net and including more family structures, types, and relationships, scholars can make increasing research contributions.

Third, an examination of the relationship between recreation and sibling relationships included in this dissertation was an introduction to an area of research that needs extensive attention. Descriptive studies examining what siblings do together, how often they spend time together, and how much time they spend together have been conducted in fields outside of family leisure research. These previous studies have not, however, explicitly examined the potential impact recreation may have on sibling relationships. From research addressing daily activities and free-time behaviors, European American children spend the majority of their free time with siblings, and young adolescents spend a substantial part of their leisure time with family, including siblings (Zeijl et al., 2000). The implications of understanding recreation as a means of relationship development and maintenance among siblings are potentially quite meaningful, especially since sibling relationships have been shown to promote health and well-being across the lifespan (Cicirelli, 2008). Understanding the ingredients (Kramer, 2010) that contribute to positive sibling relationships may create opportunities for leveraging sibling relationships to promote positive adult outcomes. Finally, researchers need to understand the processes and mechanisms explaining how sibling recreation may facilitate both higher quality relationships and health and wellbeing.
Therefore, research examining sibling recreation and outcomes is needed, and this dissertation is, to my knowledge, one of the first of its kind.

The findings reported in this dissertation demonstrated that some types of recreation appeared to contribute to perceptions of increased sibling relationship quality while others did not. This conditional relationship between recreation and family outcomes is not exclusive to siblings. For example, individual media use was negatively related to adolescent perceptions of family functioning; however, shared media use, or media connection was positively related to adolescent and parent perceptions of family functioning (Hodge et al., 2012). Findings reported in this dissertation may have implications for the examination of the outcomes associated with specific types of recreation across various family relationships. For example, further comparisons of technology-based recreation and active recreation could be made across sibling outcomes and parent-child outcomes. This analysis could help determine whether the same types of recreation facilitate the same outcomes in siblings as they do in other family relationships. Other types of leisure were negatively associated with sibling relationship quality. Existing research has identified costs and constraints of family leisure for several family roles and relationships (e.g., mothers and caregivers). However, the costs and constraints of recreation among siblings have been unexamined, and whether the same costs and constraints hold true for siblings has yet to be determined. These analyses have implications for future research examining recreation and sibling relationships in terms of how research questions could be framed and the types of methods that could be used.

Fourth, the descriptive sibling recreation research published in other fields appears to have primarily focused on populations of children and young adolescents. This dissertation
included an examination of a population of adolescent siblings who had transitioned into adulthood. Previous research has demonstrated that aspects of sibling relationships, specifically conflict and perceived closeness, change as siblings age and move across life stages. Conflict generally decreases in mid- to late-adolescence (Kim, McHale, Osgood, & Crouter, 2006), and sibling closeness appears to stabilize and even increase in late adolescence (Oliva & Arranz, 2005). This dissertation spanned a time period in which sibling conflict and closeness may have changed and then stabilized. Therefore, research examining the recreation and sibling relationships at different stages in the life cycle using longitudinal data is also necessary.

Fifth, using secondary data had implications for understanding and assessing how recreation is measured in sibling relationships. In some cases, measures of recreation included in the Add Health data did not appear to have been conceptualized from a recreation or leisure framework. Therefore, future research should endeavor to more accurately and thoroughly measure recreation in siblings. Recreation scholars in particular can bring their disciplinary perspective to interdisciplinary research to increase the ability of scholars to understand and generalize trends in the relationships between recreation and siblings outcomes. On a similar vein, several recreation variables in the Add Health data used frequency-based measures. Respondents estimated their recreation participation categorically, (e.g., once or twice a week, three or four times a week, and more than five times a week). Categorical data limited the level of detail in the analyses and conclusions. Therefore, considering how to best measure frequency and duration of recreation will also be an important consideration for future sibling recreation research.
Sixth, findings from the integrative review and the examination of recreation, sibling relationships, and physical activity and obesity had implications for translational family leisure research. First, by examining recreation in a theoretically meaningful way as a contributing factor to sibling relationships, research may uncover potential means of intervention in family processes and outcomes. Sibling relationships contribute to overall psychological and physical health and well-being and are possibly the longest-lasting and most stable across the lifespan (Feinberg et al., 2013). This dissertation suggested recreation plays some role in the formation and maintenance of those relationships. This conclusion has academic and practical implications for scholars and practitioners who may consider intentionally using recreation to promote positive sibling relationships and bonds across the lifespan, and increase physical and psychological well-being.

Finally, findings from this dissertation may have the potential to contribute to social change. Specifically, this dissertation and continued examination of sibling relationships may contribute to changing perspectives on how to promote positive and protective sibling relationships. It is because of this potential for sibling relationships to be protective that scholars have drawn attention to the importance of maintaining and protecting sibling relationships among practitioners and policymakers. Hasday (2012) outlined the relatively low-levels of legal protection afforded to siblings, calling it a “crucial, yet legally neglected, family tie” (p. 899), and discussed potential reform in family law to better protect sibling relationships that act as a source of support across various life stages. Sibling relationships are formative and supportive, as substantiated by previous research (Kramer & Bank, 2005). In general, siblings contribute to individual quality of life and development (Kramer & Bank,
2005). For example, high levels of conflict among siblings in middle childhood are a robust and consistent predictor of problem behaviors including delinquency in adolescence and adulthood (Kramer & Bank, 2005). Previous research has also demonstrated in a limited capacity the potential for some daily activities or recreation to promote either sibling conflict or closeness (Edwards, et al., 2006; Folwell, Chung, Nussbaum, Bethea, & Grant, 1997; Kramer, 2010; Whiteman et al., 2011). The findings presented in this dissertation help clarify some of the relationships between specific types of recreation and sibling relationship perceptions. Thus, if low-quality sibling relationships are predictive of adverse individual developmental and behavioral outcomes, then, it may be that high quality sibling relationships act as a protective influence that can promote positive outcomes later in life (Kramer & Bank, 2005). More specifically, if, as demonstrated in this dissertation, specific types of recreation behaviors in childhood and adolescence contribute to higher or lower quality sibling relationships, then recreation may play an important role in protecting the health and well-being of individuals, siblings, and families across the lifespan. Obtaining a more robust perspective on the protective potential of sibling relationships may have implications for family therapy, prevention and intervention programming, and even policy and legal changes that promote and facilitate long-term sibling relationships.

**Theoretical Implications**

In addition to the research implications of this dissertation, several theoretical implications exist for future research. First, this dissertation provided some context for understanding the application of family systems theory to sibling relationships. Family systems theory as applied in recreation and leisure research has been primarily used to frame
examinations and assessments of parent-child relationships and in some cases, couple relationships. This theory was true of research examining the benefits of leisure using the Core and Balance Model of Family Leisure Functioning (Zabriskie & McCormick, 2001). As described by White and Klein (2008), families are best understood when viewed holistically. Holistically viewing families requires viewing, studying, and understanding all the various elements (i.e., individuals) and subsystems (i.e., groups of 2 to 3 individuals with unique characteristics often operating under unique boundaries and expectations) within the family. Therefore, I would argue that the family leisure perspective on the family systems theory is incomplete because the subsystems of sibling relationships have not been included in previous study. Moreover, the application of the Core and Balance Model of Family Leisure Functioning could be expanded and tested for validity in sibling populations and samples. Repeated use and testing of the Core and Balance Model of Family Leisure Functioning and its associated instruments in nationally representative and purposive parent-child samples has shown the model and its measures to be reliable and valid (Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). Therefore, this model and its associated instruments could be a first step in examining sibling recreation from a more theoretically and conceptually sound perspective.

Applications of the family systems theory to family leisure have contributed to understanding how recreation and leisure provide important benefits to family outcomes such as family functioning, family bonding, communication, adaptability, cohesion, and overall satisfaction with family life (Agate et al., 2009; Orthner, 1975; Orthner & Mancini, 1990; Zabriskie & McCormick, 2001; Zabriskie & McCormick, 2003). This conceptual and
theoretical framework (i.e., the benefits perspective) is important, but its understanding and application may need to be tempered because siblings have not been included in previous research. Based on family systems theory, sibling relationships influence and are influenced by marital or parent-child relationships. From a theoretical standpoint, all systems and individuals within the family, including sibling dyads, make contributions to the overall functioning of the family system. Ignoring siblings while applying a family systems theory results in an incomplete understanding of family processes, outcomes, and more broadly, the theory of family systems itself. Therefore, testing sibling relationships within a family theory context could build a stronger case for the relevancy of family systems theory in family leisure.

Second, findings regarding the moderating effects of birth order and sibling relationship quality also have some implications for the application of social learning theory to sibling recreation research. Based on the social learning theory, we hypothesized that older siblings (i.e., firstborn siblings) would promote healthier behaviors and outcomes among later-born or younger siblings, and that birth order would moderate unhealthy behaviors and outcomes. Similarly, we hypothesized that sibling relationship quality would moderate relationships between recreation and physical activity and obesity. Our findings supported these hypotheses for some types of recreation. Specifically, birth order moderated the relationships between hours playing video or computer games and physical activity, and playing an active sport and exercising and obesity. Younger siblings appeared to have higher levels of physical activity when considering hours spent playing video or computer games, and had lower levels of BMI when considering how frequently they played an active sport.
Conversely, when considering frequency of exercise, firstborn siblings reported lower levels of BMI than younger siblings. Sibling relationship quality only moderated relationships between recreation and physical activity. In two cases (hours spent watching videos and hours spent playing video or computer games), sibling relationship quality had a boosting effect on the relationships between recreation and physical activity. Conversely, the interaction effect between hours watching TV and sibling relationship quality revealed a negative relationship in which sibling relationship quality had a depressing effect on the positive relationship between hours watching TV and physical activity.

Overall, the differences in relationships by birth order and sibling relationship quality demonstrated some qualified support for two tenets of the social learning theory: competency and perceived warmth of relationship with the social model (Whiteman et al., 2011). For example, physical activity is a behavior that is largely learned from social models in families such as parents and in some cases siblings (Hohepa et al., 2007), and the results presented in this dissertation demonstrated that sibling relationship quality (i.e., warmth of relationship with the social model) moderated relationships between recreation and physical activity in a statistically meaningful way. Other findings suggest that family leisure scholars should also consider the theoretical implications of the resource dilution model (Downey, 2001) in future sibling recreation research since birth order moderated some of the relationships between recreation and physical activity and BMI. According to the resource dilution model, firstborn children experience advantageous access (i.e., unchallenged) to resources that is related to increased academic achievement and cognitive development across the lifespan. At the same time, siblings can act as resources for social adjustment instead of solely as competitors for
resources (Downey & Condron, 2004). Therefore, continued examination of siblings as social models of recreation and health behaviors should also consider the theoretical implications of the resource dilution model.

Third and finally, recreation as a theoretically defined construct has not been empirically examined in any publication on siblings. Several studies have looked at “daily activities” (McHale & Crouter, 1996), leisure time (Zeijl et al., 2000), and “free-time activities” (Davies & Gentile, 2012; Whiteman, McHale, & Crouter, 2007). However, none of these studies has provided a theoretically justified or empirically grounded definition of recreation. By not including conceptually framed recreation measures, existing research conducted by scholars in fields other than leisure and recreation may be missing some of the nuances and meanings of recreation in sibling relationships. Therefore, using theory-driven definitions of recreation in sibling research will fill another theoretical gap in cross-disciplinary literature. Furthermore, the mixed findings may be clarified by as scholars with a strong understanding of the theoretical considerations of leisure and recreation apply their expertise to sibling relationships.

**Benefits and Limitations of Secondary Data: An Assessment of Add Health Data**

We used both primary and secondary data in this dissertation. Primary data consisted of collecting and analyzing data on published family leisure research over the last 23 years. Secondary data consisted of data gleaned from the National Longitudinal Study of Adolescent Health (Add Health). There were benefits and limitations to using secondary data to address the research questions. Broadly, by using secondary data an element of control over data collection and study design is traded for a larger, more representative sample of
longitudinal data (Vartanian, 2011). These tradeoffs, benefits, and limitations are discussed in this section along with issues of establishing reliability and validity of Add Health data.

**Limitations of Secondary Data**

Using secondary data like Add health comes with some limitations. First and foremost, because the data are secondary, they were collected for a different purpose than the research questions being addressed in the secondary analyses (McCall & Appelbaum, 1991). This limitation was primary in using Add Health (secondary) data and required that the goodness of fit between the data and the research questions be assessed (Hofferth, 2005). While the overall fit between the data and research questions was good, the conceptualization and measurement of recreation variables was not as specific as measurement would have been in primary data. For example, hours spent watching television and videos were estimated separately even though the underlying behavior (i.e., passive, sedentary, consumptive recreation) was similar. In assessing physically active recreation, some of the variables appeared to be somewhat arbitrarily constructed. This assessment was indicative that the overall conceptualization of recreation in the study was less intentional than it would have been in an original study that generated primary data. This limitation, however, was addressed. We reviewed the codebooks and item descriptions to ensure the identified variables best assessed recreation behaviors, and used extant literature and theory to frame these variables. Additionally, maximum likelihood factor analyses were used to determine whether the items were measuring the same underlying construct, and the factor analyses suggested that they were.
While requisite investment of time into understanding the data set was not necessarily a limitation to using Add Health data, it was a constraint to the research process. As with any secondary data analyses (Hofferth, 2005; McCall & Appelbaum, 1991), we spent a significant amount of time reviewing codebooks and documentation to become familiar with the format and content of the Add Health data. Permission to use the restricted access sibling pairs data also had to be obtained, and that process required an extensive agreement with the original data collector (see Appendix B). Similarly, access to study participants for follow-up questions or data collection was impossible because of confidentiality clauses built into the original study design (Vartanian, 2011). No follow-up examination to clarify meaning of recreation behaviors or sibling relationship perspectives was possible.

Benefits of Secondary Data

Although some limitations to using the Add Health data existed, there were also several benefits. Benefits of using secondary data included reduced costs (Coyer & Gallo, 1991; Hofferth, 2005; Vartanian, 2011), reduced time to publication which can enable scholars to have prompt and meaningful impact on policy (Hofferth, 2005; McCall & Appelbaum, 1991; Vartanian, 2011), and relatively easy access (Hofferth, 2005). By these terms the, using Add Health was advantageous to this dissertation. The data were available in two forms: public use and restricted use. Public use data were housed online and were available for download in various statistical software formats including SPSS and SAS free of charge. Restricted use data, specifically the sibling pairs data needed, had a cost associated with it ($800). The cost of purchasing restricted sibling pairs data was relatively low,
especially when compared to the prospect of designing and funding a comparable study, and
the process for gaining access to the restricted use data was relatively straightforward.

This impact can also be possible because the Add Health data was a large, nationally
representative sample with a rich level of family context variables. For example, the Wave 1
in-home interviews contained more than 2,000 matched sibling responses from a nationally
representative sample. Larger, more representative samples increase statistical power and
generalizability of findings. Moreover, the Add Health data were longitudinal, and
longitudinal data can increase the potential impact of research because they follow
individuals and families over time (Vartanian, 2011). Using longitudinal data contributed to
existing family leisure research by examining the relationships between recreation and
sibling relationships over time. Likewise, interdisciplinary collaboration on secondary data
analyses renders richer analyses (Cherlin, 1991) and is especially salient to family research,
which draws from bodies of knowledge in fields and disciplines.

Finally, an indirect benefit of using Add Health data was the opportunity to
familiarize myself with the study. As noted in the discussion of the limitations to secondary
data use, learning a data set, or rather becoming familiar with its contents and format is a
time-intensive process. However, once a researcher acquires this knowledge, continuing to
conduct and publish using those data in the future will be easier. Thus, by investing time into
familiarizing myself with the Add Health data, I have created the potential for multiple future
publications that will contribute to a better understanding of family leisure.

This investment has laid the groundwork for my future research. Ecological systems
theory suggests human development and behavior is influenced by varying levels of systems
(Bronfenbrenner, 1992). Thus far, my research has examined primarily individual and microsystem levels of influence. In addition to sibling pairs data addressing individual and microsystem levels of influence, Add Health collected neighborhood and school level data, which represent addition microsystems as well as exosystem levels of influence. Research has demonstrated that a combination of several elements of built environment including transportation systems, urban design, and land use patterns can be used to promote more physical activity (Handy, Boarnet, Ewing, & Killingsworth, 2002). Similarly, environmental factors contribute to some obesity-related behaviors and one study using Wave 1 of the Add Health study found that lower-SES and high-minority census-block groups had less access to physical activity facilities, and were subsequently more prone to low levels of physical activity and higher levels of obesity (Gordon-Larsen, Nelson, Page, & Popkin, 2006). These findings could be expanded on by examining longitudinal trends in physical activity and obesity relative to built environment. Additionally, Add Health data include subsamples of ethnic and racial groups (e.g., Hispanic, Asian) that have received limited attention in family leisure research. By focusing on trends in family relationships (including sibling and parent relationships) relative to recreation behaviors among these groups, I can help address some of the gaps in extant family leisure research.

**Establishing Reliability and Validity of Add Health Data**

Reliability of the Add Health data was established by examining the codebooks and the response rates of participants (Hofferth, 2005). Furthermore, instrument reliability was assessed using maximum likelihood factor analyses and reliability tests (Cronbach’s alpha).
Validity was assessed through careful examination of study design and consideration of threats to internal validity in the Add Health data. Attrition, or the loss of participants over time, may appear to affect internal validity; however, the study reported a response rate of 91% from Wave 1 to Wave 4. Therefore, attrition of subjects, which could bias the sample, will not be considered an issue. History, or events occurring outside the bounds of the study between data collection waves, may be a threat to internal validity in this study because it is longitudinal. Historic events may affect participant responses. If these historic events affect the entire sample, however, then their impact is essentially absorbed into the data because they affect all participant responses. Therefore, history will not be considered a threat to internal validity. Instrumentality, or changes in the instruments, may threaten internal validity. Examination of the Add Health codebooks demonstrated that the same measures and instruments were used across each wave of in-home interviews with the exception of the addition of some daily activity items to the Wave 3 in-home interview questionnaire.

Finally, repeated testing as was conducted in this longitudinal study can sensitize respondents to the instrument, effectually conditioning them to being tested and confounding causal relationships. However, because the waves of data collection were spaced at least one year apart, testing effects were most likely minimized. Therefore, repeated testing was not considered a threat to the internal validity of Add Health. Likewise, the external validity of the study is most likely acceptable because the sample was nationally representative, making any findings from the data generalizable back to larger populations.

The external validity of the study was acceptable because of the large and representative sample. Large sample sizes and representativeness of samples make findings
less biased and more generalizable back to larger populations (Hinton, 2014). Moreover, assessing key sample characteristics allowed identifying the specific populations to generalize the findings. Overall, the size and scope of the Add Health study represented a level of resource investment and expenditure we could not replicate nor approximate with primary data. Publication potential was the final benefit to using the Add Health data.

**Conclusions**

Most people in the United States have at least one sibling and for many, sibling relationships will be the longest-lasting relationships they experience across the lifespan. Yet siblings remain largely invisible in research (Whiteman et al., 2011). The absence of sibling research was especially glaring in family recreation and family leisure research. In my review of more than two decades of family leisure research across four major family and leisure studies journals, no more than two articles examined any type of sibling recreation or related outcomes from an analytic perspective (see Davies & Gentile, 2012; Updegraff, Thayer, Whiteman, Denning, & McHale, 2005). While several other scholars have examined sibling activities descriptively, there remain large gaps in this research. This study addressed some of those gaps by systematically reviewing family leisure literature, by examining the relationship between recreation and perceptions of sibling relationship quality, and by examining the relationships between recreation, physical activity, obesity, and the moderating effects of birth order and sibling relationship quality. These findings have important theoretical and conceptual implications for future research. Overall, recreation among siblings may help scholars understand families amid changes in structure and
function, and may also help scholars understand health and well-being outcomes in individuals and families across the lifespan.

The findings of this dissertation may also have implications for family therapy, prevention and intervention programming, and even policy and legal changes that promote and facilitate long-term sibling relationships. First, this dissertation demonstrated that recreation is related to sibling relationships in both positive and negative ways. This finding could help direct family treatments and interventions targeting improved family life, including improved sibling relationships. Improving sibling relationships may be an important part of improving overall individual well-being. Sibling relationships contribute to overall psychological and physical health and well-being (Cicirelli, 2008; Feinberg et al., 2013). Moreover, sibling relationships may be the longest-lasting and most stable across the lifespan surpassing parental and spousal relationships (Feinberg et al., 2013). Therefore, improving sibling relationships could improve the health and well-being of individuals across the life span.

This dissertation demonstrated recreation may play a role in the formation and maintenance of sibling relationships, and that both recreation and sibling relationships may influence adult physical activity and obesity. These findings could contribute to changing perspectives on how to promote positive and protective sibling relationships that support psychological and physical well-being across the life span. Thus, these findings could guide future academic and applied work. For example, scholars and practitioners may consider intentionally using recreation to promote positive sibling relationships and bonds, and to influence physical activity and obesity outcomes in adults. Therefore, findings from this
dissertation may have the potential to contribute to social change. More specifically, if, as demonstrated in this dissertation, specific types of recreation behaviors in childhood and adolescence contribute to higher or lower quality sibling relationships, then recreation may play an important role in protecting the health and well-being of individuals, siblings, and families across the lifespan.
References


Appendix A: IRB Approval

From: Jennifer Ofstein, IRB Coordinator
North Carolina State University
Institutional Review Board

Date: November 7, 2013

Title: "O Brother Where Art Thou?": A Longitudinal Examination of the Effect of Recreation on Sibling Relationship Quality and Health Behaviors and Outcomes

IRB#: 3598

Dear Camilla Hodge,

The research proposal named above has received administrative review and has been approved as exempt from the policy as outlined in the Code of Federal Regulations (Exemption: 46.101. b.4). Provided that the only participation of the subjects is as described in the proposal narrative, this project is exempt from further review. This approval does not expire, but any changes must be approved by the IRB prior to implementation.

NOTE:

1. This committee complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU projects, the Assurance Number is: FWA00003429.

2. Any changes to the research must be submitted and approved by the IRB prior to implementation.
3. If any unanticipated problems occur, they must be reported to the IRB office within 5 business days.

Please forward a copy of this letter to your faculty sponsor, if applicable.
Thank you.

Sincerely,

Jennifer Ofstein
NC State IRB
Appendix B: Add Health Use Agreement

The University of Michigan, ICPSR
National Longitudinal Study of Adolescent Health
Restricted Use Data Agreement

Agreement for the Use of Confidential Data

Acceptance of the terms and conditions of this Agreement is precedent before data access will be provided.

I. Definitions

A. "The National Longitudinal Study of Adolescent Health" (hereinafter referred to as "Add Health") is the program project undertaken by the Carolina Population Center of The University of North Carolina at Chapel Hill (hereafter referred to as UNC-Chapel Hill) directed by Dr. Kathleen Harris under Grant No. P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, data from which is made available to ICPSR for dissemination to third parties.

B. "Investigator" is the person primarily responsible for supervision of the research project, security of the data, and use of Confidential Data obtained through this Agreement.

C. "Research Staff" are all persons, excluding Investigator, who will have access to Confidential Data obtained through this Agreement.

D. "Institution" is the university or research institution that employs Investigator and that is the signatory to this Agreement on behalf of Investigator.

E. "Representative of Institution" is a person authorized to enter into contractual agreements on behalf of Institution.

F. "Confidential Data" includes any data from Add Health that might compromise the anonymity or privacy of respondents to that study. Because of the school based study design, Add Health respondents (adolescents, parents, and schools) are at higher risk of deductive disclosure than randomly sampled individuals. Therefore, all data collected from Add Health are considered to be confidential.

G. "Data File" includes any form of data, whether on paper or electronic media.
H. "Funding Agency" is a federal office or institute that provided funding for Add Health. Funding agencies are only the offices or institutes providing the funding; other divisions or institutes within the larger organization are not considered funding agencies.

I. "Agreement Period" is the three (3) year period that begins immediately after receipt of the official e-mail approval of the IDARS application from ICPSR.

J. "Processing Fee" is a nonrefundable payment of $800 (ICPSR member Institution)/$850 (ICPSR non-member) that covers the expenses of producing and shipping Data Files and codebooks, of consulting, and of administering this Agreement.

K. "IDARS" is the online Confidential Data application system.

II. Requirements of Investigators

Investigators must meet the following criteria:

A. Have a PhD or other terminal degree; and

B. Hold a faculty appointment or research position at Institution

III. Requirements of Institution

Institution must meet the following criteria:

A. Be an Institution of higher education, a research organization, or a government agency; and

B. Have a demonstrated record of using Confidential Data according to commonly accepted standards of research ethics

IV. Obligations of ICPSR

In consideration of the promises made in Section V of this Agreement and of receipt of the monies noted in Section V. I., ICPSR agrees to the following, once the application has been submitted via IDARS and approved:

A. To return one fully signed original to Investigator via e-mail.
B. To assign the effective dates of the three (3) year Agreement Period on the Institutional Signatures page. The initiation date will begin immediately after receipt of the official e-mail approval of the IDARS application from ICPSR.

C. To provide the Data Files requested by Investigator as indicated by Investigator via IDARS within a reasonable time frame following execution of this Agreement by appropriate officials of ICPSR and to send the requested Data Files to Investigator on a CD ROM by certified mail (return receipt requested). All Data Files will be compressed and password protected.

D. To provide codebooks which contain the origins, form, and general content of the Data Files sent to Investigator within the same time frame and manner as specified in paragraph C regarding the Data Files.

E. To provide up to four (4) hours of consultation to Investigator and/or Research Staff regarding the origins, form, and general content of the Data Files, and regarding required and preferred techniques for data management of those Data Files. Further consultation is available for an additional fee.

V. Obligations of the Investigator, Research Staff, and Institution

Data provided under this Agreement shall be held by the Investigator, Research Staff, and Institution in strictest confidence and can be disclosed only in compliance with the terms of this Agreement.

In consideration of the promises contained in Section IV of this Agreement, and for use of Data Files from ICPSR, the Investigator, Research Staff, and Institution agree:

A. That the Data Files will be used solely for statistical analyses: that no attempt will be made to identify specific individuals, families, households, schools, institutions, or geographic locations not provided by Add Health; and that no list of Confidential Data at the individual or family level will be published or otherwise distributed.

B. That if the identity of any person, family, household, school, or institution should be discovered inadvertently, then:

1. No use will be made of this knowledge;

2. ICPSR will be advised of the incident within one (1) business day of Investigator's, Research Staff's, or Institution's discovery of the incident;
3. The information that would identify the person, family, household, school, or institution will be safeguarded or destroyed as requested by ICPSR and a written certification of destruction provided to ICPSR; and

4. No one else will be informed of the discovered identity.

C. To avoid inadvertent disclosure of persons, families, or households by using the following guidelines in the release of statistics derived from the Data Files.

1. In no table should all cases in any row or column be found in a single cell.

2. In no case should the total for a row or column of a cross tabulation be fewer than three (3) cases.

3. In no case should a cell frequency of a cross tabulation be fewer than three (3) cases.

4. In no case should a quantity figure be based on fewer than three (3) cases.

5. Data released should never permit disclosure when used in combination with other known data.

D. That no persons other than those identified in this Agreement, or in amendments subsequent to this Agreement, as Investigator or Research Staff, be permitted access to the contents of Data Files or any files derived from Confidential Data Files.

1. That within one (1) business day of becoming aware of any unauthorized access, use, or disclosure of Confidential Data, the unauthorized access, use, or disclosure of Confidential Data will be reported in writing to ICPSR.

E. To comply fully with the Data Security Plan included as part of the IDARS application. The Data Security Plan expires at the end of the Agreement Period.

F. To respond fully and in writing within ten (10) working days after receipt of any inquiry from ICPSR regarding compliance with this Agreement or the expected date of completion of work with the Confidential Data and any data derived therefrom.
G. To make available for inspection by Add Health, during business hours, the physical housing and handling of all Data Files and any other information, written or electronic, relating to this Agreement.

H. To supply ICPSR via IDARS the following:
   1. Completed Investigator Information Form.
   2. Agreement for the Use of Add Health Confidential Data.
   3. Scanned Institutional Representative signature.
   6. A copy of the document signed by the Institution's Institutional Review Board (IRB), approving the research project AND the secure use, storage, and handling of the Add Health Data Files outlined in the Data Security Plan.

I. To provide to ICPSR a nonrefundable Processing Fee in the amount of $800 (ICPSR member Institution)/$850 (ICPSR non-member). Payment may be made by check, payable to "The University of Michigan." The nonrefundable Processing Fee will be used to cover the expenses of producing and shipping Data Files and codebooks, of consulting, and of administering this Agreement.

An exemption to the nonrefundable Processing Fee may be made if the request for Data Files is from an Investigator at one of the Add Health funding agencies or institutes. To request a waiver of the nonrefundable Processing Fee, please include a letter from the head of the Funding Agency requesting that the fee be waived.

J. To include in each written report or other publication based on analysis of Confidential Data from Add Health, the following statement:

“This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver Foundation.”
National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health Data Files is available on the Add Health website (http://www.cpc.unc.edu/addhealth). No direct support was received from grant P01-HD31921 for this analysis.”

K. That all journal articles based on analysis of Confidential Data from Add Health receive a PubMed Central reference number (PMCID). Journal articles must be submitted to PubMed Central to receive a PMCID. The method of PubMed Central submission and Investigator responsibility for submission depend on the journal and journal publisher:

1. Some journals automatically submit published articles to PubMed Central. For a list of journals that submit articles to PubMed Central please visit the NIH website: http://publicaccess.nih.gov/submit_process_journals.htm.

2. Some journal publishers may submit the articles to PubMed Central automatically or upon request by the author. For a list of journal publishers that submit articles to PubMed Central please visit the NIH website: http://publicaccess.nih.gov/select_deposit_publishers.htm#b.

3. If neither the journal nor the journal publisher will submit the article to PubMedCentral, the Investigator will be responsible to submit the final peer-reviewed manuscript to PubMed Central via the NIH Manuscript Submission System (NIHMS). For detailed instructions on the process of submitting a journal article to PubMed Central, please see the NIH website: http://publicaccess.nih.gov/submit_process.htm.

L. To destroy all Data Files at the originally approved site; submit a letter stating that all Add Health Data Files have been securely erased with the secure erasure program listed in the security plan for the originally approved site; and return all CDs containing Data Files, within thirty (30) days of the expiration of the Agreement Period, as specified on the Institutional Signatures page, or to submit a renewal application. Add Health shall be able to visit within a year of Agreement termination, to confirm the data have been destroyed. This obligation of destruction shall not apply to Investigator's scholarly work produced during the Agreement Period that is based upon or that incorporates the Confidential Data.
M. To notify ICPSR in the event Investigator plans to separate from Institution during the Agreement Period. Such notification must be in writing and must be received by ICPSR at least six (6) weeks prior to Investigator's last day of employment with Institution. Investigator's separation from Institution will terminate this Agreement. Investigator may, however, reapply to receive Add Health Data Files from ICPSR in Investigator's capacity as an employee of his or her new Institution. No fee will be charged for the administration of this process.

Concurrent with Investigator's notice to ICPSR regarding a pending separation from Institution, Investigator must:

1. Return the Data File CDs to ICPSR at the following address:

   Tannaz Sabet  
   Archive Manager  
   DSDR/ICPSR  
   1106D Perry Building  
   330 Packard Ann Arbor, MI 48104-1248

2. Destroy all electronic and paper files at the originally approved site prior to the date of relocation and submit a letter stating that all Add Health files have been securely erased with the secure erasure program listed in the security plan for the originally approved site. This obligation of destruction shall not apply to Investigator's scholarly work produced during the Agreement Period that is based upon or that incorporates the Confidential Data.

3. Submit an Add Health Agreement for the Use of Confidential Data via IDARS signed by an official representative of Investigator's new Institution.

N. To obtain approval from ICPSR prior to transferring this Agreement to another Investigator at the same Institution. No fee will be charged for the administration of this process. In order to obtain such approval, Investigator must:

1. Inform ICPSR in writing six (6) weeks prior to the proposed date of transfer.

2. Submit an Add Health Agreement for the Use of Confidential Data via IDARS signed by an official representative of Investigator's new Institution.
3. Maintain responsibility for the security of all Data File CDs until the transfer agreement has been approved.

O. To submit annual reports to ICPSR via IDARS on or before each anniversary of the initial date of the Agreement Period. Such reports must include:

1. A copy of the annual IRB approval for the research project

2. A list of public presentations at professional meetings using results based on the Data Files

3. A list of papers accepted for publication using these Data Files, with complete citations and PMCID

4. A list of grants that have been awarded for use of the Add Health Data Files

5. A list of graduate students using the Add Health Data Files for dissertations or theses, the titles of these papers, and the dates of completion

6. A current data user roster including the names of all Research Staff member(s) who have access to Data Files and their relationship(s) to the project

P. That Investigator and Institution hereby acknowledge that any breach of the confidentiality provisions herein will result in irreparable harm to The University of Michigan that are not adequately compensable by money damages. Investigator, Research Staff, and Institution hereby agree to the imposition of injunctive relief in the event of breach, in addition to money damages. Should Investigator, Research Staff, or Institution commit a material breach of this Agreement that is not cured within thirty (30) days after Investigator or Institution receives notice of such breach from ICPSR, ICPSR reserves the right to terminate the Agreement, in which case all electronic and paper files will be securely erased; a letter will be submitted by the Investigator, stating that all Add Health files have been securely erased with the secure erasure program listed in the security plan; and CDs containing Data Files are to be returned. Investigator, Research Staff, and Institution understand and agree that a violation of any of the terms and conditions of this Agreement may constitute a violation of state and federal statutes and may subject Investigator, Research Staff, and/or Institution to the criminal, civil,
and administrative penalties associated with violations of those statutes, in addition to constituting a material breach of this Agreement with attendant legal liabilities.

Q. That Investigator and Institution agree to indemnify, defend, and hold harmless The University of North Carolina at Chapel Hill, Add Health, The University of Michigan, the Inter-University Consortium for Political and Social Research and the sources of Confidential Data from any or all claims and losses accruing to any person, organization, or other legal entity as a result of Investigator's, Research Staff's and/or Institution's acts, omissions, or breaches of this Agreement.

R. That Institution shall ensure that Research Staff comply with the provisions of this Agreement.

S. That ICPSR may provide the name and address of Investigator to the original producer of these data listed in section I(A) above. The data producer may use the Investigator’s name and address for the purposes of (1) contacting Investigator to provide information regarding updates to the data, opportunities for user workshops/conferences, or other communications related to the data; or (2) conducting analyses of the types of individuals using the data.

VI. Certificate of Confidentiality

Research subjects who participated in Add Health are protected by a certificate of confidentiality issued by the Department of Health and Human Services in accordance with the provisions of section 301(d) of the Public Health Service Act (42 U.S.C. 241(d)). Institution is considered to be a contractor or cooperating agency of UNC Chapel Hill under the terms of the Confidentiality Certificate; as such, Institution, Investigator, and Research Staff are authorized to protect the privacy of the individuals who are the subjects of Add Health by withholding their identifying characteristics from all persons not connected with the conduct of the study. Identifying characteristics are all Add Health Data Files which are defined as confidential under the terms of this agreement.

VII. Incorporation by Reference

The parties agree that the following documents are incorporated into this Agreement by reference:

A. Copy of the IRB approval of the research project, taking into special consideration deductive disclosure risks.
B. All appendices included within this agreement (Please note that Appendices G-J are generated by the IDARS system once the Investigator has completed the application):

1. List of Funding Agencies (Appendix A)
2. Description of Deductive Disclosures Risk and the Department of Health and Human Services Confidentiality Certificate (Appendix B)
3. Information Regarding the Data Security Plan (Appendix C)
4. Example of Supplemental Agreement with Research Staff (Appendix D)
5. Example of Pledge of Confidentiality (Appendix E)
6. Add Health Data Files (Appendix F)
7. Data Security Plan (Appendix G)
8. Supplemental Agreement with Research Staff (Appendix H)
9. Pledge of Confidentiality (Appendix I)
10. Order Summary (Appendix J)

VIII. Miscellaneous

A. The laws of Michigan shall govern the validity and interpretation of the provisions, terms and conditions of the Agreement. In the event the parties are unable to resolve any dispute relating to this agreement, all suits, actions, claims, and causes of action relating to this Agreement shall be brought in the courts of the State of Michigan.

B. All notices, contractual correspondence, and return of data under this Agreement on behalf of the Investigator shall be made in writing and delivered to the address below:

Tannaz Sabet
Archive Manager
DSDR/ICPSR
1106D Perry Building
330 Packard Ann Arbor, MI 48104-1248
C. Provisions of Data Files, all notices, and contractual correspondence under this Agreement on behalf of ICPSR shall be made in writing and delivered to Investigator at the address listed on the Institutional Signatures page.

D. This Agreement shall be effective for the dates indicated on the Institutional Signatures page.

E. The respective rights and obligations of ICPSR and Investigator, Research Staff, and Institution pursuant to this Agreement shall survive termination of this agreement.

F. In the event of a material breach of this Agreement by the Investigator, Research Staff, or Institution, ICPSR may terminate this Agreement by providing written notice to Investigator and Institution. In this event, ICPSR will not be required to refund of any portion of the nonrefundable $800/$850 Processing Fee.

G. This Agreement may be amended or modified only by the mutual written consent of the authorized representatives of ICPSR and Investigator and Institution. Both parties agree to amend this Agreement to the extent amendment is necessary to comply with the requirements of any applicable regulatory authority.

H. This Agreement contains all of the terms and conditions agreed upon by the parties regarding the subject matter of this Agreement and supersedes any prior agreements, oral or written, and all other communications between the parties relating to such subject matters.

I. The obligations of Investigator, Research Staff, and Institution set forth within this Agreement may not be assigned or otherwise transferred without the express written consent of ICPSR.

J. Add Health's existing ownership rights in its intellectual property, including its Confidential Data and the Data Files, are not affected by this Agreement. Except as expressly set forth herein, no right, license, title, or interest in any of Add Health's intellectual property or in any invention, process, or product arising out of its intellectual property is granted or implied, whether or not patented or patentable.

K. This Agreement may be executed in one or more counterparts (facsimile transmission or otherwise), each of which counterpart shall be deemed an original Agreement and all of which shall constitute but one Agreement.
L. The parties’ electronic signatures shall be the legally binding equivalent of a handwritten signature.

M. Institution hereby appoints Investigator as its designated representative to execute, on behalf of Investigator and Institution, additional forms pursuant to this Agreement.
Investigator

Signature
Date
Print Name
Title
Institution
Building/Room Number
Street Address
City/State/ZIP
Telephone
Email

The person below signing this Agreement has the right and authority to execute this Agreement, and no further approvals are necessary to create a binding agreement.

Representative of Your Institution

Signature
Date
Print Name
Title
Institution
Building/Room Number
Street Address
City/State/ZIP
Telephone
Email
• Eunice Kennedy Shriver National Institute of Child Health and Human Development
• MacArthur Foundation
• National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, DHHS
• National Center for Minority Health and Health Disparities
• National Institute of Allergy and Infectious Diseases
• National Institute on Aging
• National Cancer Institute
• National Center for Health Statistics, Centers for Disease Control and Prevention, DHHS
• National Institute of General Medical Sciences
• National Institute of Mental Health
• National Institute of Nursing Research
• National Institute on Alcohol Abuse and Alcoholism
• National Institute on Deafness and Other Communication Disorders
• National Institute on Drug Abuse
• National Science Foundation
• Office of AIDS Research, National Institutes of Health (NIH)
• Office of Behavioral and Social Science Research, NIH
• Office of Minority Health, Centers for Disease Control and Prevention, DHHS
• Office of Minority Health, Office of Public Health and Science, DHHS
• Office of Population Affairs, Department of Health and Human Services (DHHS)
• Office of Research on Women's Health, NIH
• Office of the Assistant Secretary for Planning and Evaluation, DHHS
• Office of the Director, NIH
• Robert Wood Johnson Foundation
The problem of deductive disclosure of an individual respondent's identity has become a major concern of federal agencies, researchers, and Institutional Review Boards in the recent past. In essence, deductive disclosure is the discerning of an individual respondent's identity and responses through the use of known characteristics of that individual. This is not unique to Add Health—if a person is known to have participated in ANY survey, then a combination of his or her personal characteristics will allow an individual to determine which record corresponds to that individual. For example, in the Add Health in-school dataset of more than 90,000 cases, a cross-tabulation of five variables can distinguish an individual record.

The Add Health data poses greater confidentiality concerns than many other datasets to deductive disclosure. This is due, in part, to the clustered research design. Add Health surveyed all students in grades 7 through 12 in a pair of schools in each of 80 communities in the United States. The in-school questionnaires were administered by teachers at each school. More than 120,000 students were enrolled in these schools. Informational letters were sent to parents prior to the administration date via students and post. Assuming that most students live with two other persons (parents and/or siblings), 360,000 people know of the participation of at least one, if not many, of the adolescents attending the selected schools. Additionally, approximately 5,000 school administrators, staff and teachers were involved in the in-school data collection efforts.

The in-home selection process increased the number of persons aware of Add Health: about 5,000 participants in the in-home component had not completed an In-School Questionnaire. (Participation in the in-school session was not a prerequisite for eligibility, only the presence of an adolescent’s name on the school enrollment roster.)

Given the large number of people who know someone who, they know, participated in Add Health, researchers who use the Add Health Contractual Dataset are obligated to protect respondents from deductive disclosure risk by taking extraordinary precautions to protect the data from non-authorized use. Precautions include, but are not limited to: copying the original dataset only once and storing the original CD-ROM in a locked drawer or file cabinet; saving the computer programs used to construct analysis data files, but not the Data Files themselves; retrieving paper printouts immediately upon output; shredding printouts no longer in use; password protecting Add Health data; signing pledges of confidentiality; and using the data solely for statistical reporting and analysis.
June 1, 2012

Kathleen Mullan Harris
Carolina Population Center
123 West Franklin Street
CB#8120, University Square
Chapel Hill, NC 27515-2524

RE: CC-HD-06-09

Dear Dr. Mullan Harris:

This letter amends the Confidentiality Certificate protecting the identity of research subjects in your project entitled, "Add Health, Wave IV" has been amended to extend the Certificate expiration date until 6/20/2014.

If you determine that the research project will not be completed by the expiration date, 6/20/2014 you must submit a written request for an extension of the Certificate three months prior to the expiration date. Any such requests must include the reason for the request, documentation of the most recent IRB approval, consent forms, and the expected date for completion of the research project.

Please advise me of any situation in which the Certificate is employed to resist disclosure of information in legal proceedings. Should attorneys for the project wish to discuss the use of the Certificate, they may contact the Office of the NIH Legal Advisor, National Institutes of Health, at (301) 496-6043.

Correspondence should be sent to:

Steven Hirschfeld, MD, PhD
Associate Director for Clinical Research
Eunice Kennedy Shriver National Institute of Child Health and Human Development
31 Center Drive, Room 2A03, MSC 2425
Bethesda, MD 20892-2425

Sincerely,

Steven Hirschfeld, MD, PhD
CONFIDENTIALITY CERTIFICATE
CC-HD-96-39

issued to
University of North Carolina at Chapel Hill
conducting research known as
Add Health, Wave IV

In accordance with the provisions of section 301(d) of the Public Health Service Act 42 U.S.C. 241(d), this Certificate is issued in response to the request of the Principal Investigator, Kathleen Mullan Harris, Ph.D., to protect the privacy of research subjects by withholding their identities from all persons not connected with this research. Dr. Harris is primarily responsible for the conduct of this research, which is supported by an NCHRD grant P01HD31921.

Under the authority vested in the Secretary of Health and Human Services by section 301(d), all persons who:

1. are enrolled in, employed by, or associated with the University of North Carolina at Chapel Hill and their contractors or cooperating agencies and

2. have in the course of their employment or association access to information that would identify individuals who are the subjects of the research pertaining to the project known as, "Add Health, Wave IV,"

are hereby authorized to protect the privacy of the individuals who are the subjects of that research by withholding their names and other identifying characteristics from all persons not connected with the conduct of that research.

Add Health is a longitudinal study to investigate the determinants of health and health-related behavior during adolescence. The study began in 1994 with in-school questionnaires and was followed by three waves of in-home interviews, the last one in 2001-2002.

The current Wave IV will involve the original cohort of participants, now aged 24 to 32. It is designed to study developmental and health trajectories from adolescence into young adulthood, using an integrative approach that combines social, behavioral, and biomedical sciences in its research objectives, design, data collection and analysis.

Researchers plan to locate all eligible Wave I respondents, around 17,000 males and females from all major racial/ethnic groups found in the United States, and complete in-home interviews and a set of measures with each of them.

A Certificate of Confidentiality is needed because the study will collect sensitive information regarding health-related behaviors, emotional and physical health, school and work experiences, relationships with family, friends, spouses/partners and children, and use of alcohol and illegal drugs. The Certificate will help researchers avoid involuntary disclosure that could expose subjects or their families to adverse economic, legal, psychological, and social consequences.
All subjects will be assigned a code number and identifying information and records will be kept in locked files at the institution.

This research began January 1, 2006 and is expected to end on December 31, 2010.

As provided in section 301 (d) of the Public Health Service Act 42 U.S.C. 241(d):

"Persons so authorized to protect the privacy of such individuals may not be compelled in any Federal, State, or local civil, criminal, administrative, legislative, or other proceedings to identify such individuals."

This Certificate does not protect you from being compelled to make disclosures that: (1) have been consented to in writing by the research subject or the subject's legally authorized representative; (2) are required by the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) or regulations issued under that Act; or (3) have been requested from a research project funded by NIH or DHHS by authorized representatives of those agencies for the purpose of audit or program review.

This Certificate does not represent an endorsement of the research project by the Department of Health and Human Services. This Certificate is now in effect and will expire on December 31, 2010. The protection afforded by this Confidentiality Certificate is permanent with respect to subjects who participate in the research during the time the Certificate is in effect.

Date: 9/15/06

Yvonne J. Maddox, Ph.D.
Deputy Director
National Institute of Child Health and Human Development
Below are a number of locations where you might choose to store the Add Health data. Please read the descriptions for each option. More detail regarding the essential components of a good security plan is provided within the automated request system (IDARS) in the section that refers to security plans. It is recommended that you read through this section carefully.

**Data Stored on a Non-networked computer**
This plan is for researchers who want to store and analyze the data on a stand-alone desktop computer. A stand-alone computer is one that is in no way connected to another computer or networked device such as a switch, hub, or router.

**Data Stored on an External hard drive**
Select this plan if you will store the restricted-use data on an external hard drive and use a computer not connected to another computer or networked device to analyze the data. In this plan you must physically disconnect the computer from all networks before plugging in the external hard-drive that contains the data.

**Data stored on a Private-networked computer**
Use this plan if you will store and analyze the data on a private network (two or more computers and/or network devices, e.g., printer, switch, router that are not connected in any way to the Internet or a LAN).

**Data Stored on a Networked Windows computer**
In this plan the data are stored on a computer that is connected to the Internet or to a local or wide area network. For this plan, the data are also analyzed using software located on the networked Windows machine.

**Data Stored on a Networked Macintosh computer**
This plan is for researchers who will store and analyze the restricted-use data on a Macintosh desktop computer connected to a network. A network is two or more computers and/or network devices (e.g., printer, switch, router) connected to the Internet or a LAN.

**Data Stored on a Windows server**
For data stored on a file server running the Windows operating system, use this plan. Researchers access and analyze the data through their own computer.

**Data Stored on a NetWare server**
If the data will be stored on a NetWare server, choose this plan. Researchers access and analyze the data through their own computer.
**Networked UNIX (Linux, AIX, Solaris) computer**

Use this security plan for data stored and analyzed on a server running a version of the Unix or Linux operating system.
By virtue of my affiliation with this research project I have access to Confidential Data identified in this Agreement. I understand that access to this Confidential Data carries with it a responsibility to guard against unauthorized use and to abide by the Data Security Plan. To treat information as confidential means to not divulge it to anyone who is not a party to the Agreement for the Use of Confidential Data, or cause it to be accessible to anyone who is not a party to that Agreement.

I agree to fulfill my responsibilities on this research project in accordance with the following guidelines:

1. I have read the associated Agreement for the Use of Confidential Data.
2. I am "Research Staff" within the meaning of the Agreement.
3. I will comply fully with the terms of the Agreement, including the Data Security Plan.
4. I agree not to permit Confidential Data access to anyone not a party to the Agreement, in either electronic or paper copy.
5. I agree to not attempt to identify private persons as defined in the Agreement for the Use of Confidential Data.
6. I agree that in the event an identity of any private person is discovered inadvertently, I will (a) make no use of this knowledge, (b) advise the Investigator of the incident who will report it to ICPSR, (c) safeguard or destroy the information as directed by the Investigator after consultation with ICPSR, and (d) not inform any other person of the discovered identity.
By virtue of my affiliation with this research project I have access to Confidential Data identified in this Agreement. I understand that access to this Confidential Data carries with it a responsibility to guard against unauthorized use and to abide by the Data Security Plan. To treat information as confidential means to not divulge it to anyone who is not a party to the Agreement for the Use of Confidential Data, or cause it to be accessible to anyone who is not a party to that Agreement.

I agree to fulfill my responsibilities on this research project in accordance with the following guidelines:

1. I agree not to permit Confidential Data access to anyone not a party to the Agreement for the Use of Confidential Data, in either electronic or paper copy.

2. I agree to not attempt to identify private persons as defined in the Agreement for the Use of Confidential Data.

3. I agree that in the event an identity of any private person is discovered inadvertently, I will (a) make no use of this knowledge, (b) report the incident to ICPSR, (c) safeguard or destroy the information after consultation with ICPSR, and (d) not inform any other person of the discovered identity.
- Data will be delivered in format specified by applicant.
- Data will be sent on a CD by trackable delivery and the Investigator will be notified by email when the data are shipped.
- All data will be compressed and password protected.
- Codebooks will be delivered in electronic form on a CD.

**The following data will be sent automatically, upon execution of your agreement:**

**In-home Interview Files (#27021)**
- Wave I
- Wave II
- Wave III
- Wave IV

**School Files (#27021)**
- Wave I School Administrator
- Wave II School Administrator
- School Information
- In-School Questionnaire

**Weight Files (#27021)**
- Wave I Grand Sample Weights
- Wave II Grand Sample Weights
- Wave III Grand Sample Weights
- Wave IV Grand Sample Weights
- School Administrator Weights
- In-School Weights
The constructed datasets listed below are available by special request.

To receive one or more of these datasets, please include a brief statement in your IDARS application explaining the necessity and relevance of the data to your research agenda.
Friend Files (Study #27022)
- Wave I In-Home Nominations
- Wave II In-Home Nominations
- In-School Nominations
- Wave III Friend IDs

Sibling Files (Study #27023)
- Adolescent Pair Data
- Wave III Sibling IDs

Contextual Files (Study #27024)
- Waves I, II, III Contextual
- Wave I Spatial Analysis
- Wave I and II Neighborhood
- Wave III Grouping
- Wave III Region
- Wave III Supplemental Tract-Level
  - Contextual
- Wave IV Region
- Wave IV Grouping
- Wave IV Supplemental Tract-Level
  - Contextual

Supplemental Files (Study #27025)
- Wave III ASHA Call
- Wave III BEM Scores
- Wave III Cotinine Assays
- Wave III HPV-MGEN Assays
- Wave III Mentor
- Wave III Urinalysis
- Wave III HPV-MGEN Assay Weights

Weight Components (Study #27026)
- Wave I, II, III Weight Components
- In-School Weight Components
- Add Health School Weights
- Wave IV In-Home Weight Components

Data

Education Files (Study #27030)
- Academic Courses
- Academic Networks
- Context
- Curriculum
- Linking
- Primary
- Transition
- Weights

Genetic Files (Study #27031)
- Wave III DNA Results
- Wave IV DNA Results

Constructed Variables (Study #27033)
- School Network
- Wave IV Constructed

Disposition Files (Study #27034)
- Wave III Disposition
- Wave IV Disposition
- Wave I and II Disposition

ONE Files (Study #27881)
- Wave I and III Climate
- Wave I, III Street Connectivity
- Wave I, III Crime
- Wave I, III Geocode Source
- Wave I, III Land Cover
- Wave I, III Parks
- Wave I, III Resources
- Wave I, III Urban Distances
- Wave I, III Weather
- Wave I 1990 Population Density
- Wave III 2000 Population Density
- Wave I School Distance
- Wave III Mobility
• Wave III MSA Dataset
• Wave I, III ACCRA Cost of Living Index
• Wave I, III Employment
• Wave I, III Length of Day Dataset
• Wave I, III Road Type Length
• Wave I, III Rural-Urban Commuting Area

Alcohol Density File (Study #28841)
• Wave III Alcohol Outlet Density

Political Context Files (Study #28843)
• Wave I, II, III Political Context Data

Wave IV Medication File (Study #29261)
• Medication File Data

Wave IV Biomarker Data (Study #33443)
• Glucose-HbA1c
• CRP-EBV
• Wave IV Consent
• Lipids
Core Files

**Wave I In-home**- A merged file containing the Wave I In-home Interview data, the Parent Questionnaire data (when available), the In-school Questionnaire data (when available), and the Add Health Picture Vocabulary Test (when available), collected in 1994-1995, weights included.

**Wave II In-home**- Data collected during the 1996 In-home interview, and weights included.

**Wave III In-home**- Respondent-level data collected during the 2001-2002 In-home interview includes field interviewer characteristics, AHPVT, and weights.

**Wave IV In-home**- Respondent-level data collected during the 2008-2009 in-home interview.

**Wave I School Administrator**- Information from the Wave I self-administered questionnaire answered by an administrator at the school.

**Wave II School Administrator**- Information from the Wave II phone-administered interview answered by an administrator at the school.

**School Information**- Additional information about the individual schools.

**In-school Questionnaire**- Adolescent responses to the In-school Questionnaire administered September 1994 through April 1995.

School Files

**School Network**- Network variables constructed from the In-school questionnaire data and friendship nominations.

**Network Structure**- For each school pair, these files contain a valued friendship network and information on sex, grade in school, race, school pair, and total number of nominations made, including those to non-matchable or out-of-school friends. The files are stored as arc/edge lists in the PAJEK.PAJ format. Information on this freely available network software is at [http://vlado.fmf.uni-lj.si/pub/networks/pajek/](http://vlado.fmf.uni-lj.si/pub/networks/pajek/). Users should contact addhealth@unc.edu if they would like a copy of the Network Structure Data.

Friend Files

**In-School Nominations**- Identification numbers of the friends that the respondent nominated during the In-school questionnaire.
**Wave I In-home Nominations** - Identification numbers of the friends that the respondent nominated during the Wave I In-home interview.

**Wave II In-home Nominations** - Identification numbers of the friends that the respondent nominated during the Wave II In-home interview.

**Wave III Friend IDs** - In Wave III, respondents in the 7th or 8th grade at Wave I were asked to identify, from a list of 10 computer-generated names, which ones were current friends or which ones were their friends when they were in school together. This dataset contains the IDs of the 10 computer-generated names.

**Sibling Files**

**Adolescent Pair Data** - Information that links and describes the sibling pairs.

**Wave III Sibling IDs** - In Wave III, respondents were asked questions about their siblings who also participated in the Wave I or II In-home interviews; this dataset contains the IDs for these siblings.

**Contextual Files**

**Waves I, II and III Contextual** - Community contextual variables based on state, county, tract, and block group levels derived from the Waves I, II and III addresses.

**Waves I, II and III Grouping** - Pseudo state, county, tract, and block group variables that allow respondents to be aggregated geographically based on Waves I, II and III addresses.

**Spatial** - X, Y coordinates that can be used to calculate distances between friends in a school community.

**Wave III and IV Region** - This file contains the Census region codes for the respondents’ Wave III and IV residential locations.

**Wave IV Grouping** - The pseudo FIPS codes in this file allow you to geographically group respondents by their Wave IV locations.

**Wave III Supplemental Tract-Level Contextual** – This file contains supplemental Wave
III contextual data that include transportation and commuting measures, climate descriptors, amenities, and state-level tobacco control influences. These variables are available at the census tract-level unless otherwise specified.

**Wave IV Supplemental Tract-Level Contextual** – This file contains tract-level measures, based on the Wave IV respondent locations, reported by the U.S. Census Bureau’s 2009 American Community Survey (ACS), the Climate Atlas of the United States, the USDA Economics Research Service, Esri Data and Maps, ImpacTeen Tobacco Control Policy and Prevalence Data, and the Uniform Crime Reports. When tract level measures were not available or appropriate, state and county level variables were used.

**Wave III Supplemental Files**

- **Urinalysis**- This file contains nitrate, specific gravity, pH level, white blood cells, protein, glucose, ketone, urobilinogen, bilirubin, microalbumin, urine creatinine, and blood values from the Wave III urine specimens.

- **ASHA Call**- To receive the results of their STD assays, Wave III respondents called an Add Health dedicated number at the American Social Health Association. This file provides information on who called the results hotline and the date and time of the call.

- **HPV MGEN**- Assay results for human papillomavirus and mycoplasma genitalium are available for a subset of the Wave III respondents who provided a urine sample.

- **Mentor Codes**- For Wave III respondents who reported having a mentor, the open-ended responses to the question "How did {HE/SHE} help you?" have been coded and are available in this file.

- **BEM Scores**- The masculinity and femininity raw and standard scores from the 30 item short form BEM Sex-Role Inventory are available in this file.

- **Cotinine**- This file contains the cotinine and 3-hydroxycotinine assay values for 963 Wave III respondents.

**Genetic Files**

- **Wave III DNA Results**- Twin and full siblings interviewed at Wave III were asked to provide saliva samples for DNA analysis. This file contains the genotype values for DAT1 (dopamine transporter), DRD4 (dopamine receptor), and SLC6A4 (serotonin
transporter), MAOA_V (monoamine oxidase A-uVNTR), DRD2 (dopamine D2 receptor), and CYP2A6 (cytochrome P450 2A6) from these samples. Also included are values for the following SNPs: rs2304297, rs892413, rs4950, rs13280604.

**Wave IV DNA Results** - The Wave IV DNA Data File contains genotyping results for all Wave IV respondents who agreed to provide a saliva sample for DNA testing. This dataset has values for DAT1 (dopamine transporter), DRD4 (dopamine receptor), MAOA (monoamine oxidase A-uVNTR), 5HTTLPR (serotonin transporter), HTTLPR La-Lg-S, and triallelic activity bins for the serotonin transporter 5HTTLPR adjusted for rs25531.

**Education Files**

**Academic Courses** - These files contain academic status and/or performance indicators for math, science, foreign language, English, history, social sciences, physical education, and a combined overall category.

**Academic Networks** - The Network files provide information on social networks based on the respondents' course-taking patterns.

**Context** - School level contextual data are from the Common Core of Data (CCD), Private School Survey (PSS), the 1990 and 2000 Census, and the Office of Civil Rights.

**Course-Level** - The data in this file are needed for merging the course-level curriculum data with other Education Files.

**Curriculum** - These math and science curriculum data are derived from coding the textbooks] schools reported using for each course offered in these two subjects.

**Linking** - This file contains variables designed to link transcript data to academic or school years and to Add Health.

**Primary** - The Primary Component contains several types of indicators based on information collected from participating schools and listed directly on student transcripts such as student exit or graduation status and materials gathered from schools during the data collection process.

**Transition** - This file contains variables explaining the respondents' movement through the educational system.

**Weights** - This file contains weights for the education data along with the school weights needed for HLM analyses.
Weight Files

**Weight Components**- A weight component for each level of sampling (school and adolescents) has been created for each wave of data collection. This file contains the weight components needed for computing multilevel weights.

**HPV MGEN Weights**- Sample weights for respondents with HPV and MGEN assay results are in this file.

The Obesity and Neighborhood Environment (ONE)

**Wave I and III Connectivity Files**- These files contain road network connectivity measures within 1, 3, 5, and 8.05 km (5 miles) of the Wave I and III respondent locations.

**Wave I and III Crime Files**- The county level crime data in these files are based on the Wave I and III respondent locations.

**Wave I and III Geocode Source**- The data sources of the Wave I and III respondent residential geocodes (latitude and longitude) are provided in these files.

**Wave I and III Land Cover Data**- These files contain land cover metrics within 1, 3, 5, and 8.05 km (5 miles) of each respondent’s location.

**Wave I and III Parks Data**- The counts of public parks within a Euclidean distance of 1, 3, 5, and 8.05 km (5 miles) of each respondent at Wave I and III are in these files.

**Wave I and III Resources Data**- The Add Health files provide data on the presence of various physical activity (PA) resources situated near respondent residences at Wave I and III.

**Wave I and III Urban Distances**- W1URBDST contains Euclidean distances to both 1990 and 2000 U.S. Census Urbanized Areas (UAs) for each Wave I respondent. W3URBDST contains the Euclidean distance to 2000 U.S. Census-Bureau-defined urbanized areas (UAs) for each Wave III respondent.

**Wave I School Distance Measures**- This file contains the distance between the geocoded point locations of each respondent's Wave I location and that respondent's school.

**Wave III MSA Pseudo Codes**- The MSA pseudo code created for each respondent's Wave III location is in this file.
**Wave III Mobility Data**- W3MOBIND reports the distance between each respondent's geocoded point location for each survey wave and that respondent's school location, along with the respondent's move distance between each survey wave.

**Wave I, III Climate Data**- This file contains the climate data for each Wave III respondent based on the nearest climate station. Information is available on precipitation, total snowfall, sky cover, temperature, and total hours of sunshine.

**Wave I, III Population Density**- The Wave I population density file contains the proportion of 1990 U.S. Census block group population and area (in square meters) within 1, 3, 5, and 8.0472 km (5 mi) of each Wave I respondent. The Wave III population density file contains the proportion of 2000 U.S. Census block group population and area (in square meters) within 1, 3, 5, and 8.0472 km (5 mi) of each Wave III respondent.

**Wave I, III Weather Data**- This file contains weather data for each Wave III respondent based on the nearest weather station reporting data for the correspondent survey month and year.

**Wave I, III ACCRA Cost of Living Index**- These Add Health Data Files contain ACCRA Cost of Living Index based on the location of the Wave I and Wave III respondents.

**Wave I, III Employment**- These Data Files contain county-level employment data attached to each Wave I and Wave III respondent location.

**Wave I, III Length of Day Datasets**- These Data Files contain the number of hours of daylight at each Wave I and Wave III respondent location on that respondent's survey date.

**Wave I, III Road Type Length**- These Data Files contain road type length calculations within radii of 1, 3, 5, and 8.05 kilometers (5 miles) of Wave I and Wave III respondent locations.

**Wave I, III Rural-Urban Commuting Area (RUCA)**- These Data Files contain Rural-Urban commuting area (RUCA) codes at the U.S. Census tract-level based on the location of Wave I and Wave III respondents.

---

**Alcohol Density Files**
**Wave III Alcohol Outlet Density Data**- This Add Health Data File measures the prevalence of alcohol outlets in respondent communities by reporting the tract-level density of establishments possessing on- and/or off-premise alcohol licenses.

**Political Context Files**

**Wave I, II, III Political Context Data**- The Add Health Political Context Database provides an array of measures that describe the political environments in which Add Health respondents reside. These contextual variables include measures of commuting, election results for gubernatorial, presidential, and senatorial races, and voter registration law.

**Wave IV Medication File**

The files contained in this component of the Add Health restricted data include the type of medication used by participants during Wave IV

**Wave IV Biomarker Data**

**Glucose and HbA1c Data**- This file contains two measures of glucose homeostasis based on the assay of the Wave IV dried blood spots.

**CRP and EBV Data**- The results of the assays for CRP (C-reactive protein) and EBV (Epstein-Barr virus) are in this Data File.

**Wave IV Consent**- In this file are variables indicating the types of consent (archive, no archive, refused, incarcerated) obtained for the Wave IV blood spot and saliva DNA collections.

**Lipids Data**- The Lipids data file contains measures of triglycerides (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), non-high-density lipoprotein cholesterol, and total cholesterol to high-density lipoprotein cholesterol ratio.