MEDIATORS AND MODERATORS OF THE RELATIONSHIP BETWEEN FAMILY VARIABLES AND CHILD PHYSICAL ACTIVITY

By

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PUBLIC ABSTRACT

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Parents and family are important influences on children's health behaviors (e.g., physical activity), yet few factors reflecting family dynamics and parenting behaviors/strategies have been explored in relation to child physical activity. 'Parenting styles' refer to the emotional climate that parents establish for children. Parenting style is classified based on (1) parental warmth/love shown to the child (high or low), and (2) parent's behavioral expectations/rule enforcement for the child (high or low). It is not clear how parenting style might influence child physical activity. It is also not clear if other variables known to be related to child physical activity (e.g., parent depression) may influence the relationship between parenting style and child physical activity; exploring these relationships may help clarify understanding of why some children are more active than others. Another family variable which has not been explored in relation to child physical activity is marital conflict. Marital conflict has a negative influence on parenting and child wellbeing but has not been explored in relation to physical activity or parenting behaviors shown to be associated with child physical activity. Therefore, the purpose of this dissertation was to address the need to examine new family variables in relation to child physical activity; specific aims were to: (1) examine whether parent depression and parenting style of mothers and fathers demonstrate a combined association with physical activity among male and female youth; and (2) examine whether marital conflict is associated with child physical activity and whether marital conflict influences child physical activity through parent encouragement of child physical activity. **Methods**: Data came from the Study of Early Child Care and Youth Development. To

address aim one, physical activity (measured when children were in 6th grade) was examined in relation to parent depression (measured when children were in 6th grade) and harsh/strict and lax/relaxed parenting practices (measured when children were in 3rd grade). These relationships were examined for all parent and child sex combinations, accounting for child's weight status and family income. To address aim two, measures of physical activity, marital conflict, and encouragement of child physical activity when children were 10-, 11-, and 15-years old were used. The effect of marital conflict (at age 10) on child physical activity (at age 15) was examined. In addition, the indirect effect of marital conflict (at age 10) on child physical activity (at age 15) via parent encouragement of activity (at age 11) was examined. **Results**: The first study indicated a small, borderline significant, combined influence of depressive symptoms and harsh parenting by the mother on female youth, but not males. Higher depression score and harsher parenting by the mother were associated with lower physical activity among females. There was no evidence of a combined effect of father's depression and parenting on youth physical activity. The second study indicated that more marital conflict at age 10 predicted more parent encouragement of physical activity at age 11 and more youth physical activity at age 15. These results were found for females only. There was no evidence that the influence of marital conflict on child physical activity acted through parent encouragement of physical activity. **Conclusions**: The studies indicate small effects of family variables on youth physical activity and suggest the continued exploration of family variables to better understand variation in child activity. The findings suggest that relationships among family variables and child physical activity may depend on the sex of the parent and child. The results indicate that the physical activity of girls (compared to boys) may be more susceptible to family/parenting factors.

ABSTRACT

MEDIATORS AND MODERATORS OF THE RELATIONSHIP BETWEEN FAMILY VARIABLES AND CHILD PHYSICAL ACTIVITY

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Parents and family are salient influences on child physical activity. Family variables examined in relation to physical activity thus far are limited to parenting practices and styles. Findings regarding parenting styles and child physical activity are mixed, suggesting the value of exploring moderators. Parent depression moderates the association between parenting style and child obesity, but has not been explored in relation to youth physical activity. Examining additional family variables in relation child physical activity would be valuable. Existing studies suggest the potential mediating role of parenting in associations between family variables and child physical activity, yet there is currently no empirical support for this notion. Belsky (1984) outlines alternative family variables and emphasizes the salience of the marital relationship. Marital conflict negatively influences parenting and child outcomes yet has not been explored in relation to physical activity-specific parenting behaviors or child physical activity. Thus, the purpose of this dissertation was to address the need for further examination of family variables in relation to child physical activity; specific aims were to: (1) examine the moderating influence of parent depression on associations between mothers' and fathers' parenting styles and physical activity among male and female youth; and (2) test an indirect effects model, examining the mediating influence of parental encouragement on the association between marital conflict and youth physical activity during early adolescence. **Methods**: Data came from the Study of Early Child Care and Youth Development. To address aim one, physical activity (measured when children were in 6^{th} grade) was examined in relation to parent-reported depression (measured

when children were in 6th grade) and parent-reported harsh and lax parenting practices (measured when children were in 3rd grade). Separate analyses were performed for all parent and child sex combinations, with and without covariates (child BMI z-score and socio-economic status). To address aim two, measures of physical activity, marital conflict, and encouragement of child physical activity when children were 10-, 11-, and 15-years old were used. A longitudinal, autoregressive model was used to examine the indirect effect of marital conflict (at age 10) on child physical activity (at age 15) via encouragement of activity (at age 11). **Results**: The moderation study indicated a borderline significant interaction between maternal depressive symptoms and harsh parenting strategies for female youth whereby higher depression and harsh parenting predicted lower activity. The interaction effect of mother variables on physical activity among male youth, and father variables on physical activity among male and female youth was non-significant. The mediation study indicated a significant, positive effect of marital conflict at age 10 on encouragement of activity at age 11 and on physical activity at age 15. When analyzing by child sex, associations were significant/marginally non-significant for females and non-significant for males. The indirect effect of marital conflict on activity via encouragement was non-significant for males, females, and the total sample. **Conclusions**: The studies indicate small, significant, direct and moderating effects of family variables on youth activity and support the further exploration of family variables in relation to child physical activity. The findings suggest that the moderating role of parent and child sex in the associations should be accounted for in future research. Girls' physical activity may be more susceptible to family/parenting dynamics and there is likely to be value in considering family and parent psychosocial variables in the endeavor to understand variation in youth physical activity levels.

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CHAPTER 1: INTRODUCTION

Regular physical activity affords a multitude of physical and mental health benefits to youth and adults (Roriz Oliveira et al., 2015; Kelishadi et al., 2014; Bursnall, 2014). Physical activity levels in childhood are reported to track into adulthood, with more active youth becoming more active adults who have a lower risk of developing multiple chronic diseases and mental illnesses (Telema et al., 2014). Despite the benefits of regular physical activity becoming increasingly common knowledge, a majority of youth do not participate in the U.S Department of Health and Human Services' (2008) recommended dose of physical activity (Troiano et al., 2008). It is therefore important to identify factors which will promote physical activity among youth in the endeavor to establish regular physical activity patterns in childhood which may continue into adulthood.

Since establishing the positive relationship between physical activity and health outcomes, research efforts have focused on determining antecedents and correlates of youth physical activity. Recent reports indicate the salience of parents and family to a child's physical activity (e.g., Elder et al., 2015; Ohri-Vachaspati et al., 2015; Verloigne et al., 2012; Davison and Birch, 2001). The current literature on parenting and family influences on child physical activity has focused on the associations among parenting practices, parenting styles, and physical activity.

Parenting Practices and Physical Activity in Children

Parenting practices refer to specific parent behaviors such as setting limits on television time and paying for a child's sport club fees. Few parenting practices demonstrate a consistent association with child physical activity, despite the wide range of practices that have been explored. The

parenting practice most consistently associated with child physical activity is parental support of child physical activity; parental support takes a variety of forms, the main three are logistical support (e.g., transportation and payment), parent involvement in physical activity with the child, and parental emotional support/encouragement of the child's physical activity involvement. Of these three types of support, parental encouragement/emotional support appears to be the most salient (e.g., Pugliese and Tinsley, 2007; Duncan et al., 2015). Parent encouragement is reported to influence child physical activity through a variety of psycho-social mechanisms, including self-efficacy and attraction to physical activity (Trost et al., 2003; Biddle and Goudas, 1996). Parent encouragement may thus be worthy of further examination as an important parental influence on child physical activity.

Parenting Styles and Physical Activity in Children

Parenting style refers to the emotional climate established through the warmth and structure conveyed by the parents in their interactions with the child, and it is typically classified as one of four styles: authoritative (high levels of warmth and structure conveyed to the child), authoritarian (low levels of warmth and high structure), permissive (high levels of warmth, low structure) or negligent/neglectful (low levels of warmth and structure; Baumrind, 1971; Maccoby and Martin, 1983). Parenting styles have received less empirical attention than parenting practices in relation to child physical activity. While significant associations between parenting styles and physical activity are consistently reported, the findings regarding which parenting styles are positively and negatively associated with child physical activity are inconsistent, and conclusions regarding the ideal parenting style to promote physical activity in children cannot be drawn. The mixed nature of the findings implies the value of exploring moderators of the associations between parenting style and child physical activity (Ventura and Birch, 2008).

Other Family/Parenting Variables and Physical Activity in Children

The existing literature on family/parenting and child physical activity currently demonstrates a restricted focus to parenting practices and styles. This is a recognized limitation and the extant literature calls for future research to examine: (1) the determinants/predictors of parenting practices and styles, and (2) other family variables in relation to child physical activity. These identified research directions are supported by the tenets of Family Systems Theory (Minuchin, 1985; Cox and Paley, 1997). Family Systems Theory explains that the development of a given family member is dependent on other family members and provides a theoretical basis for examining family influences on the development of child behaviors. Berge (2009) proposed an application of Family Systems Theory to the health behavior domain (see figure 1.1). The model refers to an additional type of family variable, 'family functioning'. Family functioning refers to variables which reflect communication between family members and the ability to function cohesively with others – as such, measures of communication, conflict, problem-solving strategies, the ability to support and respond to other family members, can all be considered indicators of 'family function'.

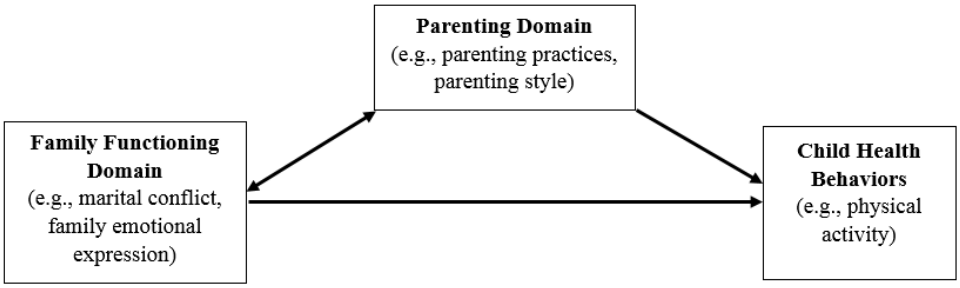

Figure 1.1 Part of Berge's (2009) application of Family Systems Theory to child health behaviors.

The model by Berge (2009) specifies a direct influence of family functioning on parenting and child health behaviors, and an indirect influence of family functioning on child health behaviors, via parenting. While the tenets of this framework have been examined and are supported in relation to child nutrition behaviors and childhood obesity (e.g., Zeller et al., 2007; White et al., 2004; Kitzman-Ulrich et al., 2010), the direct and indirect relationships between family function variables and child physical activity have received limited empirical attention. Examining associations between family function variables and child physical activity would expand the currently restricted focus on parenting styles/practices and address some of the future research directions highlighted by the existing literature on parenting practices/styles and child physical activity.

While limited, there is an existing body of literature examining family function indicators and child physical activity. To date, eleven studies have examined these variables. Family function variables demonstrating direct associations with child physical activity include general family functioning, family cohesion and conflict, parent distress/stress, family intimacy, maternal depression, and employment demands (Atkin et al., 2015; Berge et al., 2013; Loprinzi, 2015; Bigman et al., 2014; Ornelas et al., 2007; Fernald et al., 2008; Johnson and Allen, 2013). Identified mediators of family influences on child physical activity (from three studies; Ornelas et al., 2007; Fernald et al., 2008; Gray et al., 2008) include child self-esteem, child depressive symptoms, child perceived barriers to physical activity, and child internalizing behaviors. Collectively, the results are consistent with the notion of Family Systems Theory, that a more positive family system (e.g., lower parent depressive symptoms, higher family cohesion) is associated with more favorable child outcomes, e.g., higher child physical activity, and the

significant findings indicate the value of further exploring the relationships between family function variables and child physical activity.

Although the majority of studies examining family function variables and child physical activity (ten out of eleven) reported significant associations, there are several limitations which should be addressed in future research. The current literature is small and further studies are needed to confirm or refute the existence of associations among family function variables and child physical activity. In addition, measurement issues are raised across the eleven studies including the use of self-report measures to assess physical activity. An abundance of literature suggests that objective measurement of physical activity is more valid in children (e.g., Going et al., 1999; Welk et al., 2000). Research exploring associations between child physical activity and family variables using objective measures of physical activity will make a valuable addition to this literature.

Eight of the eleven studies examining associations between family function indicators and child physical activity reported cross sectional associations and only three studies have used longitudinal data. Temporal associations cannot be inferred from cross-sectional investigations, and additional longitudinal studies examining associations between family function indicators and child physical activity are needed to better assess temporality and causality.

There has also been a limited application of family theory to the examination of family and parenting influences on child physical activity. Family Systems Theory (Minuchin, 1985; Cox and Paley, 1997) is briefly discussed in existing studies on family function indicators and child physical activity. Other theoretical models mentioned in the literature on family function indicators and child physical activity include Resource Drain Theory (Edwards and Rothbard, 2000) and the Family Stress Model (Conger, Rueter and Conger, 2000), which explain the

negative influence of parent stress on parenting and child outcomes. Using relevant theoretical frameworks to guide research questions involving family variables and child physical activity will facilitate the progression of the research field by testing theories and potentially identifying more pertinent research questions and variables for study. In addition, Family Systems Theory has received limited empirical attention in the health domain. Research which can report on the applicability of family-focused theoretical frameworks to child physical activity will indicate the potential of such frameworks for facilitating the progression of research on family function and parenting influences on child physical activity.

In summary, theoretical frameworks and existing literature on family function indicators suggest the value of examining the relationships among family variables and child physical activity, as well as parenting variables which may be associated with physical activity, e.g., specific parenting practices and styles (Berge, 2009). Future research is required to substantiate the small pool of existing findings, and studies using objective measures of child physical activity will make valuable contributions. Considering family theory (e.g., Minuchin et al., 1985) will help guide research questions and the selection of variables for future study. Studies examining longitudinal data are also needed. Research which can address one or more of these limitations will make a valuable contribution to current understanding of family and parent influences on child physical activity.

Family Function Variables and Child Physical Activity

The model by Berge (2009) indicates the influence of family function indicators on child physical activity, although does not identify specific family function indicators for further examination. To this point, the work on parenting determinants presented by Belsky (1984; see figure 1.2) may be helpful. Belsky (1984) suggests that variables such as the marital relationship,

employment stress, and parent characteristics (e.g., aspects of personality) are parenting antecedents. Of the variables model proposed in the model, parent characteristics and the marital relationship are highlighted as particularly salient influences on parenting, and may thus be important to examine in relation to child outcomes such as physical activity. The model by Berge (2009) indicates the influences of family function indicators on both child physical activity and parenting, and thus suggests the value of exploring the direct influence of such family variables on child physical activity, as well as how family function variables operate with parenting variables such as parenting practices and styles, to influence physical activity in youth.

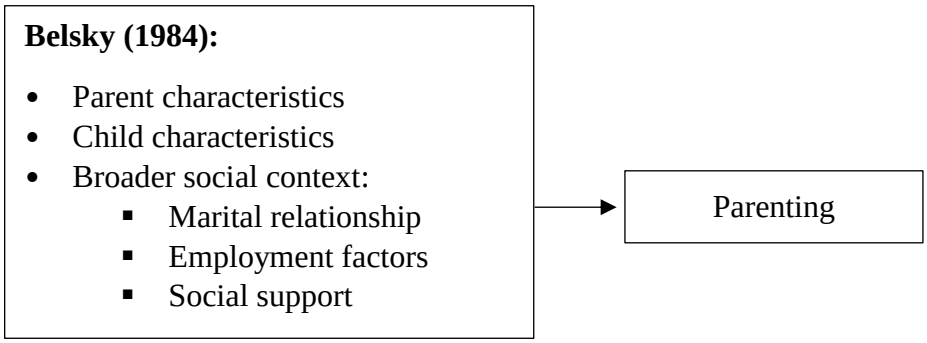

Figure 1.2 Determinants of Parenting (Belsky, 1984)

Family Function Variables, Parenting Style, and Child Physical Activity

The equivocal findings reported from the literature on parenting styles and child physical activity suggest the value of exploring moderators of this relationship. The models by Berge (2009) and Belsky (1984), indicate that family function variables may be worth exploring as moderators of the associations between parenting style and child physical activity. Family variables may exacerbate aspects of parenting styles known to encourage or discourage physical activity in youth and have an interactive effect with parenting style on physical activity in youth.

Moderators of associations between parenting style and physical activity in youth have not been explored.

Of the factors outlined in the framework by Belsky (1984), parenting characteristics are identified as being a particularly salient influence on parenting. One parenting characteristic which has been consistently linked with parenting, and has demonstrated links with child health behaviors and outcomes, is parent depression (Topham et al., 2010; Sterrett et al., 2013). Parent depression is detrimental to parenting and increases hostility towards children (Lovejoy et al., 2000; Goodman and Brumley, 1990; Forehand et al., 1986). Consistent with the predictions of Family Systems Theory, parent depression is associated negative outcomes for children including a higher risk of obesity (Audelo et al., 2016) and poor nutrition behaviors (Goulding et al., 2014). Only one study has examined the influence of parent depression on child physical activity (Fernald et al., 2008). This study reported a significant, negative influence of maternal depression on the physical activity of young (<5 years old) Mexican children. The role of parent depression in influencing the physical activity of older youth has not been explored.

Parent depression has been identified as a significant moderator of the association between parenting style and child BMI (Topham et al., 2010), and parenting style and a healthy lifestyle index (Sterrett et al., 2013). The authoritarian and permissive (i.e., less optimal) parenting styles, and parent depression are independently associated with showing more irritability/hostility and less warmth towards youth (authoritarian parenting style), and inconsistent discipline strategies (permissive parenting style). Thus, parent depression may exacerbate parenting behaviors reported to have negative consequences for child development, and as such have an interactive, moderating influence on relationships between parenting style and child outcomes. The salience of depression to parenting, the reported role of depression as a

moderator of the relationship between parenting styles and health indictors, and the indication of a direct association between depression and physical activity in younger children indicates the value of exploring depression as a moderator of the association between parenting styles and youth physical activity.

Family Function Variables, Parenting Practices and Child Physical Activity

Among the parenting antecedents outlined by Belsky (1984), factors pertaining to the martial relationship are reported to be of high importance. Marital conflict pertains to the marital relationship and is associated with negative parenting practices, less emotional support provided to children, and less parent-child closeness, (Kendler et al., 1997; Erel and Burman, 1995; Macfarlane et al. 1995; Coln et al., 2013). In addition, Resource Drain Theory (Edwards and Rothbard, 2000) and the Family Stress Model (Conger, Rueter & Conger, 2000) predict that emotional resources expended in dealing with stress (such as that caused by marital conflict) will reduce emotional energy and attention available for parenting, and result in poorer parenting behaviors. Marital conflict may thus reduce parental energy and be detrimental to aspects of the parent-child relationship which are reported to predict the enactment of salient child physical activity support behaviors. This, in turn, may consequently be detrimental for child physical activity. The potential mediating influence of parenting factors, such as child physical activity support behaviors, on the association between family function variables and child physical activity is indicated by existing studies (e.g., Berge et al., 2013, Gray et al., 2008, Fernald et al., 2008) yet has received limited empirical attention. A parenting support practice consistently reported to be associated with child physical activity is parental encouragement of physical activity (e.g., Pugliese and Tinsley, 2007) and as such, this variable may be worth exploring as a potential mediator of the association between family factors and child physical activity.

Given the negative consequences of marital conflict on the parent-child relationship and on positive parenting behaviors, it is plausible that marital conflict will be negatively associated with parental encouragement of child physical activity and therefore salient to child physical activity. This mediation model has not been tested and would provide information on the dynamics of associations among family function, parenting, and child physical activity.

To date, only three studies examining associations between family function variables and child physical activity have examined variables which might mediate the direct relationship. These studies primarily examined the mediating role of child characteristics, with only one study examining a parenting behavior as a potential mediating variable (mother's physical activity; Ornelas et al., 2007). There is a need for further research examining parenting variables as mediators of direct associations between family variables and child physical activity. Further to this, the mediation studies examined thus far are cross-sectional (Gray et al., 2008) or half longitudinal models with data collected at two time points (Fernald et al., 2008; Ornelas et al. 2007); there are weaknesses to this half-longitudinal statistical approach, which include the assumption that relationships between variables in the model have reached equilibrium and demonstrate consistency across time points (Cole and Maxwell, 2003). Early and middle adolescence are a time of intense physical and social change (Collins and Steinberg, 2006); relationships observed between family function or parenting variables, and measures of child/adolescent behavior may thus be prone to change during the late childhood and early adolescent years. Thus, there is a need for research employing more robust data analysis strategies to examine mediating influences, such as full longitudinal mediation model, where data for all variables are collected at all time points of interest, and data are collected at a minimum of three time points (Cole and Maxwell, 2003). Statistical analysis of the mediating

influence of parenting variables on the association between family function indicators and child physical activity would provide valuable information on the dynamics of family function and parenting variables in relation to child physical activity.

Summary

There is a need to expand the range of parenting and family-related variables examined in relation to child physical activity. Research on the predictors of childhood obesity, child nutrition behaviors, child physical activity, as well as theoretical frameworks, support the examination of family function indicators in relation to child physical activity. Empirical evidence and theoretical frameworks imply the value of examining the role of family function indicators in moderating and mediating relationships with parenting variables and child physical activity. Such findings would provide valuable information on the dynamics of family, parenting and child behavior variables in the health domain, and could inform intervention design.

The current body of literature examining family factors and child physical activity is limited by measurement issues, a small number of studies, a lack of theoretically driven research questions and variable choices, and the primarily cross-sectional nature of the majority of the studies. Research using objective measures of physical activity, and studies drawing on family-focused theoretical frameworks to select relevant variables will facilitate the progression of research in this area. In addition, there is a need for more studies examining longitudinal data, which will permit conclusions regarding temporality as well as robust statistical testing of the mediation pathway suggested to operate between family function indicators and child physical activity.

This project addressed limitations of the current literature on the relationship between (1) parenting styles and child physical activity, and (2) family function indicators and child physical activity. Both studies were based on the tenets of Family Systems Theory and drew on the theoretical framework outlined by Belsky (1984) to identify salient family variables for examination. The first study explored the role of parent depression as a moderator of associations between parenting styles and child physical activity. This study attempted to clarify the equivocal findings currently reported regarding parenting styles and child physical activity. To address limitations of previous studies, physical activity was measured by accelerometry and parenting style strategies were assessed using a continuous measure. Parent depression has not been considered in relation to child physical activity among early adolescents, nor has it been examined as a moderator of the relationship between parenting style and child physical activity. As such this study makes a valuable contribution to the literature.

In the second study, marital conflict was examined as a direct and indirect predictor of youth physical activity (via parent encouragement of physical activity) in a longitudinal indirect effects model. This study sought to provide empirical evidence for the notion that direct associations between family function variables and child physical activity were mediated by parenting factors. To address limitations of previous studies, a full longitudinal mediation model was examined with all variables measured at all time points which allowed prior levels of mediator and outcome variables to be controlled. In addition, physical activity was measured by accelerometry. This study was the first to examine the cross-sectional and longitudinal influence of marital conflict on child physical activity and parent encouragement of child physical activity, and therefore makes a valuable contribution to the literature examining relationships among family function indicators, parenting behaviors, and child physical activity.

Purpose and Aims

The purpose of this dissertation was to use theory to inform an examination of moderating and mediating relationships among family factors, parenting, and physical activity in youth. Specific aims and hypotheses follow.

Aim 1: To examine the moderating influence of parent depression on associations between mothers' and fathers' parenting styles and physical activity among male and female youth.

Hypothesis 1: Maternal and paternal depression would moderate the association between harsh (authoritarian) and lax (permissive) parenting strategies and child physical activity.

Aim 2: To test a longitudinal indirect effects model examining the mediating influence of parental encouragement on the association between marital conflict and youth physical activity during early adolescence.

Hypothesis: A negative relationship between marital conflict and child physical activity would be partially mediated by parent encouragement of child physical activity.

The remaining chapters of this dissertation include a literature review (chapter 2), a manuscript addressing the first aim and hypothesis (chapter 3), a manuscript addressing the second aim and hypothesis (chapter 4), and an overall summary of the findings (chapter 5).

CHAPTER 2: LITERATURE REVIEW

Youth Physical Activity: The Importance of the Family

Despite public awareness that physical activity and regular exercise are beneficial for health, a minority of children are sufficiently active to attain the health benefits associated with achieving the physical activity guidelines promoted by the U.S Department of Health and Human Services (2012; Troiano et al., 2008). To date, current intervention efforts have been met with weak to moderate success (Biddle et al., 2014), and the need to continue to examine and identify predictors of physical activity in children is apparent. With the aim of identifying efficacious physical activity intervention strategies, research efforts directed towards identifying factors associated with physical activity in children is necessary.

Examination of predictors of physical activity among youth began in the 1980's (e.g., O'Connell et al., 1985) and the continued exploration of these factors led to the first literature review of correlates of physical activity in youth a decade later (Kohl and Hobbs, 1998). Since then, research efforts and reviews have identified the family and parents to be a salient influence on child physical activity and related health outcomes and behaviors. For example, in a review of ecological factors associated with children's nutrition and physical activity behaviors, Davison and Birch (2001) concluded that all risk factors for the development of childhood obesity (e.g., diet and physical activity behaviors) have beginnings in the family domain. Baskin et al. (2013) also highlighted the relatively greater importance of family social support for physical activity among African-American adolescents when compared to the influence of adolescent demographics, home environment characteristics, and neighbourhood characteristics. Similarly, a review of physical activity correlates reported that of 14 predictor variables (from multiple levels of the socio-ecological model), four were significantly associated with child physical activity:

parent physical activity, parent support, gender, and self-efficacy (Van der Horst et al., 2007). Two of the four significant predictors (parent physical activity and parent support) represent parenting variables, consistent with the suggestions of the importance of the parenting domain by Baskin et al. (2013) and Davison and Birch (2001). In another literature review of correlates, Verloigne et al. (2012) reported that 17 of 50 family- and school-based variables demonstrated a significant association with child physical activity, and of these 17 significant predictors, 13 were parenting variables (e.g., parent sedentary time and parent enjoyment of physical activity). These findings imply the importance of the family and parents to child physical activity, and are further supported by systematic reviews in related bodies of literature such as the antecedents of child weight status. For example, Ohri-Vachaspati et al. (2015) concluded that parent-related variables, compared to a range of other predictors, explained the largest proportion of variation in child weight status, and Elder et al. (2015) reported the stronger contribution of family factors, relative to school and community factors, to weight status among Latino youth. Collectively, the reviews indicate that family/parents are salient to understanding variation in child health behaviors, including physical activity, and suggest the value of further exploration of variables pertaining to the family/parents.

Current literature on Family/Parenting and Child Physical Activity

A range of parenting variables have been examined in relation to child physical activity and two main areas of research have emerged: (1) parenting practices and child physical activity; and (2) parenting styles and child physical activity. Parenting practices refer to specific parenting behaviors, for example, setting limits on television viewing time, encouraging the child to be physically active, and transporting the child to sports clubs. Parenting styles refer to the socio-emotional climate created by parents through their interactions with the child. Parenting style is

typically classified as one of four types, based on responsiveness/warmth/emotional support and demandingness/structure/rule enforcement (see figure 2.1; Baumrind, 1971; Maccoby and Martin, 1983). An authoritative parenting style (associated with high responsiveness and high demandingness) is associated with optimal child outcomes (e.g., academic achievement and social development; Cohen and Rice, 1997; Radziszewska et al., 1996; Rintala et al., 2000). Multiple studies have reported on the association between practices, styles and physical activity in youth, and reviewing the findings will serve to identify gaps for future research and specific practices and styles which may be worthy of further examination in the endeavor to understand variation in child physical activity.

		Demandingness	
		High	**Low**
Responsiveness	**High**	Authoritative	Permissive
	Low	Authoritarian	Neglectful/Rejecting

Figure 2.1 Baumrind (1971) and Maccoby & Martin's (1983) Parenting Style Classifications

Parenting Practices and Physical Activity in Children

One of the earliest reviews of correlates of child physical activity identified significant associations between several parenting behaviors and physical activity in children, including parent's participation in physical activity with youth, parent encouragement of child physical activity, and parent transportation of child to physical activity opportunities (Sallis et al., 2000). Since then, the literature has grown and a wide range of parenting practices have been examined (see table 2.1).

Synthesizing the literature on parenting practices is challenging due to the use of varying assessment tools and definitions of parenting practices and behaviors. For example, 'parent support' is sometimes assessed as a single variable, and in other instances, multiple types of parent support are assessed and reported separately. Common sub-categories of parental support include encouragement/emotional support, instrumental/logistic support and parent involvement (i.e., parent being active with the child). Modelling of physical activity by the parent is often reported as a separate variable, although some studies have considered parent physical activity as a form of parent support or 'family influence'. In addition, some studies assessed 'parent support' or 'family influence' using a questionnaire with items pertaining to parent physical activity, parent transportation of child to physical activity, and parent encouragement for physical activity. In these instances, results for a 'parent support' variable are presented and associations between child physical activity and specific parenting behaviors (i.e., parent physical activity and parent transportation of child to physical activity) cannot be ascertained. This assessment inconsistency makes it challenging to draw conclusions regarding the influence of specific parenting practices and behaviors on child physical activity.

Table 2.1 Parenting practices identified as correlates of child and adolescent physical activity

Parent modelling of PA	Parent encouragement of child PA	Child PA rules/restrictions
Family modelling of PA	Parent logistic support for PA	Sedentary time with child
Parent support of PA	Parent control/supervision of child PA	Parent influences on PA
Family support of PA	Sedentary behavior modelling	Family influences on PA
Parent PA with child	Sedentary behavior rules/restrictions	

Notwithstanding these limitations, there are several points which can be drawn from the current body of literature examining parenting practices and child physical activity. It is clear that some parenting behaviors have received more empirical attention than others (e.g., parent modelling of physical activity and parent support behaviors; see tables 2.2 and 2.3). While the results of each literature review cited in tables 2.2 and 2.3 reflect the inclusion criteria established by the authors, the findings for parenting behaviors indicate that more consistent results are reported for parenting support variables when compared to parental role modeling of physical activity. Of studies reporting on the association between parent role modeling and child physical activity, a positive association was found among an average of 44% of samples; for studies examining the association between parent support and child physical activity, a positive association was found among an average of 53% of samples (see tables 2.2 and 2.3). The greater consistency of findings for parent support over parent modeling is also indicated by the conclusions of review articles (e.g., Gustafson and Rhodes, 2006). In addition, a meta-analysis of 30 studies on parenting socialization behaviors and child physical activity reports that parents providing encouragement to children were twice as likely (relative risk = 1.86) to have a child classified as 'active', compared to those providing no/low encouragement (Pugliese and Tinsley, 2007). The presence of parental modelling was associated with a relative risk statistic of 1.22, indicating that the children of parents who modelled physical activity were 20% more likely to be classified as active compared to the children of parents who did not role model physical activity. Further to this, Loprinzi et al. (2012) reviewed articles examining parenting practices/orientations on known mediators of child physical activity (e.g., perceived competence and self-efficacy). The authors concluded the relatively greater importance of parental support (e.g., encouragement for physical activity, over-seeing child at physical activity events, and

facilitating physical activity participation) when compared to role modelling of physical activity by the parent. Finally, studies conducted since the literature reviews summarized in tables 2.2 and 2.3 continue to indicate the value of parental support, and in particular, parental encouragement (e.g., Duncan et al., 2015; Ferrao and Janssen, 2015; Lloyd et al., 2015; Tate et al., 2015). Thus, parental support (especially parental encouragement) appears to be more salient to children's physical activity than parent role modeling of physical activity.

The consistency of findings and conclusions from multiple systematic reviews and a meta-analysis, as well as the collated results from tables 2.2 and 2.3, suggests the value of targeting parent support for physical activity in youth physical activity interventions. The results also indicate the potential value of exploring the parent support variable further. The literature outlines the diverse forms that 'parent support' can take (e.g., emotional support, such as encouragement for physical activity, vs. logistic support, such as transporting the child or paying fees for sports clubs), yet the inconsistency in the operationalization and presentation of 'parent support' variables precludes identification of the most salient type of support regarding children's physical activity. Although based on a sub-set of available literature (30 studies), the meta-analysis indicates the relatively greater importance of encouragement over instrumental support and modelling influences (Pugliese and Tinsley, 2007). This suggests the value of socio-emotional support from parents to child physical activity and the potential value of exploring this variable further.

Limitations of the literature on parenting practices and physical activity include the focus on parenting practices specific to the physical activity domain (i.e., encouragement for physical activity, transportation to physical activity), rather than more general parenting practices, which may be more pervasive or occur more frequently than those related specifically to physical

activity. In addition, the need to explore determinants/precursors of parenting practices is highlighted by multiple studies and reviews. It is possible that specific parenting practices are

Table 2.2 Summary of findings for parent support for physical activity

	Positive association	Negative association	No association	% positive association
Sallis et al. (2000)				
Children:				
Encouragement	4	0	9	31%
Transportation	2	0	6	25%
Paying fees	1	0	3	25%
Active with child	5	0	5	50%
Adolescents:				
Direct help with physical activity	3	0	1	75%
Parent support	2	0	1	67%
Gustafson and Rhodes (2006)				
Parent support	18	0	1	95%
Van der Horst et al. (2007)				
Parent support	4	0	3	57%
Stanley et al. (2012)				
Parent/family support	0	1	2	0%
Verloigne et al. (2012)				
Encouragement	7	3	3	54%
Logistic support	4	0	2	67%
Active with child	9	0	1	90%
Family support	9	0	7	56%

Table 2.3 Summary of findings for parent physical activity

	Positive association	Negative association	No association	% positive association
Sallis et al. (2000)				
Children:	11	1	17	28%
Adolescents:	9	0	18	33%
Gustafson and Rhodes (2006)	6	1	7	43%
Van der Horst et al. (2007)	5	0	3	63%
Stanley et al. (2012)	0	0	1	0%
Verloigne et al. (2012)	9	0	4	69%
Maternal physical activity	12	2	5	63%
Paternal physical activity	7	1	7	47%
Family modelling	2	0	2	50%

consistent with a more global/general parenting/family variable, which may be a more appropriate intervention target than the parenting practice in question. The future research directions arising from reviewing the current literature on family/parenting and physical activity (i.e., more general parenting practices, precursors of parenting practices, and a focus on the socio-emotional support role of parents) are consistent in indicating the potential value of considering non-physical activity specific parenting behaviors and factors, including the socio-emotional climate of the family, in the endeavor to better understand variation in youth physical activity.

Summary: Parenting Practices and Child Physical Activity

Parent physical activity and parent support are the most commonly studied parenting practices, and there is limited evidence regarding other parenting practices. While Social Cognitive Theory

(Bandura, 1986) predicts the positive influence of parental role modeling on child physical activity, a substantial body of evidence reports mixed findings. More consistent findings are reported for parent support for child physical activity, which describes a range of practices including emotional (e.g., encouragement) and logistical (e.g., payment for activities) support for child physical activity. The evidence indicates a positive association between parental support and child physical activity and suggests the particular importance of socio-emotional forms of parent support, such as encouragement for physical activity. The majority of studies have examined parenting practices specific to physical activity (such as logistic support for physical activity) rather than parenting practices which are non-specific to physical activity. In addition, researchers have indicated the need to examine the precursors to parenting practices in the endeavor to better understand variation in child physical activity.

Parenting Styles and Physical Activity in Children

Compared to parenting practices, parenting style has received less attention in the physical activity literature. A recent review of parenting styles and obesogenic behaviors among children (Vollmer and Mobley, 2013) identified four studies examining physical activity, across which mixed findings were reported (Schmitz et al., 2002; Chen et al., 2008; Jago et al., 2011; Park & Walton-Moss, 2012). Among girls, a more authoritative mother (high warmth/high demandingness) was associated with greater physical activity, whereas among boys a more authoritarian parenting style (low warmth, high demandingness) was associated with greater physical activity (Schmitz et al., 2002). Chen et al. (2008) also reported modification by gender for the association between parenting style and child physical activity; a less authoritarian parenting style was associated with more moderate-vigorous physical activity among boys, and there was no influence of parenting style on physical activity among girls. Jago et al. (2011)

reported that more permissive parenting (high warmth, low demandingness) was associated with more moderate-vigorous physical activity than authoritative parenting among 10-11 year old boys, whereas Park and Walton Moss (2012) reported an authoritative parenting style to be positively associated with outdoor activity among youth. Subsequent studies examining the association between parenting style and child physical activity continue to report inconsistent findings. Hennessy et al. (2010) indicated that among preschool children, a permissive parenting style was associated with significantly more moderate-vigorous physical activity than an uninvolved parenting style (low warmth, low demandingness), whereas Langer et al., (2014) and Philips et al. (2014) reported no independent associations between parenting style and moderate-vigorous physical activity among 7-year old, and 6-12 year old children, respectively. Saunders et al. (2012) reported cross-sectional, negative associations between authoritative and permissive parenting styles and walking and cycling behaviors in adolescent girls, as well as a positive longitudinal association between an authoritative parenting style and walking and cycling and after-school MVPA in girls. The mixed findings and limited number of studies on parenting style prevent making conclusions regarding an optimal parenting style for the promotion of physical activity in children.

The results from studies examining parenting style are less consistent and appear weaker than the findings for parenting practices and physical activity. Despite the disagreement across studies regarding which parenting style is salient for promoting physical activity, the majority of studies report a significant association (either positive or negative) between one parenting style and physical activity for males or females. The consistency of significant findings suggests the importance of the socio-emotional climate established by parents for children's physical activity and the value of continuing to examine these variables. The consistent modification influence of

child gender on the association between parenting style and child physical activity is important to note for future research in this area. While the existing literature on parenting styles does not boast striking or consistent results, the results should be interpreted in the context of some methodological limitations. For example, existing studies have been conducted on participants of a range of ages (preschoolers to adolescents). The salience of parents in a child's life changes with age (Collins & Steinberg, 2006) and the inconsistent results may reflect an age modification influence, thus, comparing findings from samples of different ages may not be appropriate. The limited amount of research in this area means small numbers of studies are conducted on a given age group and conclusions pertaining to an age modification influence cannot be made.

In addition, the use of different assessment tools to identify parenting style means differences in results may partly be a function of differences in measurement tools. These methodological limitations should be considered when interpreting the results and addressed in future research in this area. Another measurement influence on research findings may include the categorization of parenting styles. Categorization has been criticized for being overly simplistic and masking valuable variation in parenting. The examination of continuous measures of parenting style may provide different results. It should also be noted that parenting styles are typically classified on dimensions of parenting warmth and demandingness; other parenting variables and characteristics may be important to children's physical activity behaviors.

Only two studies examining the longitudinal influence of parenting style on child physical activity were identified (Berge et al., 2010; Saunders et al., 2012). The findings of these studies regarding the salience of parenting style to child physical activity were inconclusive. Berge et al. (2010) reported a significant association between parenting style and physical activity before controlling for covariates, but not after. Saunders et al. (2012) reported marginally

significant longitudinal associations (p=.051-.097). Additional longitudinal studies will help ascertain the temporal associations among variables and provide more robust evidence of relationships between family and parenting variables and child physical activity than cross-sectional findings. Finally, the weaker results of the parenting styles literature when compared to the parenting practices literature may reflect an indirect influence of parenting style on child physical activity; parenting styles and parenting practices are suggested to interact in accordance with the model outlined in figure 2.2 (Darling and Steinberg, 1993). The model indicates that parenting style moderates the effectiveness of parenting practices, whereby practices delivered in the context of

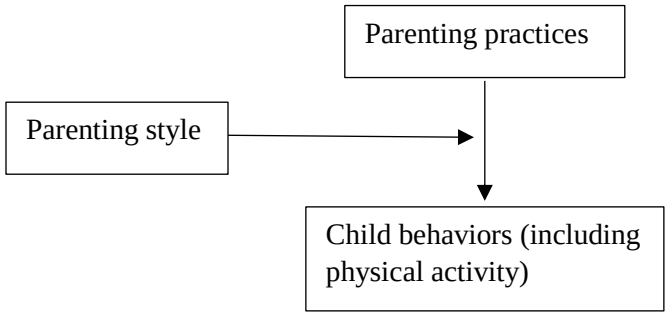

Figure 2.2 Darling and Steinberg (1993) interaction of parenting style and practice.

a warm, emotionally-supportive parent-child relationship with boundaries/rules (authoritative parenting style) will be more effective than practices delivered in the context of a more didactic relationship (authoritarian parenting style) or one where rules and restrictions are not strongly enforced (permissive parenting style). For example, a rule concerning limited TV time may be received differently by children of authoritarian vs. authoritative parents. Evidence supports the dynamics of this model in academic and social settings (van der Horst et al., 2007; Hennessey et al., 2010), although research has not examined the tenets of this model in the health behavior

domain (Patrick et al., 2013). Further research is required to examine whether this model can be applied to understanding health behaviors among children.

Some studies report that specific parenting practices may be predicted by different parenting styles (Jago et al., 2011; Hennessey et al., 2010; Langer et al. 2014), suggesting a mediation relationship between parenting styles and practices, instead of the moderation effect outlined above. For example, an authoritative parenting style is reported to be associated with significantly greater parent reinforcement for child physical activity, and an authoritarian parenting style is reported to be associated with significantly less role modelling of physical activity by parents (Hennessey et al., 2010). Future research in this area should endeavor to perform the appropriate data collection and statistical analysis to examine whether the moderating influence of parenting styles observed in academic and social settings extends to the physical activity domain, or whether the variables interact to influence physical activity in a different manner. This could provide a more accurate reflection of the influence of parenting styles on child physical activity.

Finally, the inconsistent results may indicate the role of moderating influences on the association between child physical activity and parenting style (Baron and Kenny, 1986; Ventura and Birch, 2008). Variables with the potential to exacerbate the positive and negative influences of parenting strategies on child outcomes may be worth exploring as moderators of the association between parenting style and child physical activity. The role of moderators on the association between parenting style and health outcomes has been reported, for example, Topham et al. (2010) reported the moderating effect of parent depression and socio-economic status on the association between parenting styles and child BMI, and Sterrett and colleagues (2013) reported the significant moderating effect of parent depression on the association between

parenting style and an index of healthy lifestyle engagement. Thus, in the endeavor to clarify the association between parenting styles and child physical activity, evidence supports the exploration of potential moderators of these associations.

Summary: Parenting Styles and Child Physical Activity

The examination of parenting style represents an exploration of the general socio-emotional climate established by parents, an area of research identified as important by literature on parenting practices. Research in this area is currently limited and reports mixed results, although the consistency of one or more significant associations reported by the majority of studies in this area suggests these variables are salient, and worthy of further exploration. The extent to which parenting styles and parenting practices interact to influence children's health behaviors is a new area of research and further work will provide a better understanding of how practices and styles work together to influence child physical activity. It is possible that the way these variables are currently examined in relation to physical activity is not appropriate for how the variables function to influence child behavior. In addition, the mixed findings indicate the value of examining moderators of the associations between child physical activity and parenting style in future research. An additional research direction highlighted by the current parenting styles literature is the need to examine precursors of parenting styles. This may help clarify the dynamics of associations between parenting factors and child behavior. More longitudinal studies of parental influences on child physical activity later in life will also provide valuable information regarding the role of parents in shaping children's health behaviors. In summary, the current findings regarding parenting style and physical activity, although mixed and inconsistent in direction, support the further examination of family/parent variables related to a child's socio-

emotional climate, particularly longitudinal studies, in the endeavor to better understand variation in child health behaviors.

Current Literature on Family/Parenting and Child Physical Activity: Conclusions and Future Directions

The literature on parenting practices and styles and child physical activity demonstrates (with the exception of parental support) a lack of consistency and/or small-to-moderate effect sizes. The literature on parenting practices suggests that parental support, in particular emotional support/parental encouragement, is important for increasing child physical activity and indicates the potential value of examining the child's socio-emotional climate to better understand variation in physical activity. The examination of parenting styles and physical activity represents an effort in this regard. The literature on parenting styles is currently inconsistent and primarily cross-sectional, although consideration of methodological limitations leads to the conclusion that further work is needed to examine how parenting styles and practices work together to influence health behaviors in children. Examining moderators of the parenting style – physical activity associations may be a worthwhile effort in this endeavor.

The current literature on family and parent influences on child physical activity is limited to the examination of two lines of research (styles and practices). This restricted view is highlighted when examining family and parent influences on related child outcomes/behaviors such as child nutrition behaviors and childhood obesity. A range of alternate parent and family variables have been considered. For example, parent life satisfaction and family satisfaction were significantly and positively associated with BMI change during a weight loss program for overweight, African-American adolescent girls (White et al., 2004). Maternal depression was associated with fewer positive parenting nutrition behaviors (Morrissey, 2014). Maternal distress

was associated with an increased risk of childhood obesity, independent of maternal body mass index (Zeller et al., 2007), and review level evidence highlights the value of targeting indicators of family function, such as family communication, family problem-solving skills, and the family emotional climate as part of interventions to improve children's weight status (Kitzman-Ulrich et al., 2010). Family variables such as these have received little attention in the physical activity literature, and the results reported in the dietary behavior and childhood obesity literature indicate that the examination of such variables in relation to physical activity would be logical and prudent.

The potential value of examining these variables is also highlighted by theories of family functioning. For example, Family Systems Theory (Minuchin, 1985) is an application of systems science to the family domain and the theory explains that an individual's behavior results from that person's existence within a family system, within which family member relationships shape each individual. The theory describes how prolonged exposure to regular patterns of family functioning reflects in the development and regulation of behavioral outcomes and subsequent behavioral variation across family members. Family Systems Theory recognizes various sub-systems within the larger family system, such as the parenting subsystem (made up of parent and child, only) and the sibling subsystem (made up of siblings only). These subsystems collectively influence individual outcomes.

Family Systems Theory has been applied to the examination of childhood obesity. In a review of childhood obesity predictors, Berge (2009) presented family subsystems of relevance to the study of child health behaviors (see figure 3.3). The theoretical model predicts direct and indirect (via parenting and sibling subsystems) influences of the larger family system on children's health behaviors. There is empirical support for this model; research indicates that a

positive family system (for example, good communication, supportive parenting style, family cohesion, low conflict) is associated with favorable child outcomes (Kitzmann-Ulrich et al., 2010) including general well-being, self-esteem, and healthier dietary practices (Mellin et al., 2002; Beveridge and Berg, 2007; Fulkerson et al., 2007), while inadequate family functioning is reported to lead to the development of unhealthy behaviors in children (Loprinzi et al., 2015).

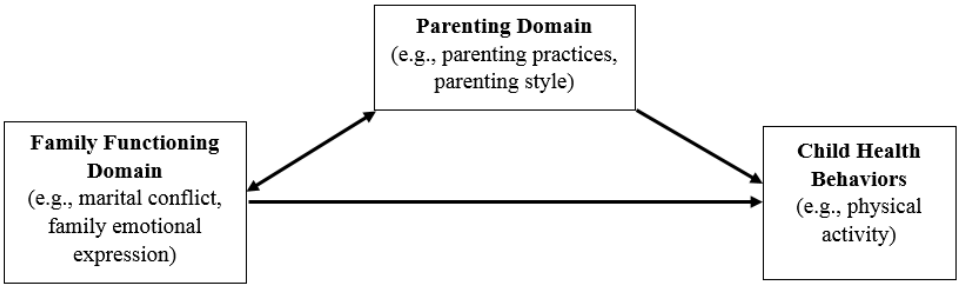

Figure 2.3 Part of Berge's (2009) application of Family Systems Theory to child health behaviors.

One criticism of Family Systems Theory is that it does not identify specific variables for examination, nor does it forward specific hypotheses. Alternative family theories can be considered alongside Family Systems Theory to facilitate the identification and examination of family function variables which are salient to child outcomes. For examples, a complimentary family-focused framework is the Family Stress Model (Conger, Rueter and Conger, 2000; see figure 2.4). The Family Stress Model outlines how a stressor, such as economic pressure, can lead to increased parental distress and marital conflict, which in turn disrupts supportive and positive parenting practices, leading to adverse child outcomes. Although not explicitly identified as an adverse child outcome by the framework, it is plausible that physical inactivity could represent an adverse child outcome. Also, psycho-social factors associated with physical activity such as self-esteem and perceived competence can be considered child outcomes which

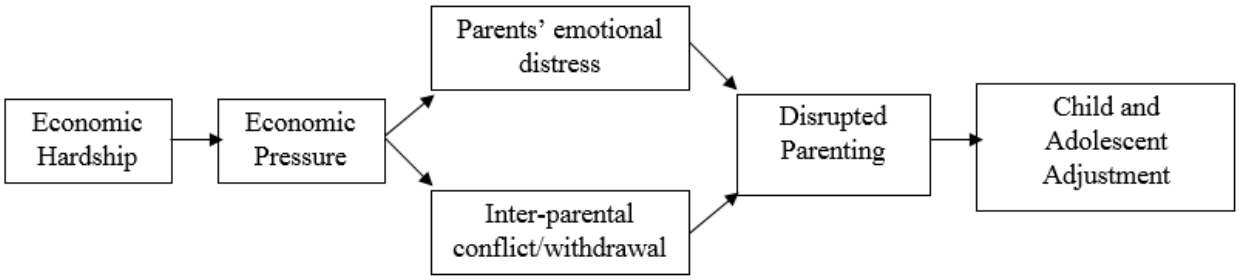

Figure 2.4 Family Stress Model (Conger, Rueter, & Conger, 2000)

may be negatively influenced by disrupted parenting. The development of negative psycho-social characteristics may have a negative influence on child physical activity. The Family Stress Model is consistent with Family Systems Theory in its consideration of the child being part of a family system and subject to parental influences. In attempting to understand child physical activity, the Family Stress Model directs attention to the examination of family stressors and the effect on parenting styles and practices. Using the Family Stress Model in conjunction with Family Systems Theory permits specific hypotheses regarding the influence of family function variables on child physical activity to be made (Family Systems Theory does not provide such specific detail).

Resource Drain Theory (Edwards and Rothbard, 2000) is another theoretical framework which predicts that parents with more physical and emotional stressors have less socio-emotional resources to invest in their child and will consequently lack energy and drive to engage in practices shown to increase and encourage physical activity among children. This notion has been supported by research examining the negative influence of stressors and distress among parents on provision of physical activity role modeling by parents as well as emotional and logistical support provided to the child (Dwyer et al., 2008; Harnisch et al. 1995). Consistent

with the Family Stress Model, Resource Drain Theory also indicates the value of exploring parenting precursors and family function indicators to gain a comprehensive understanding of the influence of family on child physical activity. These theories can be used in conjunction with Family Systems Theory to help identify salient variables for examination and form hypotheses about the specific effect on child outcomes.

Current limitations and identified future research directions of the literature on parenting/family and child physical activity could be addressed by examining how broader family variables highlighted by the childhood obesity/nutrition behavior literature, and by family-focused theories are associated with physical activity in children. For example, research on parenting practices and styles indicates the potential value of examining parenting determinants, more global indicators of family functioning (i.e., which factors which are not physical activity-specific), and variables which capture other family or parent characteristics than those associated with parenting style (warmth and structure). Such factors have received limited empirical attention in physical activity literature; existing research on dietary behaviors and childhood obesity, and family theories indicate that these variables are worthy of further examination in the endeavor to better understand variation in child physical activity.

Family Functioning Indicators and Physical Activity in Children

Since 2007, eleven studies have been published examining the influence of several family-function variables on physical activity in children (see table 2.4): general family functioning (3 studies; Atkin et al., 2015; Berge et al., 2013; Loprinzi, 2015), family cohesion and conflict (2 studies; Bigman et al., 2014; Ornelas et al., 2007), parent distress/stress (3 studies; Walton et al., 2014; Parks et al., 2012; Gray et al., 2008), family intimacy (1 study; Kuo et al., 2007), maternal

Table 2.4 Summary table of studies examining family functioning and youth physical activity

Author	n	Age (years)	Population	Study Design	Independent Variable	Physical Activity Assessment
Ornelas et al. (2007)	13,246	12-18	'National Longitudinal Study of Adolescent Health' participants (United States). White (54%), African-American (21%), Hispanic (17%), males (52%) and females.	Longitudinal (1 year)	Family cohesion, communication, engagement, monitoring	Child-reported physical activity (7-day recall)
Kuo et al. (2007)	221	14-15	'Project Heart' (randomized physical activity trial) participants. African-American (83%), females (United States).	Cross-sectional	Family intimacy	Child-reported physical activity (7-item, 7-day recall)
Fernald et al. (2008)	168	5	Low-income, Mexican males (54%) and females (living in semi-urban Mexico).	Longitudinal (5 years)	Maternal depression	Mother-reported child physical activity (International Physical Activity Questionnaire)
Gray et al. (2008)	95	8-17	Overweight Caucasian (52%), African American (30%) males (46%) and females attending an obesity clinic.	Cross-sectional	Parent distress	Child-reported physical activity (1 item)
Parks et al. (2012)	2,119	3-12	'Southern Pennsylvania Household Health Survey' participants. Non-Hispanic White (56%) and non-Hispanic Black (24%) males (52% and females.	Cross-sectional	Parent stress	Mother-reported child physical activity (1 item)

Table 2.4 (cont'd)

Johnson & Allen (2013)	359	10-18	'Panel Study of Income Dynamics' participants (United States). Caucasian (32%) and African American (18%), males (53%) and females.	Cross-sectional	Maternal employment demands	Mother-reported child physical activity (1 item)
Berge et al. (2013)	2,793	14	'Eating and Activity in Teens' study participants (United States). White (19%), Black (29%), males (47%) and females.	Cross-sectional	Family functioning	Child-reported physical activity (Godin Leisure-Time Exercise Questionnaire)
Bigman et al. (2014)	1,000	11-13	From prospective cohort study (United States). Low-active, Mexican, males (43%) and females.	Longitudinal (2 years)	Family cohesion and conflict	Child-reported physical activity (1 item from Youth Risk Behavioral Surveillance System)
Walton et al. (2014)	110	2-5	'Parents and Tots Together' (parenting intervention) participants. Hispanic (55%), White (13%), Black (22%) males (51%) and females.	Cross-sectional	Parent stress	Mother-reported child physical activity (2 items)
Atkin et al. (2015)	800	14	From ROOTS prospective cohort study (United Kingdom). White (95%) males (44.3%) and females.	Cross-sectional	Family functioning	Combined heart rate and movement assessment (Actiheart)
Loprinzi (2015)	101,672	6-17	'National Study of Children's Health' participants (United States). Hispanic (85.7%), males (51%) and females.	Cross-sectional	Family functioning	Parent-reported child physical activity (1 item)

depression (1 study; Fernald et al., 2008), and employment demands (1 study; Johnson and Allen, 2013). Sample size ranged from 95 – 101,672 participants. The age of participants ranged from 2-18 years old, with six studies conducted on children over 10 years old and two conducted on children younger than 5 years old. Two studies were conducted on samples comprised of primarily racial/ethnic minority groups, and one study was conducted on overweight youth. Three studies reported on longitudinal data (1, 2, and 5 year follow up), and the remaining eight studies reported cross-sectional associations. Of the eleven studies, ten reported significant relationships between family function variables and child physical activity whereby healthier parent psychology (e.g., lower stress, fewer depressive symptoms), better family functioning, and a less demanding job were associated with higher physical activity in children. The one study not reporting a significant association with physical activity reported a non-significant relationship between the number of parent-reported stressors and parent-perceived stress with child physical activity (Parks et al., 2012). The significant, positive associations reported by the majority of studies indicate that this is an area worthy of further exploration in the endeavor to improve understanding of variation in youth physical activity.

In addition to the need for further research to substantiate the findings of the small number of studies currently addressing this topic, there are limitations of the literature on physical activity and family functioning variables. Firstly, there are measurement issues pertaining to the dependent variable. Of the eleven studies, only one used an objective assessment of physical activity (Atkin et al., 2015) and the rest used self-report measures. Studies using objective measures of physical activity are well represented in the literature on parenting practices and parenting styles, and the use of activity monitors vs. self-report measures, particularly among youth, has important implications for the validity of the findings. The use of

self-report measures in children incurs validity issues due to recall error, respondents answering in a socially desirable manner, and variability in understanding questionnaire items; correlations between objective, more robust measures of physical activity and self-report measures of physical activity among youth are typically weak to moderate (r=0.3-0.4; Ekelund et al. 2011). Compounding the concern of insufficiently valid measurements of physical activity in the current literature on family function and child physical activity, is the fact that several studies have used non-validated self-report tools comprised of just one or two questions to assess physical activity (e.g., Gray et al. 2008; Johnson and Allen, 2013; Walton et al. 2014; Parks et al. 2012). Research exploring associations between child physical activity and family function variables, using objective measures of physical activity will make a valuable addition to this literature.

Secondly, there has been a focus on the direct associations between family function variables and child physical activity and little consideration for other ways that family function variables might influence child physical activity. Only three studies have explored mediation research questions involving a family variable and there are currently no studies examining moderating relationships involving family variables, in relation to child physical activity. Considering some of the alternative ways that family factors may operate to influence physical activity in youth may offer novel information to our understanding of the relationships between family function indicators and child physical activity.

Thirdly, the consideration and use of family theory/a framework to guide the selection of family function variables has been limited. A minority of studies have discussed Family Systems Theory in the rationale for examining family function indicators and physical activity in youth (Atkin et al., 2015; Loprinzi et al., 2015; Berge et al., 2013), and one study discussed Resource Drain Theory (Edwards and Rothbard, 2000) in relation to the association between maternal job

demands and child physical activity (Johnson and Allen, 2013). The use of theory and/or a guiding framework in future research will facilitate the identification of pertinent family function indicators, allow theoretically-informed hypotheses regarding the associations between family functioning and physical activity to be generated, and facilitate progression of research in this area.

Identifying Salient Family Function Indicators

The model by Berge (2009) outlines the relationships between family function variables and parenting and child health outcomes, but does not indicate specific family variables which may be salient to examine in relation to child physical activity. To this point, the work of Belsky (1984) may be helpful. The framework put forward by Belsky (1984) indicates that characteristics of the parent, characteristics of the child, and factors pertaining to the broader social environment (such as employment factors and social support) represent determinants of parenting (see figure 2.5) and consistent with the relationships outlined by Berge (2009), may therefore be salient to child physical activity. Multiple studies have confirmed the tenets of the model outlined by Belsky, i.e., the various parenting antecedents and their effects on parenting. For example, research reports that mothers with higher optimism and self-esteem (parent characteristics) engage in more positive parenting behaviors (Brody et al., 2002). Similarly, lower maternal depression is predictive of more positive parenting (Lovejoy et al., 2000) and more positive family functioning is associated with more care and lower levels of over-protection by parents (Macfarlane et al., 1995). In support of the influence of the 'broader social context' on parenting, multiple studies report the influences of employment factors and social relationships on parenting. For example, economic pressure has been negatively associated with parent positivity (Neppl et al., 2015) and marital conflict is associated with less emotional

closeness in the parent-child relationship (Macfarlane et al., 1995). Emotional and tangible social support is reported to promote favorable parenting attitudes and behaviors (Andersen and Telleen, 1992). Other social context factors associated with positive parenting include perception of partner relationship quality (Bryanton et al., 2008), greater levels of partner support (Bryanton et al., 2009) and a more favorable maternal perception of the social network (Crockenberg, 1981;

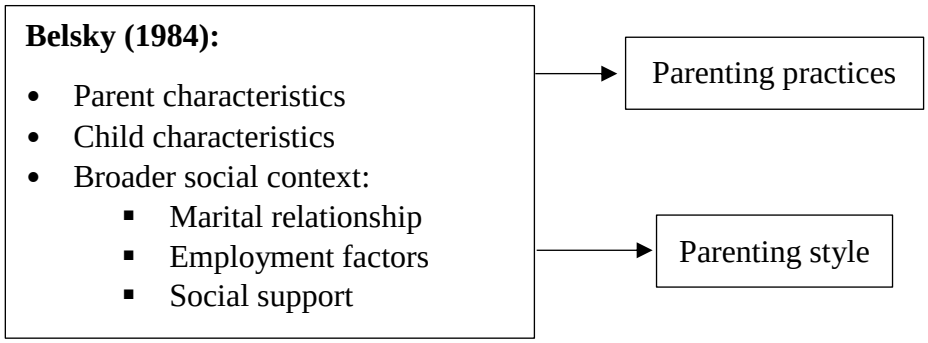

Figure 2.5 Determinants of Parenting (Belsky, 1984)

Waylen and Stewart-Brown, 2010; Green, 2007). Mistry et al. (2002) reported that mothers with financial difficulties had higher levels of distress, which led to less parental control and subsequent adolescent problem behaviors. The empirical support for this model indicates its utility in identifying family-focused parenting determinants, which in line with the tenets of the model by Berge (2009) may therefore be salient to child physical activity either indirectly (via parenting) or directly.

Summary

The significant associations reported by the current literature on family function indicators and physical activity in children suggest that further exploration of this research topic is warranted. Additional studies are required to substantiate the existing results. Plausible explanations for the

influence of family function indicators on youth physical activity are provided by all studies, yet few use a theoretical framework to drive and interpret the research question and results. The model by Berge (2009) represents a suitable theoretical framework for applying Family Systems Theory to the examination of the influence of family functioning on physical activity. The work of Belsky (1984) provides a useful, complementary framework for identifying family function variables that may be worth exploring in future research on child physical activity. Other theories (e.g., the Family Stress Model and Resource Drain Theory) permit specific hypotheses regarding the influence of family factors on child physical activity to be constructed and tested. The incorporation of appropriate theory into research in this area will facilitate the identification of potentially pertinent family variables. Further to this, while several theoretical frameworks (e.g., Conger, Rueter and Conger, 2000; Edwards and Rothbard, 2000) and publications suggest the potential mediating influence of parenting on the association between family function variables and child behaviors, there has been limited testing of parenting mediation in the health behavior domain. Exploring the mediating influence of parenting variables on the associations between family function indicators and child physical activity will make a valuable contribution to the literature.

Salient Family Function Variables: Parent Depression and Marital Conflict

The work of Belsky (1984) can add detail to the theoretical framework outlined by Berge (2009) and guide the identification of family variables which may be salient to understanding variation in child physical activity. In the original article Belsky (1984) outlines the particular importance of parent characteristics to parenting behaviors, and the superior importance of the marital relationship compared to other broader social context influences on parenting. Thus, parent characteristics and variables reflecting aspects of the marital relationship may be particularly

important to consider in the examination of family influences on child physical activity. Examining the role of such variables in relation to physical activity and the parenting variables known to be associated with physical activity represents an area for future research.

Parent Depression

Belsky (1984) identifies parent characteristics as a salient determinant of parenting behaviors. A parenting characteristic which is consistently, negatively associated with parenting behaviors, is parent depression (Lovejoy et al., 2000). A meta-analysis on maternal depression and parenting behaviors reported that maternal depression is associated with an increase in irritability and hostility shown towards the child (Goodman and Brumley, 1990; Forehand et al., 1986). Depression is also suggested to increase parent disengagement from the child and reduce positive parent-child interactions (Lovejoy et al. 2000). Research supports that hostile parent-child interactions have negative consequences for child well-being (Connell and Goodman, 2002) and are not consistent with positive parenting behaviors, such as parent emotional support and encouragement, which are shown to promote physical activity among youth (Gustafson and Rhodes, 2006; Pugliese and Tinsley, 2007). Maternal depression may thus have a negative influence on child physical activity due to the enactment of more negative parenting behaviors and the provision of less emotional support to children.

There are similarities between the negative parenting behaviors resulting from parent depression, and the parenting behaviors which characterize the authoritarian and permissive parenting styles outlined by Baumrind (1971) and Maccoby and Martin (1983). For example, a permissive parenting style and parent depression are both associated with a lack of structure and rules, and the provision of inconsistent discipline to children (Johnston et al., 2001). Parent depression and an authoritarian parenting style are both associated with lower levels of warmth

and nurturing behaviors, and more irritability and hostility towards children (Goodman and Brumley, 1990; Forehand et al., 1986; Downey and Coyne, 1990; Beardslee et al., 1983). It follows that parent depression among authoritarian or permissive parents may result in additive negative effects on child outcomes, and moderate the influence of a given parenting style on a child. The value of exploring parent depression as a potential moderator of relationships between parenting style and child outcomes such as physical activity is thus indicated.

Studies have reported mixed findings regarding the independent effect of authoritarian and permissive parenting style on child physical activity. The independent effects of depression on child physical activity have been explored in one study. Fernald et al. (2008) examined the longitudinal influence of maternal depression on child physical activity among a Mexican sample of mothers and children. Findings indicated that higher maternal depression at an earlier time point (child age = 5 years old) was associated with lower child physical activity five years later, after adjusting for multiple confounding variables including maternal depression at follow up, physical activity of the mother, and child externalizing behavioral problems. These results provide evidence of the negative influence of maternal depression on physical activity in children, although the examination of Mexican mothers and children means the results may not be generalizable to other racial/ethnic groups. Thus, consistent with previous research findings, and in line with empirical evidence of the effects of depression on parenting behaviors, it can be hypothesized that maternal depression will be negatively associated with child physical activity among a primarily Caucasian sample. Further studies reporting the independent influence of parent depression on physical activity in youth will make a valuable contribution to the literature.

As outlined previously, findings from the literature examining relationships between parenting styles and child physical activity are mixed, which may indicate the role of moderating

variables. There is evidence that parent depression influences parenting and physical activity independently, and findings suggest that depression may exacerbate aspects of authoritarian and permissive parenting styles, which may subsequently influence physical activity habits in youth. As such, the examination of depression as a moderator of the association between parenting style and physical activity may provide valuable clarification to the mixed findings currently reported by this body of literature. Further to this, previous research has confirmed the significant moderating influence of depression on the association between parenting style and child obesity (Topham et al., 2010). The significant role of depression in determining a related health indicator endorses the examination of depression as a moderator of the relationship between parenting style and youth physical activity.

Marital Conflict

Belsky (1984) suggests that factors pertaining to parents' broader social context, including the marital relationship, employment factors, and social support will influence parenting behaviors. In the accompanying article, Belsky (1984) suggests that the marital relationship is the most salient broader social context influence on parenting. Marital conflict and resolution represent an aspect of the marital relationship, and research reports that lower levels of marital conflict are associated with more positive, and fewer negative, parenting behaviors, including the demonstration of greater parental warmth towards the child (Kendler et al., 1997; Erel and Burman, 1995). Marital conflict is negatively associated with parent self-efficacy, a predictor of positive parenting behaviors (Bryanton et al., 2009), and Macfarlane et al. (1995) reported that higher marital conflict is associated with less emotional closeness in the parent-child relationship. These findings are consistent with the tenets of Resource Drain Theory and the

Family Stress Model which suggest that parental stress, caused by marital conflict, reduces parents' socio-emotional resources and results in disrupted parenting.

The relationship between marital conflict and youth physical activity has not been examined. The influence of marital conflict on parent warmth and emotional closeness may have implications for parental encouragement and emotional support demonstrated to the child, which are associated with higher physical activity in youth (Pugliese and Tinsley, 2007). In addition, the tenets of Resource Drain Theory and the Family Stress Model predict that marital conflict would detract from socio-emotional resources available for parenting behaviors shown to be associated with higher physical activity in youth. It can thus be hypothesized that marital conflict will be negatively associated with youth physical activity.

Studies examining (i) family functioning variables and child weight status, (ii) parenting styles/practices and child physical activity, and (iii) family functioning variables and child physical activity call for future research to examine the mechanisms by which family functioning variables are related to child physical activity, to better understand the causal relationships among the variables. Current studies examining associations between family functioning variables and child physical activity have primarily examined direct associations. The mediating role of parent behaviors is consistently suggested in studies observing a direct association between family functioning variables and child health behaviors and the notion of mediation is consistent with the tenets of theoretical frameworks (e.g., Conger, Rueter and Conger, 2000; Edwards and Rothbard, 2000). However, the testing of mediational hypotheses in the child health behavior domain has been limited, and particularly so in relation to child physical activity.

Within the literature on family function variables and child physical activity, three studies have examined mediating influences on the association between family function and child

physical activity (Gray et al., 2008, Fernald et al., 2008, Ornelas et al., 2007). Gray et al. (2008) examined a cross-sectional mediation model and reported the mediating influence of child perceived barriers to physical activity on the association between parent distress and child physical activity. The Baron and Kenny (1986) approach to mediation analysis was used, with which there are limitations (Maxwell and Cole, 2007). In addition, the cross-sectional nature of the study also means causality cannot be inferred. Fernald et al. (2008) reported the mediating influence of child internalizing behaviors on the association between earlier maternal depression and later child physical activity. The only parenting behavior examined as a potential mediator was mother's activity level, which had a non-significant influence on the association between maternal depression and child physical activity. Data were collected at two time points: maternal depression when the child was aged 15 months, and potential covariates and child physical activity when the child was aged between 4-6 years. This represents a half-longitudinal model, which is not as robust as using data collected at three time points. The Baron and Kenny (1986) approach to mediational analysis was employed, with which there are limitations (Maxwell and Cole, 2007). Ornelas et al. (2007) used longitudinal data to examine whether adolescent self-esteem and depressive symptoms mediated the association between family function indicators (such as family cohesion and communication) on child physical activity, one year later. Among male participants, self-esteem and depressive symptoms were significant mediators; among females, self-esteem was a significant mediator. In this study, data on family and mediating variables were collected at wave one only, and physical activity was measured at wave 2 only, thus the model cannot account for baseline physical activity levels, which has implications for the validity of the results. The Baron and Kenny (1986) approach to mediational analyses was used and has limitations (Maxwell and Cole, 2007).

Thus, the current literature examining mediation models of the association between family function indicators and physical activity is limited and further mediation studies are required to substantiate the findings. In addition the three existing mediation studies examined child psycho-social factors, rather than parenting behaviors which are commonly suggested to mediate the association between family function indicators and child physical activity. There is a need for studies examining mediation models with a parenting behavior as the potential mediating factor. Finally, the three mediation papers employed statistical analysis strategies with identified limitations and the results should therefore be interpreted with caution. Half longitudinal models and the Baron and Kenny (1986) approach to mediation analysis were used in the three existing studies and such approaches are not as robust as using a path analysis or structural equation modelling approach, or when the three variables within the mediation model are all measured at three different time points (Cole and Maxwell, 2003, Maxwell and Cole, 2007). There is a need for future research to use more advanced and robust statistical approaches to examining potential mediators of the associations between family function indicators and child physical activity.

Potential Mediation Pathway: Marital Conflict, Parent Encouragement, Physical Activity

The literature on parenting practices and physical activity indicates the important role of parental support, in particular parent encouragement (a parent behavior), to youth physical activity. Specifically, parent encouragement is reported to influence child physical activity both directly and indirectly, via influences on child self-efficacy (Trost et al., 2003; Biddle and Goudas, 1996). Bandura's self-efficacy theory (1986) suggests that verbal persuasion (i.e., encouragement) is an antecedent of self-efficacy, a consistently identified predictor of physical activity among children and adolescents (Craggs et al., 2011). Parental encouragement is also

reported to be positively associated with other predictors of child physical activity, including child attraction to physical activity and perceived competence for physical activity (Welk et al., 2003; Biddle and Goudas, 1996). Consistent findings of a positive association between parent encouragement and child physical activity and studies indicate the value of exploring the determinants of this specific type of parent support further. The suggestion of examining the determinants of parent encouragement with a view to increasing child physical activity implies the role of parental encouragement as a mediator between parental encouragement antecedents and child physical activity. Identifying predictors of parental encouragement as well as examining the dynamics of associations between child physical activity, parental encouragement and determinants of parental encouragement will provide valuable information regarding potential intervention targets to improve child health prospects.

A small number of studies have explored predictors of parental support and encouragement for physical activity. For example, Trost et al. (2003) explored predictors of parental support for physical activity (including parent encouragement) and reported that parental enjoyment of physical activity, age, gender, parent physical activity and importance of physical activity to the parent accounted for 22% of the variance in parental support. While this study provides valuable information on important antecedents of parental support, a large proportion of variance remains unexplained. Rhodes et al. (2015) reported that a host of theoretical predictors of parent support for child physical activity, including parent perceptions of child competence, ethnicity, education, and income, have shown null or small associations with support provision by parents. Recent investigations highlight the predictive value of two parenting factors which may warrant further consideration. Firstly, de la Haye et al. (2014) reported that closeness within the parent-child relationship strongly predicted the provision of

parent encouragement of child physical activity. Specifically, among parent-child dyads considered to have a close relationship, the provision of parental encouragement was over two times greater than among dyads not classified as having a close relationship. Secondly, Rhodes et al. (2015) reported the importance of a parent's perceived control to provide physical activity support to a child, particularly for the provision of parental encouragement. Potential predictors of support examined thus far focus on parents' demographic and psychological characteristics. The model proposed by Berge (2009) and the work of Belsky (1984) suggest that other antecedents of parent behaviors, such as parent encouragement of child physical activity, may lie in the family domain. The findings reported by Rhodes et al. (2015) and de la Haye et al. (2014) indicate the value of exploring other social determinants of parent support of child physical activity.

As a result of the negative effects of marital conflict on salient aspects of the parent-child relationship, it is possible that marital conflict will be negatively associated with encouragement of physical activity among children, and therefore negatively associated with physical activity

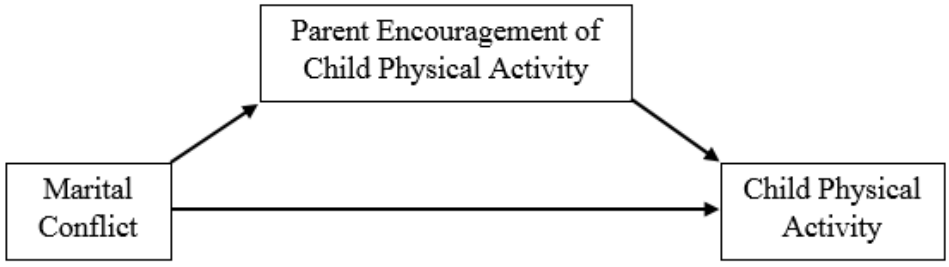

Figure 2.6 Proposed mediation model

(see figure 2.6). This notion has not been empirically explored and would provide valuable information on antecedents of parental encouragement for child physical activity and the

dynamics of associations among variables hypothesized to be directly and indirectly related to child physical activity.

Literature Review: Final Summary

The majority of children and adolescents are insufficiently active to attain the health benefits associated with regular physical activity. Research is needed to identify antecedents of physical activity in the endeavor to develop effective public health interventions. Multiple studies examining predictors of children's physical activity identify parents and family as a key influence. Existing literature on parenting/family variables and physical activity is currently limited to the examination of parenting practices and parenting styles. These bodies of literature report inconsistent findings and the need to examine parenting precursors, other family variables, and the potential role of moderating variables is highlighted. This is supported by findings from the literature on child nutrition behaviors and obesity, which conclude significant associations with family variables such as marital conflict and family communication and cohesion, as well as the significant role of moderating variables on associations between parenting styles and indicators of child health.

Results from a small number of studies examining family function variables and child physical activity support further exploration of this group of variables, although the validity and generalizability of the findings is currently limited by a small pool of findings, the use of self-report measures of physical activity, an unclear understanding of the dynamics of family and parenting variables and their influence on child physical activity, and a predominance of cross-sectional investigations. Exploration of additional family variables, guided by theory, using longitudinal data to test pathways of causal influence among variables assessed using objective

instruments will provide valuable information regarding the influence of family/parenting on child physical activity.

Theoretical frameworks indicate the particularly salient role of parenting characteristics, (such as parent depression) and the marital relationship on parenting. Theory and empirical evidence support the examination of such variables in relation to child physical activity. Thus far, the literature on family function variables and child physical activity has primarily examined direct associations. The exploration of alternative relationships, such as moderating and mediating pathways would make valuable additions to the literature.

CHAPTER 3: MODERATING EFFECT OF PARENT DEPRESSION ON THE ASSOCIATION BETWEEN PARENTING STYLE AND PHYSICAL ACTIVITY IN YOUTH

Abstract

Studies exploring the association between parenting styles and physical activity in youth has produced mixed findings, indicating the value of exploring potential moderators of this relationship. Parent depression may increase negative aspects of parenting such as irritable parent-child interactions and inconsistent discipline, and therefore have an additive, negative effect on child physical activity. Parent depression has been identified as a significant moderator of the association between parenting style and child body mass index, but it has not been explored as a moderator of the association between parenting styles and child physical activity. The purpose of this study was to examine the moderating influence of parent depression on associations between mothers' and fathers' parenting styles and physical activity among male and female youth. **Methods**: Data for this study were drawn from the Study of Early Child Care and Youth Development (1991-2008). In the 6th grade, children wore an Actigraph accelerometer for one week to assess physical activity, and both parents completed the Center for Epidemiological Studies Depression Scale. The Raising Children Checklist was used as a measure of parenting style and was completed by the mother and father when the children were in 3rd grade. Moderation effects of depression on parenting style were examined using regression analyses in SPSS 22.0. **Results**: After controlling for covariates, the interaction term between harsh maternal parenting tendencies and maternal depression was borderline significant for female youth and indicated a small, additive, negative effect on physical activity (b=-.01, s.e.=.01, p=.05). Before adding covariates to the model, there was evidence of a trend for lower

maternal depressive symptoms and harsh maternal parenting tendencies to have a positive effect on physical activity among male youth (b=-.01, s.e.=.01, p=.07), although this trend disappeared with the addition of BMI z-score as a covariate (b=-.01, s.e.=.01, p=.15). There were no significant paternal influences on youth physical activity in this study. **Conclusions**: The findings indicate that the small, moderating effect of maternal depression may help explain the mixed findings currently reported for associations between a harsh/authoritarian parenting style and child physical activity. The results also suggest the moderating role of parent and child sex when examining relationships between family variables and child physical activity. Considering the psycho-social health and parenting habits of mothers may help progress understanding of variation in youth physical activity habits.

Introduction

Regular physical activity is associated with health benefits for youth, including improved body composition (Roriz Oliveira et al., 2015; Kelishadi et al., 2014) and a favorable lipid profile (Roriz Oliveira et al., 2015; Väistö et al., 2015), yet a large proportion of youth are insufficiently active to accrue these health benefits. Recent investigations report that the majority of children (59.4%) and adolescents (93.6%) do not meet the U.S Department of Health and Human Services' (2008) physical activity guidelines (Loprinzi et al., 2015). Identifying correlates of physical activity among youth could inform the design of effective public health interventions to increase engagement in health-enhancing behaviors.

Recent literature reviews of youth physical activity correlates indicate the importance of family and parents (Davison et al., 2012; Ohri-Vachaspati et al., 2015). Literature examining parent/family influences on child physical activity to date has primarily focused on the association between physical activity and physical activity-specific parenting 'practices'.

Parenting ‘practices’ refer to specific parenting behaviors in which parents engage; examples of physical-activity specific practices include taking a child to a physical activity venue or encouraging a child to be physically active. Despite a large body of literature examining parenting practices, findings regarding whether specific parenting practices increase or decrease youth physical activity are mostly equivocal. The need to examine non-physical activity specific, broader parenting factors is highlighted by these findings, as well as the conclusions of recent review articles (e.g., Power et al., 2013; Patrick et al., 2013).

To this point, a body of literature examining the association between parenting ‘styles’ and child physical activity is currently emerging. Parenting ‘styles’ refer to the socio-emotional climate established through parent-child interactions and are typically differentiated by levels of warmth/emotional responsiveness and structure/behavioral expectations conveyed to the child; Baumrind, 1971; Maccoby and Martin, 1983. Four parenting styles are identified: authoritative (high levels of warmth and structure), authoritarian (high levels of structure, less emotional responsiveness/warmth), permissive (low structure, high emotional responsiveness) and neglectful parenting (low levels of structure and warmth). An equivalent system of examining parenting styles measures parents’ engagement in harsh (i.e., authoritarian), firm (i.e., authoritative) and lax (i.e., permissive) parenting behaviors (Shumow et al., 1998). In other domains of research on child behavior and development, such as academic achievement and social skills, the authoritative/firm parenting style is considered the optimal parenting style (Cohen and Rice, 1997; Radziszewska et al., 1996; Rintala et al., 2000), research examining the relationship between parenting styles and physical activity has produced equivocal findings. Among female youth, studies have reported positive associations between an authoritative parenting style and physical activity (e.g., Schmitz et al., 2002, Park and Walton-Moss, 2012),

while others have reported a negative association (Saunders et al. 2012). A permissive parenting style has also been positively (Hennessey et al., 2010) and negatively (Saunders et al., 2012) associated with physical activity in females. In addition, some studies report a non-significant association between parenting style and physical activity among females (e.g., Chen et al., 2008; Jago et al., 2011; Langer et al., 2014). For male youth, studies have reported positive associations between physical activity and authoritative (Park and Walton-Moss, 2012), authoritarian (Schmitz et al., 2002), and permissive parenting styles (Jago et al., 2011; Hennessy et al., 2010), while others report non-significant associations (e.g., Langer et al., 2014; Philips et al., 2014). The mixed findings prevent drawing conclusions regarding an optimal parenting style for the promotion of physical activity in children.

The inconsistent findings may be indicative that other variables are moderating the relationship between parenting style and youth physical activity (Baron and Kenny, 1986). Research from the parenting styles and child obesity literature suggests the value of examining moderators of relationships between parenting styles and child health indicators (Ventura and Birch, 2008). Further, recent studies report the significant moderating effect of other parent-related variables on the association between parenting style and health behaviors/outcomes. One variable which has been identified as a moderator of the association between parenting style and health behaviors/outcomes is parent depression. Parent depression (reported by female caregivers) significantly moderated the association between parenting style and child weight status (Topham et al., 2010), whereby greater parent depressive symptoms and a permissive parenting style had an interactive, positive association with childhood obesity risk. The authors suggested that the lack of maternal involvement predicted by both maternal depression and a permissive maternal parenting style likely explained the additive effect on obesity risk. Thus, the

findings indicate the potential for depression to exacerbate aspects of parenting associated with health behaviors. Parent depression has not been explored as a moderator of the relationship between parenting style and child physical activity; the results reported by Topham et al. (2010) suggest that exploring parent depression as a moderator may offer clarification to the currently mixed findings reported from the literature examining parenting styles and child physical activity.

Multiple studies have reported the negative influence of depression on parenting behaviors (e.g., Lovejoy et al., 2000). Maternal depression is linked with lack of structure/rules and inconsistent discipline (consistent with a permissive/lax parenting style; Johnson et al., 2001), as well as an increase in irritability and hostility, and decreased warmth and nurturing shown towards the child (consistent with an authoritarian/harsh parenting style; Goodman and Brumley, 1990; Forehand et al., 1986; Downey and Coyne, 1990; Beardslee et al., 1983). As such, depression among parents may exacerbate negative aspects of parenting (particularly those associated with authoritarian/harsh and permissive/lax parenting styles). Examining the interactive influence of depression and parenting style on child physical activity may thus help clarify the influence of parenting style on child activity behaviors.

In addition, few studies have distinguished between maternal and paternal influences on child physical activity, despite evidence suggesting that mothers and fathers have different influences on child physical activity (Schoeppe et al., 2016; Zahra et al., 2015). Across research domains, the examination of parenting variables leans heavily on mother-reports of parenting factors, and the role of the father and father-reports of parenting factors have received less attention (Costigan and Cox, 2001; Phares et al., 2005). Beyond this, evidence suggests that parent behaviors related to child physical activity vary based on child sex (Fuemmeler et al.,

2011); however few studies have examined how mothers' and fathers' parenting styles and psychological factors differentially influence the physical activity habits of male and female youth.

Thus, the purpose of this study was to examine the moderating influence of parent depression on associations between mothers' and fathers' parenting styles and physical activity among male and female youth.

Methods

Data for this project came from the Study of Early Child Care and Youth Development (SECCYD), a multi-site, longitudinal study funded by the National Institute of Child Health and Development starting in 1991. The ten data collection sites were: (1) Boston, MA; (2) Charlottesville, VA; (3) Hickory and Morganton, NC; (4) Irvine, CA; (5) Lawrence, KS; (6) Little Rock, AR; (7) Madison, WI; (8) Philadelphia, PA; (9) Pittsburgh, PA; and (10) Seattle, WA. The primary objective was to investigate associations between modes of childcare and indicators of child development (e.g., academic and social) during different stages of childhood (infancy, early childhood, middle childhood and middle adolescence). Data were collected in four phases: phase I when children were 1 month to 3 years old (1991-1994), phase II when children were 4-8 years old (1995-1999), phase III when children were 9-13 years old (2000-2004) and phase IV when children were 14-15 years old (2005-2006). Families were followed intensively during the child's infancy and then annually from early childhood through middle adolescence. Each data collection protocol involved a series of home visits and laboratory visits and the completion of observations, questionnaires and interviews. The institutional review board of each participating university site approved the study protocol, and all participating families provided written informed consent.

Participants

From a possible 8,986 mothers that gave birth in hospitals at ten, U.S., university-based data collection sites in 1991, 1,364 families were enrolled. These families were enrolled over an 11-month period, with each hospital providing a list of eligible families to the data coordinating center to conduct enrollment procedures. Exclusion criteria were (1) the family having plans to move away from a study area, (2) the mother being insufficiently fluent in English, (3) the child having disabilities or being admitted to hospital for more than seven days following birth, and (4) the mother having a substance abuse issue. For the first four months, eligible families were selected from the randomly-ordered lists provided by recruiting hospitals. After the first four months, the data coordinating center made efforts to recruit families based on characteristics which would maintain the national representativeness of the sample (the sample from each site was expected to be comprised of at least 10% ethnic minority mothers, 10% of mothers with less than high school education, and 10% single parent households). The random sampling plan also ensured that the following proportions of participants were recruited: 60% were mothers intending to work full time during their child's first year, 20% were mothers intending to work part time during their child's first year, 20% were mothers intending to stay at home with their child during the first year. The sampling plan was effective in recruiting a sample that was representative of the population of the United States of America in terms of race (SECCYD sample = 80.3% white, U.S. population = 80.4% white) and household income (SECCYD sample = $36,520, U.S. population = $37,948). At phase IV, 1,073 families (79% of original cohort) were retained in the study. Data from phase III were used for this study.

Demographics

Parents self-reported demographic information. Race/ethnicity and sex of child participants were recorded at study enrollment. Socioeconomic status was assessed using the income: needs ratio, where a ratio of less than one indicates that a family is living at a standard below the poverty line.

Anthropometry

The height and weight of each child were measured at university sites (in laboratory settings). A wall-mounted 'yardstick' and a scale were used for measurements. Children were measured without shoes and after removing heavy outer clothing (when possible). Two measures for height (cm) and weight (kg) were taken. The average of the two measures was used to compute body mass index (BMI; weight [kg]/height [m^2]), and BMI z-scores were calculated using SAS software provided by the Centers for Disease Control and Prevention (2016).

Parent Depression

An adapted version of The Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1997) was used to assess parent depression. The CES-D is a widely used and well validated tool for the assessment of depressive symptoms among non-clinical adults. When the child participant was in sixth grade, the mother and father completed the 20-item questionnaire. The following instructions were provided: "*these statements describe how people sometimes feel about themselves. Please answer all questions. There are no right or wrong answers. Give your honest opinions and feelings. Please circle the answer that comes closest to describing how often you have felt this way during the past week*". Participants responded to statements describing depressive symptomology by indicating the frequency with which they experienced each

symptom on a four-point Likert scale, for which the response options were: 'rarely or none of the time' (less than once a week; score = 0), 'some or a little of the time' (1-2 days a week; score = 1), 'occasionally or a moderate amount of time' (3-4 days a week; score = 2) and 'most or all of the time' (5-7 days a week; score = 3). Example statements included 'I felt sad', 'I was bothered by things that usually don't bother me', and 'I felt that people dislike me'. A total score was calculated with scores ranging from 0-60. Higher scores indicate greater depressive symptomology. A score of more than 16 is considered clinically significant and indicative of clinical depression (Radloff, 1997). Internal reliability indices were high for mothers (Cronbach's alpha = .91) and fathers (Cronbach's alpha = .90) for the 20-item scale.

Parenting Style

A revised version of the Raising Children Checklist (Greenberger and Goldberg, 1989; Shumow et al., 1998) was used to assess parenting strategies along three dimensions: harsh, firm, and lax, which correspond to authoritarian, authoritative and permissive parenting styles outlined by Baumrind (1971), respectively. Parenting styles are assumed to demonstrate stability over time (Baumrind et al., 1989), and studies have confirmed the modest stability of parenting styles over time, among parents of adolescents (Williams et al., 2012). The questionnaire was administered when children were in 3rd grade and used in the present study to examine associations with variables measured in 6th grade, as it was not assessed in 6th grade. Parents responded to questions on a four-point Likert scale (response options ranged from 'definitely no', to 'definitely yes'). Scores for the harsh and lax control dimensions are separate entities and range from 9-36, with higher values indicating a harsher or more lax degree of parental control. Scores on the harsh parenting scale were negatively correlated with scores on the lax parenting scale for mothers ($r=-.14$, $p<.001$) and fathers ($r=-.17$, $p<.001$). For mothers, Cronbach's alpha values for

the harsh and lax subscales were .53 and .63, respectively. For fathers, Cronbach's alpha values for the harsh and lax subscales were .47 and .65, respectively. Harsh and lax parenting subscale scores were treated as separate, continuous variables in the statistical analyses.

Physical Activity

Participating youth wore an accelerometer for seven consecutive days, during a typical school week. Parents were instructed that their child should wear the monitor every day, removing the monitor when going to sleep at night, and during water-based activities (e.g., bathing and swimming). Participants wore a uniaxial accelerometer (Computer Science and Applications, Inc., Shalimar, FL) on the right hip. A minimum of four days of sufficient data were required to include the child's physical activity measurement in the statistical analysis. Daily physical activity monitor recording started with the first non-zero accelerometer count recorded after 5am on each day of data collection, and ended when one of the following criteria were met: (a) the last non-zero accelerometer count recorded before midnight, (b) 60 minutes of consecutive zero accelerometer counts after 9pm, (c) 30 minutes of consecutive zero accelerometer counts after 10pm. Activity was recorded in 60-second epochs. Minutes per day spent performing moderate (3-5.9 METs), vigorous (6-8.9 METs) and very vigorous (≥9 METs) physical activity were calculated using the Freedson et al. (2005) equation: METs = 2.757 + (.0015 * count) – (.08957 * age in years) – (.000038 * count * age in years). Total accelerometer wear time (minutes per day) was recorded using the time-stamped, first and last accelerometer counts for each day. To control for wear time in the statistical analyses, minutes of moderate-vigorous physical activity were expressed as a percentage of total wear time.

Statistical Analysis

Data were analyzed using SPSS 22.0 for Windows. A power analysis to detect a moderate effect size (0.15; Cohen, 1988) at 80% power and an alpha level of .05 indicated a sample size of 95 participants was required. Descriptive statistics were examined and one way ANOVA analyses were run to assess whether there were significant differences between mother and father variables, for male and female youth. Linear regression models were run to examine the main effects of parent depression and harsh/lax parenting strategies without the interaction variable. The PROCESS method outlined by Field (2014) was followed for the moderation analysis; this method is based on regression analyses, with the interaction term created by multiplying the independent and moderating variables. Percent time spent in MVPA was entered as the dependent variable, harsh/lax parenting score was entered as the independent variable, and parent depression was entered as the moderating variable. In the instance of identifying a significant interaction term, post-hoc analyses were examined to identify the direction of the interaction effect. Separate moderation analyses for male and female youth, using mother and father variables, separately for harsh and lax parenting strategy scores were examined. Models were initially run without covariates, and subsequently, with BMI z-score and SES entered as covariates. Significance was set at a level of $p \leq .05$.

Results

The descriptive characteristics of the sample are displayed in table 3.1. Approximately half the sample was male (51.7%) and the majority identified their ethnic/racial group as White (80.4%). Boys spent a significantly greater percent of time in MVPA than girls. Father's depression scores were significantly lower than mother's depression scores. Father's scores for lax parenting strategies were significantly higher than mother's scores for lax parenting strategies.

Table 3.1 Sample characteristics; mean (SD)

	Total Sample (n=696-1,023)[$]	Boys (n=347-512)[$]	Girls (n=349-515)[$]
Income: Needs Ratio	4.5 (4.2)	4.5 (4.2)	4.6 (4.1)
BMI z-score	0.5 (1.1)	0.6 (1.2)	0.5 (1.1)
Harsh parenting score – Mother	24.5 (3.8)	24.6 (3.7)	24.4 (4.0)
Harsh parenting score – Father	24.8 (3.8)	24.9 (3.7)	24.7 (3.9)
Lax parenting score – Mother	14.8 (3.3)	14.7 (3.2)	14.8 (3.3)
Lax parenting score – Father	15.3 (3.4) [†]	15.4 (3.4) [†]	15.1 (3.3)
Depression Score – Mother	9.0 (8.8)	8.8 (8.8)	9.1 (8.9)
Depression Score - Father	7.5 (7.8) [†]	7.2 (7.2) [†]	7.9 (8.4) [†]
Percent time in MVPA	11.7 (4.6)	13.0 (4.9)	10.5 (3.9)*

[†] Significantly different from mother score (p<.05).
* Significantly different between boys and girls (p<.05).
[$] Sample size varies depending on data availability for variables

Analysis of the main effects of parent depression and harsh/lax parenting strategies on youth physical activity revealed no significant independent effects. Before controlling for covariates (child BMI z-score and socio-economic status) there was a trend towards a significant interaction effect for mother's depression and harsh parenting strategies for male youth (p=.07). Post-hoc tests indicated that among mothers with lower depression scores, harsh parenting strategies were positively associated with physical activity among male youth. Following adjustment for covariates, the p-value of this interaction effect deteriorated (p=.15; see table 3.2).

Before controlling for covariates the interaction effect of mother's depression and harsh parenting strategies was non-significant (p=.11). After adjusting for covariates, a borderline significant interaction effect was observed for mother's depression and harsh parenting strategies on female youth's physical activity (p=.05; see table 3.2). Post hoc tests indicate that among mothers with higher depression scores, harsh parenting strategies were negatively associated

with physical activity among female youth. The results for fathers indicated that there were non-significant

Table 3.2 Regression analyses predicting physical activity from mother's depression and harsh/lax parenting strategies after controlling for covariates

Boys		**R^2**	**Df**	**P**	**b**	**se**	**t**	**Lower 95% CI**	**Upper 95% CI**
Harsh	Overall	.035	5	.02					
n=301	Child BMI			.00	-.72	.21	-3.35	-1.14	-.30
	SES			.83	.02	.10	-.22	-.21	.17
	Depression			.92	.00	.03	.10	-.06	.06
	Harsh			.30	.07	.07	1.03	-.07	.22
	Harsh x Dep			.15	-.01	.01	-1.45	-.02	.00
Lax	Overall	.028	5	.04					
n=300	Child BMI			.00	-.65	.22	-2.95	-1.08	-.22
	SES			.71	-.04	.10	-.37	-.23	.16
	Depression			.99	.00	.03	.00	-.06	.06
	Lax			.45	-.06	.08	-.76	-.22	.10
	Lax x Dep			.87	.00	.01	-.17	-.02	.02
Girls		**R^2**	**Df**	**P**	**b**	**se**	**t**	**Lower 95% CI**	**Upper 95% CI**
Harsh	Overall	.040	5	.03					
n=304	Child BMI			.41	-.17	.21	-.83	-.57	.23
	SES			.01	-.16	.06	-2.74	-.28	-.05
	Depression			.08	-.05	.03	-1.81	-.10	.00
	Harsh			.44	-.04	.06	-.77	-.16	.07
	Harsh x Dep			.05	-.01	.01	-1.96	-.03	.00
Lax	Overall	.023	5	.13					
n=303	Child BMI			.44	-.16	.21	-.77	-.57	.25
	SES			.01	-.15	.06	-2.71	-.26	-.04
	Depression			.18	-.04	.03	-1.35	-.09	.02
	Lax			.91	.01	.06	.12	-.12	.13
	Lax x Dep			.97	.00	.01	.04	-.02	.02

interaction influences of harsh/lax parenting strategies and depression for physical activity for males and females (see table 3.3).

All models for male youth indicated that BMI z-score was significantly, negatively associated with physical activity, i.e., larger/heavier boys engaged in less physical activity than their lighter/smaller male peers. BMI z-score was non-significantly associated with physical

activity among females. All models for female youth indicated that socio-economic status was significantly, negatively associated with physical activity, i.e., girls from families with a

Table 3.3 Regression analyses predicting physical activity from father's depression and parenting strategies after controlling for covariates

Boys		**R^2**	**df**	**P**	**b**	**se**	**t**	**Lower 95% CI**	**Upper 95% CI**
Harsh	Overall	.039	5	.08					
n=185	Child BMI			.04	-.58	.28	-2.07	-1.13	-.03
	SES			.53	.07	.10	.63	-.14	.27
	Depression			.81	.01	.04	.24	-.07	.07
	Harsh			.22	-.11	.09	-1.23	-.28	.06
	Harsh x Dep			.85	.00	.01	-.19	-.02	.02
Lax	Overall	.037	5	.10					
n=185	Child BMI			.05	-.58	.29	-2.00	-1.15	-.01
	SES			.30	.11	.10	1.04	-.10	.31
	Depression			.73	.01	.04	.34	-.07	.10
	Lax			.96	.00	.08	-.05	-.16	.15
	Lax x Dep			.33	.01	.01	.98	-.01	.03
Girls		**R^2**	**df**	**P**	**b**	**se**	**t**	**Lower 95% CI**	**Upper 95% CI**
Harsh	Overall	.035	5	.19					
n=173	Child BMI			.86	-.05	.28	-.18	-.60	.50
	SES			.02	-.17	.07	-2.38	-.30	-.03
	Depression			.32	-.04	.04	-1.00	-.11	.04
	Harsh			.46	-.06	.07	-.74	-.20	.09
	Harsh x Dep			.30	-.01	.01	-1.03	-.03	.01
Lax	Overall	.033	5	.24					
n=172	Child BMI			.89	-.04	.28	-.14	-.60	.52
	SES			.03	-.15	.07	-2.16	-.28	-.01
	Depression			.12	-.06	.04	-1.57	-.13	.02
	Lax			.86	-.02	.09	-.17	-.19	.16
	Lax x Dep			.25	.01	.01	1.14	-.01	.03

lower income: needs ratio (lower SES) engaged in more physical activity than their more affluent peers. SES was non-significantly associated with physical activity among males.

Small proportions of variance in youth physical activity were explained regardless of the combination of parent sex, child sex, and harsh/lax parenting strategies in the models (R^2 values range from .023 to .040).

Discussion

This study explored parent depression as a moderator of the relationship between harsh/lax parenting strategies and physical activity among youth, examining separate influences of mothers and fathers on male and female youth. The results were partially supportive of a hypothesized interaction effect between mothers' depression and harsh/lax parenting strategies with youth physical activity and indicated a different influence among male and female youth. Specifically the results suggest the value of considering maternal factors to understand variation in physical activity among female youth. In this study, there was no evidence of a paternal influence on physical activity for male or female youth.

Consistent with the study hypothesis, the results indicated a small, additive, negative influence of mother depression and a harsh parenting strategies on female youths' physical activity. This is the first study to examine the moderating effect of the depression in the relationship between harsh/lax parenting strategies and youth physical activity, and the findings are consistent with studies reporting independent, negative associations between an authoritarian parenting style, depression, and child physical activity (Fernald et al., 2008; Chen et al., 2008). Previous research indicates the role of parent and child psycho-social characteristics in explaining these associations. For example, Fernald and colleagues (2008) reported that maternal depression predicted more child internalizing behaviors, which in turn was associated with lower child physical activity; in other words, withdrawn children may not engage in as much active play (Gosmann et al., 2015). Depressed mothers also tend to be more socially withdrawn and as such, may not provide as many play opportunities for children (Lovejoy et al., 2000). Authoritarian parenting is associated with lower autonomy among female youth (Baumrind, 1971), and autonomy is a predictor of physical activity in youth (Deci and Ryan, 2008). The

small, additive, interactive effect of maternal depression and harsh parenting strategies is consistent with studies reporting a positive association between parent depressive symptoms and an authoritarian parenting style (Aubuchon-Endsley et al., 2012). Parent depression increases the risk of insecure parent-child attachments, which has a negative influence on parent-child interactions (Wachs, 2009) and may explain the additive, negative effect on child outcomes observed in this study. The additive, negative consequences of depression and parenting style have been observed in other domains. For example, Topham et al. (2010) reported an interactive influence of depression and a permissive/lax parenting style on child obesity, such that the risk of obesity was higher among children whose parents reported more depressive symptoms and a more permissive parenting style. Taken together with findings from the current study, results suggest the value of considering parent psychological health when examining parenting behaviors. Further examination of other potential psychological mediators and moderators may clarify the influence of parenting style on child physical activity.

Before controlling for covariates, the results indicated a trend for mother's harsh parenting strategies to have a positive effect on physical activity among male youth, in the presence of lower maternal depressive symptoms. Previous studies have also reported a positive association between authoritarian parenting and physical activity in male youth (Schmitz et al. 2002). Higher physical activity among males with 'harsher' mothers may reflect the dependency on parents of this age group (11 years old). Compared to older youth, mothers assert more control over the behaviors of younger children (Bulcroft et al., 1996), and any maternal actions and instructions to encourage and promote engagement in physical activity are perhaps more likely to be executed among this age group. This association was observed only among mothers with low depressive symptoms, who tend to be less withdrawn (Lovejoy et al., 2000) and thus

potentially more likely to take their child to activity venues and encourage activity outside the home. However, this interaction effect became non-significant with the addition of BMI z-score as a covariate, suggesting the greater salience of body size, compared to these parent-related variables, with regard to physical activity among males.

In both instances where mother factors were marginally significantly interacting to influence physical activity, harsh parenting strategies were involved. Lax parenting strategies did not demonstrate an interactive association with parent depression in relation to child physical activity. One interpretation of this finding is that parent depression may have a stronger exacerbating influence on aspects of a harsh parenting strategies (e.g., irritable parent-child interactions, high levels of parent control) than lax parenting strategies (e.g., lack of rules/structure and inconsistent discipline). Consistent with this suggestion, Aubuchon-Endsley et al. (2012) reported stronger correlations between authoritarian parenting and depressive symptoms than permissive parenting and depressive symptoms ($r = .42$ vs. $.30$, respectively). The lack of association between lax parenting strategies and child physical activity is consistent with the findings of some previous studies (e.g., Langer et al., 2014; Berge et al., 2010) yet inconsistent with results of others (e.g., Jago et al., 2011). The current study indicates that concurrent parent depression does not explain the conflicting results reported for the association between a permissive parenting style and child physical activity, but may offer a small amount of explanation for the conflicting associations reported between an authoritarian parenting style and child physical activity. The results support the further exploration of moderators of the association between parenting style and child physical activity.

In the current study there was no evidence of a significant influence of the father on youth physical activity. The finding of a borderline significant influence of the mother, and non-

significant influence of the father, on child outcomes is consistent with studies exploring parent influences on child obesity risk (Berge et al., 2010). However, other studies have reported the significant influence of fathers on physical activity among male youth (e.g., Cheng et al., 2014). It is possible that a father's influence on youth physical activity does not operate through harsh/lax parenting strategies or depressive symptoms, and as such, was not captured in the current study. For example, research reports the importance of fathers' role-modeling of physical activity, to youth's development of physical activity behaviors (Schoeppe et al., 2016). The role of fathers in promoting youth physical activity is a relatively unexplored area and represents an important area for future research.

Covariates examined in this study (BMI and SES) demonstrated different associations with physical activity based on child sex. The finding of a significant association between BMI and physical activity among boys and not girls has been previously reported (Basterfield et al., 2014; Trost et al., 2003; Byrd-Williams et al., 2007). Taken together with the current investigation, these studies support that the inverse relationship between BMI and physical activity is typically clearer in boys than girls. Suggested explanations for the different association between BMI and physical activity among male and female youth include variation in energy intake among girls, although this association is not well understood and requires further research.

The inverse relationship between SES and physical activity in youth has been previously reported (e.g., McMurray et al., 2000; Shi et al., 2006), although review articles indicate that the relationship between economic status and physical activity among adolescents is far from clear (Stalsberg and Pedersen, 2010). Higher activity among those from a low socio-economic status may be explained by higher levels of active transport (Fulton et al., 2005; Pabayo and Gauvin, 2008) and/or greater involvement in household duties (Shi et al., 2006). Previous studies

examining physical activity by gender and socio-economic status report different results to those found in the current study; others have reported the significant influences of SES among males (Baquet et al., 2014; Fuchs et al., 1988; Inchley et al., 2005) and the non-significant influence of SES on physical activity among females (Baquet et al., 2014; Fuchs et al., 1988). The different effect of socio-economic status among boys and girls in the current sample may be due to the greater involvement of females in household responsibilities (Shi et al., 2006). In line with the original goals of the SECCYD study, 60% of mothers in the baseline sample had plans to return to work full-time, which may increase household responsibilities for daughters. An alternative interpretation of the different influence of socio-economic status for male and female youth is that the strong influence of BMI on physical activity among boys may be over-shadowing any influence of socio-economic status among males. Further research on the influence of SES and gender on physical activity will help clarify the associations.

Low proportions of variance in child physical activity were accounted for across all models. It is known that child physical activity is influenced by a multitude of factors (Baskin et al., 2013; Davison and Birch, 2001; Van der Horst et al., 2007; Verloigne et al., 2012), which may explain the small effect sizes observed in the current study. In addition, parenting variables that are non-specific to physical activity are expected to demonstrate weaker associations with physical activity than variables that are directly associated, such as parent physical activity or parent encouragement of physical activity (Power et al., 2013). Thus, the small proportions of variance explained by the current models including parenting variables which were non-specific to physical activity make empirical sense.

Limitations of this study include the use of parenting style/strategies reported in 3rd grade as a proxy of parenting style/strategies in 6th grade. Research indicates the stability of parenting

style over time, yet the study results rest on this assumption. In addition, the Cronbach's alpha values for mothers and fathers were below the recommended values of .7-.8; this indication of lower scale reliability represents a potential source of bias in this study and suggests that the results should be interpreted with caution. A second limitation of the study is that the calculation of moderate-intensity physical activity in the current study is based on the Freedson equation (Freedson et al., 2005), which uses a moderate-intensity physical activity MET value of three. Recent research indicates that a 4-MET cut-off is more appropriate to use among pediatric populations (Trost et al., 2011). While the physical activity values reported in this study are comparable to other samples where the Freedson equation has been used with a MET value cut-off of three METs (McClain et al., 2007) and four METs (Adams et al., 2013), research also reports the substantial influence that using three vs. four MET cut-offs can have on estimates of physical activity levels in youth (Adams et al., 2013). Based on recent recommendations, the four MET cut-off should be used in future research to identify moderate-intensity physical activity in youth; the data for this study were drawn from a pre-collected data set and as such, the re-analysis of accelerometer data was not an option. This study benefits from the large, nationally-representative sample and the measurement of physical activity by accelerometer. Additional strengths of this study include the ability to examine four subgroups (mother and daughters, mothers and sons, father and daughters, fathers and sons), with sample sizes which were sufficient to detect effects. In addition, mother and father scores for depression and parenting measures were similar to those reported previously (Topham et al., 2010; Watkins et al., 2011), which suggests the generalizability of the findings.

Conclusions

This study suggests that the effect of harsh maternal parenting strategies on youth physical activity may be moderated, to a small degree, by child sex and level of depressive symptoms. As such, lack of adjustment for these variables in previous studies may provide some explanation for the mixed associations currently reported in the literature on parenting styles and youth physical activity. The findings indicate the differential influence of mothers and fathers on youth physical activity and that fathers may not influence youth physical activity through the psychological and parenting variables considered in this study. This study supports the further examination of moderators of the association between parenting style and child physical activity, as well as the examination of separate maternal and paternal predictors of physical activity among male and female youth. Future research exploring the differential influences of mothers and fathers on child physical activity will facilitate the design of effective intervention strategies to promote child physical activity. The results suggest a small, detrimental, additive influence of maternal depression and harsh parenting strategies among mothers on the physical activity of female youth. Considering the psycho-social health and parenting habits of mothers may help progress understanding of variation in physical activity among female youth.

CHAPTER 4: EXAMINING THE MEDIATION EFFECT OF PARENT ENCOURAGEMENT IN THE RELATIONSHIP BETWEEN MARITAL CONFLICT AND CHILD PHYSICAL ACTIVITY BEHAVIOR

Abstract

The direct and indirect relationships between indicators of family function (e.g., family cohesion) and child physical activity have received limited attention, although initial studies suggest such variables are worthy of further exploration. Marital conflict is identified as a salient family variable with a range of negative consequences for parenting and youth outcomes. The influence of marital conflict on physical activity-specific parenting behaviors, and child physical activity has not been examined. Thus, the purpose of this study was to test an indirect effects model examining the mediating influence of parent encouragement for physical activity (at 11 years) on the direct association between marital conflict (at 10 years) and child physical activity (at 15 years). **Methods**: Data for this study came from the Study of Early Child Care and Youth Development. When children were 10-, 11-, and 15-years old, they wore an Actigraph accelerometer for one week to assess physical activity. At these time points, mothers completed a measure of marital conflict and a physical activity interview, during which they indicated the frequency of parental encouragement for child physical activity. An autoregressive indirect effects model was examined for the total sample, and then for males and females separately. Data analysis was conducted using Mplus version 7.4. **Results**: The direct effect of marital conflict at 10 years on physical activity at 15 years was significant for the total sample (b=.13, s.e.=.06, p=.02), and marginally non-significant for female youth (b=.11, s.e.=.06, p=.06). The direct effect was non-significant for male youth (b=.13, s.e.=.09, p=.14). The indirect effect of marital conflict at 10 years on physical activity at 15 years, via parent encouragement of physical

activity at 11 years was non-significant for the total sample (b=.00, s.e.=.01, p=.55) and for male and female youth. **Conclusions**: The hypothesized indirect effect of marital conflict on physical activity via parent encouragement of physical activity at 11 years was not supported. The positive association found between marital conflict and physical activity may reflect a conflict avoidance strategy whereby youth accrue more activity by physically distancing themselves from conflict. Female youth may be particularly susceptible to the negative consequences of marital conflict. These initial findings require replication and support the further examination of these variables at different time points, as well as the relationships between family function variables and child physical activity.

Introduction

Regularly engaging in physical activity affords positive health outcomes to children, yet a majority of youth are insufficiently active to attain the health benefits (Troiano et al., 2008). The identification of predictors of physical activity is necessary to facilitate the design of public health interventions which can increase youth engagement in physical activity. Family and parents assert a strong influence on the development of child health behaviors (Bornstein, 2002), and research identifies the family as a social agent worthy of further examination (e.g., Elder et al., 2015; Ohri-Vachaspati et al., 2015; Verloigne et al., 2012; Davison and Birch, 2001).

A theoretical model presented by Berge (2009) indicates that family function variables may be antecedents to both child health behaviors and parenting practices/styles (see figure 4.1). The framework suggests direct and indirect (via parenting factors) influences of family factors on child health behaviors and supports the examination of family function variables in the endeavor to understand the development of child health behaviors.

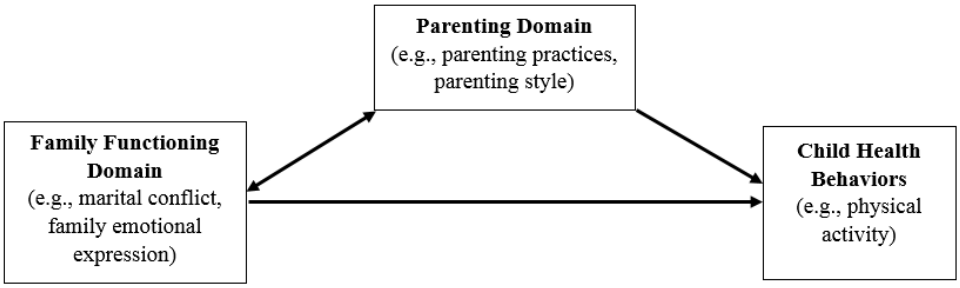

Figure 4.1 Part of Berge's (2009) application of Family Systems Theory to child health behaviors.

At present, only eleven studies have examined family function variables in relation to child physical activity, including general family functioning, maternal distress, job-related stress and family cohesion. Overall the results suggest that a more positive family system (e.g., higher family cohesion and lower maternal distress) is associated with greater engagement in child physical activity (e.g., Atkin et al., 2015; Bigman et al., 2014; Gray et al., 2008). Thus, the results imply the value of further examining family function indicators in relation to child physical activity. The model by Berge (2009) indicates the salient influence of family variables on child health behaviors and parenting, but it does not indicate specific family variables to examine. To this point, Belsky (1984) proposed a model which outlines several, family-related

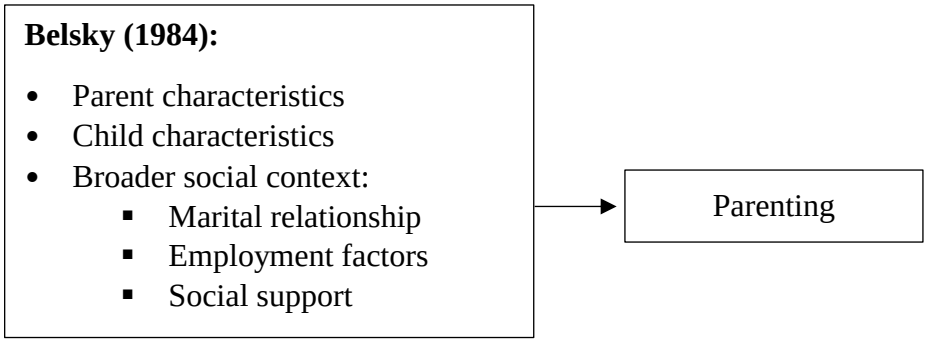

Figure 4.2 Determinants of Parenting (Belsky, 1984)

parenting determinants which have not been explored in relation to child physical activity (see figure 4.2). In the accompanying article, Belsky (1984) highlighted the particular importance of the marital relationship to parenting. Variables pertaining to the marital relationship may therefore be valuable to examine in relation to child outcomes.

Marital conflict represents an aspect of the marital relationship, and research reports a negative association between marital conflict and parenting behaviors, including the demonstration of greater warmth towards the child (Kendler et al., 1997; Erel and Burman, 1995). Marital conflict is negatively associated with parent self-efficacy, a predictor of positive parenting behaviors (Bryanton et al., 2009), and Macfarlane et al. (1995) reported that marital conflict was associated with less emotional closeness in the parent-child relationship. Marital conflict may thus have negative implications for child physical activity as a result of the negative influence of marital conflict on parenting behaviors, parent warmth, and the parent-child relationship. The association between marital conflict and youth physical activity has not been examined.

The findings outlined above indicate the potential mediating role of parenting behaviors on the hypothesized association between marital conflict and child physical activity. Of the eleven studies currently published on associations between family variables and child physical activity, only three have examined potential mediators of the relationship between family variables and child physical activity, and the majority of mediators examined have been child psycho-social factors (Gray et al., 2008; Fernald et al. 2008; Ornelas et al., 2007). The mediating influence of parenting variables has received limited empirical attention.

One parenting practice consistently associated with child physical activity is parental encouragement of physical activity (e.g., Pugliese and Tinsley, 2007; Duncan et al., 2015). As a

salient predictor of child physical activity, parental encouragement may be worth exploring as a mediating variable between marital conflict and child physical activity. Marital conflict is associated with identified predictors of parental physical activity support, including emotional support and parent-child closeness (Kendler et al., 1997; Erel and Burman, 1995; Macfarlane et al. 1995). In addition, Resource Drain Theory (Edwards and Rothbard, 2000) and the Family Stress Model (Conger, Rueter & Conger, 2002) suggest that socio-emotional resources expended in dealing with a stressor such as marital conflict, will leave less energy and attention available for positive parenting such as encouraging children to be physically active. As a result of the negative effects of marital conflict on parenting (Coln et al., 2013) and salient aspects of the parent-child relationship, it is plausible that marital conflict will be negatively associated with child physical activity and that the negative association will be partly mediated by parenting behaviors such as encouragement of child physical activity. This notion has not been empirically explored and would provide valuable information on the dynamics of associations among family and parenting variables hypothesized to be related to child physical activity.

Physical activity is known to decline across the lifespan, with a particularly striking decrease occurring for all youth during the early adolescent years. Identifying factors which can predict change in physical activity during the early adolescent years is of value to public health interventionists. In addition, during the early adolescent years, youth gain autonomy and parent-child relationships change (Collins and Steinberg, 2006). Thus, examining how changes in parenting variables drive changes in physical activity during this time frame is of interest.

The purpose of this study was to test a mediation model, examining the mediating influence of parental encouragement on the association between marital conflict and youth physical activity during early adolescence.

Methods

Data for this project came from the Study of Early Child Care and Youth Development (SECCYD). The SECCYD study started in 1991 and was a multi-site, longitudinal project funded by the National Institute of Child Health and Development. The ten data collection sites were: (1) Boston, MA; (2) Charlottesville, VA; (3) Hickory and Morganton, NC; (4) Irvine, CA; (5) Lawrence, KS; (6) Little Rock, AR; (7) Madison, WI; (8) Philadelphia, PA; (9) Pittsburgh, PA; and (10) Seattle, WA. The primary objective of SECCYD was to gather data to permit examination of the associations between different types of childcare and child development indicators (e.g., academic and social), during different stages of childhood and adolescence (infancy, early childhood, middle childhood and middle adolescence). Data were collected in four phases: phase I when children were 1 month to 3 years old (1991-1994), phase II when children were 4-8 years old (1995-1999), phase III when children were 9-13 years old (2000-2004) and phase IV when children were 14-15 years old (2005-2006). Data collection sessions occurred more than once a year during the child's infancy and annually from early childhood onwards. Data collection sessions involved home and laboratory visits, and the completion of observation/interaction sessions, questionnaires and interviews. All participating families provided written informed consent, and the institutional review board of participating university sites approved the study protocol.

Participants

From 8,986 mothers that gave birth in one of the ten university-based hospitals in the United States of America during an 11-month enrollment period in 1991, 1,364 families were enrolled into the SECCYD project. For the first four months of the recruitment period, each hospital provided the data coordinating center with a randomly ordered list of eligible families, to contact

regarding study participation. Exclusion criteria were (1) the family having plans to move away from a study area, (2) the mother being insufficiently fluent in English, (3) the child having disabilities or being admitted to hospital for more than seven days after being born, and (4) the mother having a substance abuse issue. After the initial four months of recruitment, characteristics of eligible families were screened by the data coordinating center and an effort was made to recruit families to ensure adequate representation of under-represented groups (at least 10% ethnic minority mothers, 10% of mothers with less than high school education, and 10% single parent households). The sampling strategy was effective and the recruited sample (n=1,364) was racially and socio-economically representative of the population of the United States of America at study onset (SECCYD sample = 80.3% white, U.S. population = 80.4% white; mean SECCYD sample household income = $36,520, mean U.S. population household income = $37,948). At phase IV, 1,073 of the original 1,364 families (79%) remained in the study. Data from phases III and IV are used for this study.

Marital Conflict

Marital conflict was assessed using the 'Frequency' subscale of the CPS questionnaire (Kerig, 1996) when the participating study child was 10, 11, and 15 years old. Scores on this measure demonstrate significant, positive associations with child outcomes, including anxiety and internalizing behaviors, and child perceptions of the frequency and intensity of parent conflict (Kerig, 1996). Frequency CPS subscale scores also demonstrate significant associations with alternate measures of marital conflict including the Dyadic Adjustment Scale ($r = -.52$, $p < .001$; Spanier, 1976) and the O'Leary Porter Scale ($r = .63$, $p < .001$; Porter and O'Leary, 1980; Kerig, 1996). The Frequency CPS subscale is comprised of two items asking about the frequency of (1) minor conflict episodes, and (2) major conflict episodes, within a relationship. The following

instructions were provided: "*the following questions ask about certain aspects of your relationship with your partner. Please answer these questions for the present time in your relationship by circling the number that best describes your relations with your partner*". Participants respond on a six-point Likert scale for which the options are: 'once a year or less', 'every 4-6 months', 'every 2-3 months', 'once or twice a month', 'once or twice a week', and 'just about every day'. The option selected for the frequency of 'minor' conflict episodes is scored 1-6 (1 = 'once a year or less', 6 = 'just about every day'). The option selected for the frequency of 'major' conflict episodes is scored 2-12 (2 = 'once a year or less', 12 = 'just about every day'). A total score of the two items was calculated (possible range = 3-18). Higher scores indicate greater frequency of marital conflict. Cronbach's alpha for this scale when children were 10 years was .68, at 11 years was .68, and at 15 years was .69.

Parent Encouragement of Physical Activity

As part of a physical activity interview (conducted when participating children were 10, 11, and 15 years old), mothers were asked about the support provided for their child's physical activity. The interview consisted of 13 questions, one of which was "during a typical week, how many days do you encourage your child to exercise, or be physically active?" The participant's response (a number of days between 0-7) was recorded by the interviewer.

Physical Activity

Participating youth wore an accelerometer for seven consecutive days, during a typical school week when they were 10-, 11- and 15 years old. Parents were instructed that their child should wear the monitor every day, removing the monitor when going to sleep at night, and when during water-based activities (e.g., bathing and swimming). Participants wore a uniaxial accelerometer

(Computer Science and Applications, Inc., Shalimar, FL) on the right hip. A minimum of four days of sufficient data were required to include the child's physical activity measurement in the statistical analysis. Daily physical activity monitor recording started with the first non-zero accelerometer count recorded after 5am on each day of data collection, and ended when one of the following criteria were met: (a) the last non-zero accelerometer count recorded before midnight, (b) 60 minutes of consecutive zero accelerometer counts after 9pm, (c) 30 minutes of consecutive zero accelerometer counts after 10pm. Activity was recorded in 60-second epochs. Minutes per day spent performing moderate (3-5.9 METs), vigorous (6-8.9 METs) and very vigorous (≥9 METs) physical activity were calculated using the Freedson et al. (2005) equation: METs = 2.757 + (.0015 * count) – (.08957 * age in years) – (.000038 * count * age in years). Total accelerometer wear time (minutes per day) was recorded using the time-stamped, first and last accelerometer counts for each day.

Data Analytic Strategy

A longitudinal indirect effects model was used to examine the mediating influence of parent encouragement of physical activity on the association between marital conflict and child physical activity. All variables were assessed when enrolled children were 10, 11, and 15 years old. The measurement of each study variable at all time points is recommended for examining indirect effects, as this permits prior levels of mediator and outcome variables to be controlled for; not controlling for prior levels of these variables can introduce substantial bias into the results (Cole and Maxwell, 2003; Maxwell and Cole, 2007). As part of the SECCYD study, marital conflict was assessed when participating children were 10, 11 and 15 years. The time intervals between measures were dictated by availability of data at these time points. While an argument could be made for examining earlier or more evenly spaced time points, there are only a few studies

which have used longitudinal data to examine change in parent encouragement of child physical activity upon which such an argument could be based; the ideal time points for examining changes among these variables is not known. As such, this study represents an exploration of the longitudinal influence of family factors on child physical activity during a time frame when physical activity and the parent-child relationship are known to be changing.

The sample size required for a structural equation model varies; in addition to the specified significance, power and effect size, the number of required participants also depends on (for example) amounts of missing data and the number of parameters estimated (Wolf et al., 2013). Wolf and colleagues (2013) reported that the sample size required for a number of commonly used structural equation models ranged from 30-460 cases. The variable with the lowest number of cases available was child physical activity at 15 years (n=602).

Model fit was assessed by examining multiple indices including the chi-square statistic (Bollen, 1989), the Comparative Fit Index (CFI), where values greater than .95 indicate adequate fit (Bentler, 1990), and Root Mean Square Error of Approximation (RMSEA), where values of less than .08 indicate adequate fit (Hu and Bentler, 1999). All data analyses were conducted using Mplus (Mplus version 7.4; Muthén and Muthén, 1998-2015). Missing data were accommodated using the full-information maximum likelihood estimation procedure.

Results

Descriptive Statistics and Correlations

Mean values for independent, mediator and outcome variables, for all time points, are shown in table 4.1. The majority of participants identified their ethnic group as ‘White’ (80.4%) and

Table 4.1 Means and Standard Deviations of Study Variables

	Total Sample			Boys Only			Girls Only		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Marital Conflict (10 years)	840	7.32	3.27	407	7.30	3.16	403	7.34	3.38
Marital Conflict (11 years)	865	7.30	3.20	433	7.26	3.12	432	7.34	3.28
Marital Conflict (15 years)	765	7.54	3.23	388	7.50	3.27	377	7.57	3.19
Parent PA Encouragement (10 years)	963	4.34	2.45	484	4.52	2.45	479	4.16	2.44
Parent PA Encouragement (11 years)	894	4.17	2.44	449	4.46	2.44	445	3.88	2.41
Parent PA Encouragement (15 years)	960	3.47	2.55	479	3.66	2.65	481	3.29	2.45
Physical Activity (10 years; % time spent in MVPA)	850	15.16	4.89	416	16.12	5.19	434	14.24	4.39
Physical Activity (11 years; % time spent in MVPA)	696	11.74	4.56	347	12.95	4.87	349	10.53	3.87
Physical Activity (15 years; % time spent in MVPA)	602	5.66	3.50	324	6.72	3.78	278	4.42	2.65

approximately half were male (51.7%). The average marital conflict score was consistent from ages 10 to 11, and increased by a small amount between 11 and 15 year time points. The average number of days per week that parents encouraged their children to by physically active decreased from age 10 to 11, and from 11 to 15 years. Average percent time spent in moderate-vigorous physical activity also decreased from age 10 to age 11, and from age 11 to age 15. Correlations between measures of the same variable at different time points were positive and significant, consistent with expectations of longitudinal data (see table 4.2). Marital conflict measures made at different time points were significantly, positively correlated with each other; assessments

made closer together (e.g., assessments at age 10 and 11 years) were more strongly correlated than when more time elapsed in between the assessments (e.g., assessments at 10 and 15 years).

Table 4.2 Longitudinal and Cross-sectional Correlations of Study Variables

	MarCon (11 yrs)	MarCon (15 yrs)	ParEnc (10 yrs)	ParEnc (11 yrs)	ParEnc (15 yrs)	ChildPA (10 yrs)	ChildPA (11 yrs)	ChildPA (15 yrs)
MarCon (10 yrs)	.715**	.567**	-.050	.137**	.018	.053	.011	.151**
MarCon (11 yrs)		.578**	-.020	.083*	.035	.053	-.041	.022
MarCon (15 yrs)			-.004	.096*	.054	.073	.014	.041
ParEnc (10 yrs)				.361**	.278**	.158**	.134**	.082
ParEnc (11 yrs)					.373**	.088*	.123**	.091*
ParEnc (15 yrs)						.018	-.002	.043
ChildPA (10 yrs)							.412**	.382**
ChildPA (11 yrs)								.402**

MarCon = marital conflict; ParEnc = parental encouragement of child physical activity; ChildPA – child physical activity
* $p < 0.05$. ** $p < 0.01$.

This pattern of stronger correlations between adjacent data collection points was observed for parent encouragement of child physical activity, and child physical activity variables as well. Marital conflict at 10 years and parent encouragement at 11 years were significantly correlated with child physical activity at 15 years. Martial conflict at 10 years was also significantly correlated with parent encouragement of physical activity at 11 years.

Marital Conflict, Parent Encouragement of Physical Activity, Child Physical Activity

The first model examined whether parent encouragement of physical activity at 11 years mediated a potential association between marital conflict at 10 years and child physical activity

at age 15 for the whole sample. The model fit the data adequately, chi square (16, N=1091) = 115.82, p = .000; CFI = .93, RMSEA = .076 (see figure 4.3). As depicted by the cross-lagged

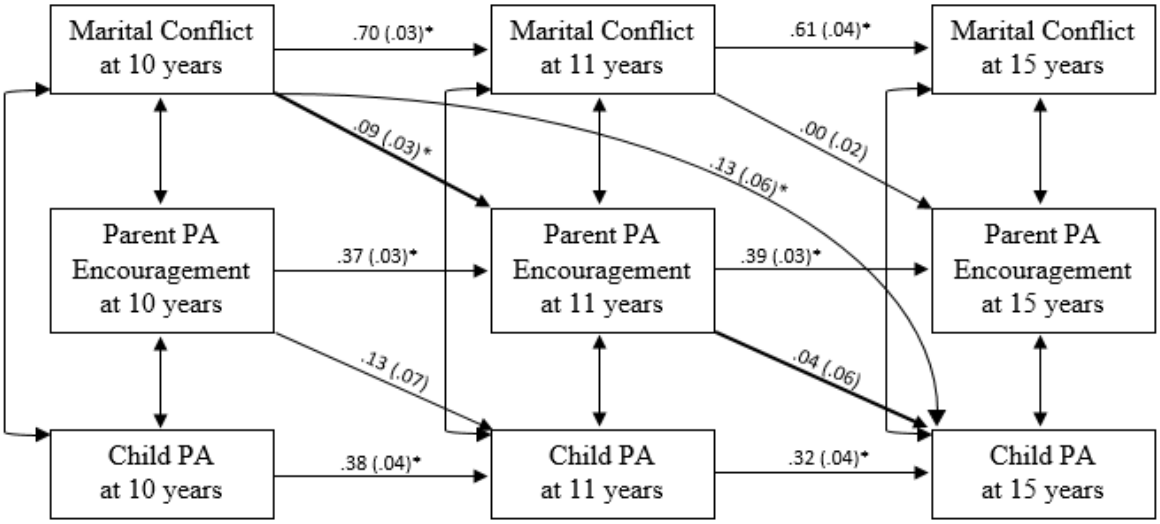

Figure 4.3. Indirect effects model for the total sample, with marital-conflict driven pathway in bold arrows. Path coefficients are outside of parentheses and standard errors are inside parentheses. Covariance pathways were tested but are not presented on the model for clarity; see table 4.3.
** Pathway was significant at p≤.05.*

paths, marital conflict at 10 years significantly predicted parent encouragement of physical activity at 11 years. The pathway between marital conflict at 10 years and physical activity at 15years was also significant. There was a non-significant effect of parent encouragement at age 11 on physical activity at age 15. The 95% confidence interval for the indirect effect of marital conflict at age 10 on child physical activity at age 15, via parent encouragement of physical activity at age 11 was [-.01, .02], indicating that this mediating path was non-significant.

A second model included child sex as a grouping variable which allowed examination of the indirect effect separately for male and female youth. The model demonstrated an adequate fit to the data, (chi square [32, male N=533, female N=528] = 135.12, p = .000; CFI = .92, RMSEA = .078). Consistent with the model for the total sample, among female youth marital conflict at

age 10 significantly predicted parent encouragement of physical activity at age 11 and almost significantly predicted

Table 4.3 Indirect model path coefficients used to test study hypotheses for the total sample, male and female participants

	Total Sample			Males			Females		
Parameters	**Est.**	**S.E.**	**P**	**Est.**	**S.E.**	**P**	**Est.**	**S.E.**	**P**
MC10 → MC11	.70	.03	.00	.67	.04	.00	.73	.03	.00
MC11 → MC15	.61	.04	.00	.63	.05	.00	.58	.05	.00
PE10 → PE11	.37	.03	.00	.33	.05	.00	.40	.05	.00
PE11 → PE15	.39	.03	.00	.40	.05	.00	.38	.05	.00
PA10 → PA11	.38	.04	.00	.34	.07	.00	.37	.05	.00
PA11 → PA15	.32	.04	.00	.32	.05	.00	.18	.05	.00
MC10 → PE11	.09	.03	.00	.05	.04	.19	.12	.04	.00
MC11 → PE15	.00	.02	.91	.02	.04	.71	-.01	.03	.79
PE10 → PA11	.13	.07	.08	.03	.11	.80	.17	.08	.03
PE11 → PA15	.04	.06	.52	.03	.09	.77	-.03	.07	.64
Covariances									
MC10 → PE10	-.47	.31	.12	-.31	.42	.45	-.58	.42	.17
PE10 → PA10	1.81	.45	.00	2.19	.70	.00	1.04	.55	.06
MC10 → PA10	.98	.63	.12	.76	.91	.41	1.07	.90	.23
MC11 → PE11	-.03	.18	.88	.12	.26	.64	-.15	.27	.60
PE11 → PA11	.68	.49	.17	.23	.80	.77	.77	.42	.07
MC11 → PA11	-.63	.36	.08	-.70	.58	.23	-.33	.42	.44
MC15 → PE15	.14	.23	.54	.04	.31	.91	.25	.31	.42
PE15 → PA15	.25	.34	.47	-.10	.60	.88	.69	.38	.06
MC15 → PA15	.11	.35	.76	.27	.53	.61	-.15	.43	.74
Direct effect									
MC10 → PA15	.13	.06	.02	.13	.09	.14	.10	.05	.05
Indirect effect									
MC10 → PE11 → PA15	.00	.01	.55	.00	.01	.82	.00	.01	.67

Est. = estimates; S.E. = standard error; P = p value; MC = marital conflict; PE = parent encouragement of child physical activity; PA = child physical activity; 10 = 10 years old; 11 = 11 years old; 15 = 15 years old.

physical activity at age 15 (see table 4.3). These pathways were not significant for male youth. For female and male youth, parent encouragement at age 11 was a non-significant predictor of physical activity at age 15. In contrast to male youth, parent encouragement of physical activity at age 10 was a significant predictor of physical activity at age 11 among females. Statistical analysis revealed a non-significant moderation effect of gender on the direct pathway from

marital conflict at age 10 to child physical activity at age 15 (b=.02, S.E.=.10, p=.83) and on the direct pathway from marital conflict at age 10 to parent encouragement of activity at age 11 (b=-.07, S.E.=.05, p=.17). For male and female youth, the 95% confidence interval for the indirect effect of marital conflict on child physical activity via parent encouragement of physical activity was [-.01, .02] and [-.03, .01], respectively, indicating that this mediating path was non-significant for male and female youth.

Discussion

This study explored the potential indirect effect of marital conflict on child physical activity via parental encouragement of child physical activity using a longitudinal mediation model. Despite theoretical and empirical support for the potential indirect effect, there was no evidence of an indirect, mediating influence of parent encouragement on the association between martial conflict and physical activity among the whole sample, or when examining the associations among male and female subgroups. When examining the relationships for the whole group, and among females, there was evidence of a trend for marital conflict in 5th grade (10 years old) to positively predict physical activity when children were 15 years old (this path was non-significant when examining only males). Effect sizes were small, which is consistent with expectations of variables which are not specifically tied to physical activity (Power et al., 2013), as well as the understanding that physical activity is influenced by a wide range of variables (e.g., Verloigne et al., 2012). The results of this study suggest a role of family variables in determining later physical activity among youth, and a differential effect for males and females.

Consistent with previous findings, physical activity and parent encouragement of physical activity declined as children aged (Bauer et al., 2011; Dowda et al., 2007; Dumith et al., 2011; Hardie Murphy et al. 2016). Marital conflict demonstrated little change over the study time

period, consistent with the findings of studies conducted over a similar time period, on children of a similar age to those in the current study (Tu et al., 2015; Goeke-Morey et al., 2013). The average values for marital conflict and percent time spent in physical activity were similar to those previously reported (Cummings et al., 2014; McClain et al., 2007).

The small, significant trend for higher levels of marital conflict at age 10 to predict more physical activity when children were 15 years old was contrary to the study hypothesis. Theories discussing the influence of family and parenting variables on child physical activity predict that lower family/parent stress and better family function will be associated with favorable child outcomes (e.g., Resource Drain Theory, Edwards and Rothbard [2000]; Family Systems Theory, Minuchin [1985]; Family Stress Model, Conger, Rueter, Conger [2000]). While these theories do not directly focus on predicting physical activity (and instead, focus on alternate child development goals), other studies have explored indicators of family function in relation to youth physical activity, and have reported findings which are more consistent with hypotheses forwarded by these theories. For example, Berge et al. (2013) reported that better family functioning was associated with physical activity among youth, and Bigman et al. (2014) reported that more family cohesion was associated with higher youth physical activity. Marital conflict can elicit behavioral responses from children, which are theorized to have the goal of maintaining a sense of security within the family (marital conflict represents a threat to this security; Davies and Cummings [1994]). One of the more commonly enacted behavioral strategies by children is conflict avoidance, i.e., removing oneself from the conflict situation (Koss et al., 2011). It is plausible that among older youth, who have more autonomy than younger children, this conflict avoidance strategy could manifest in youth spending more time outside the home, leading to more physical activity, either by engaging in sports or activities

with friends, or through travel to alternate locations to avoid the home environment. Research also supports that marital conflict is associated with more externalizing behavior problems in both children and adolescents (Tu et al., 2015). Externalizing disorders and behaviors in youth have been associated with higher levels of physical activity (Van Egmond-Fröhlich, 2012; Gosmann et al., 2015). These results may offer partial explanation as to why a positive association was observed between physical activity and marital conflict.

Analysis by child sex indicated that the direct association between marital conflict at age 10 and physical activity at age 15 was stronger among females; this finding is consistent with literature suggesting that the determinants and predictors of physical activity are different for male and female youth (e.g., Fuemmeler et al., 2011). Research examining other family-related variables such as parent distress and work-family conflict also suggest differential effects on physical activity among male and female youth (e.g., Atkin et al., 2015; Berge et al., 2013). The different associations observed for males and females in the current study are thus consistent with previous findings indicating gender-specific physical activity determinants. The literature also supports the differential effects of marital conflict on male and female youth (e.g., Brock and Kochanska, 2015). Females are reported to be more sensitive than boys to marital discord (Crawford et al., 2001; Emery et al., 1982). The suggestions outlined previously regarding why marital conflict demonstrated a positive association with child physical activity may therefore be more apparent among females.

Beyond this, higher marital conflict at age 10 also significantly predicted more parent encouragement of child physical activity at age 11. The positive effect of marital conflict on parenting behaviors is also inconsistent with the predictions of family-focused theories and empirical evidence supporting the negative influence of martial conflict on parenting behaviors

(Kendler et al., 1997; Erel and Burman, 1995). In the literature on the effect of marital conflict on parenting and parent-child relationships, there are two conflicting hypotheses: the 'spillover hypothesis' and the 'compensation hypothesis'; the spillover hypothesis explains that the negative emotions associated with marital conflict spillover into parenting behaviors and parent-child relationships and predict negative child outcomes. The compensation hypothesis predicts that as a result of a conflictual marital relationship, parents will invest more effort in parenting and parent-child relationships. The results from the current study regarding the positive influence of marital conflict on parent encouragement may be interpreted as consistent with the compensation hypothesis; it is possible that mothers made more efforts to encourage their children to be active, in an attempt to enact better parenting. This suggestion is consistent with the findings of other researchers who report enhanced parenting strategies alongside higher levels of marital conflict (Brody et al., 1986; Engfer et al., 1988; Emery and Tuer, 1993; Kerig et al., 1993). An alternative interpretation of this finding is that the positive relationship between parental encouragement and marital conflict represents a more controlling parenting strategy by the mother. This suggestion is in keeping with the spillover hypothesis and supported by research reporting that marital conflict demonstrates a strong, positive association with authoritarian parenting among female youth (Stoneman et al., 1989), and that more marital conflict is also associated with more power-assertive parenting among mothers (e.g., Webster-Stratton, 1989). The positive association may therefore reflect a mother's effort to assert control in other areas of her life, when perhaps lacking feelings of control within the marital relationship.

When examining the indirect model by child sex, the association between marital conflict at age 10 and parent encouragement at age 11 remained significant for females only, indicating differential effects for male and female youth. As boys tend to be more active than girls (de

Moraes et al., 2013), mothers may not perceive the need to provide physical activity encouragement to males, or that it is more the father's responsibility to support physical activity among sons (Zahra et al., 2015). The influence of paternal variables on physical activity among male and female youth is an area for future research.

The lack of significant longitudinal influence of parent encouragement on child physical activity between ages 11 and 15 years contradicts findings from previous cross-sectional and longitudinal studies. While there are mixed findings reported from cross sectional studies examining parent encouragement and child physical activity, a majority report a positive association, and this is supported by the results of a meta-analysis on parent support behaviors and child physical activity (Pugliese and Tinsley, 2007). There are fewer longitudinal studies with which to compare the current findings, although those that are available also support the positive influence of parent encouragement on child physical activity across a similar time span, for youth of a similar age. For example, Verloigne et al. (2013) reported that more parent encouragement at age 10 significantly predicted higher levels of child physical activity at age 16, although it is not clear that the authors of this study controlled for prior levels of physical activity, or concurrent levels of parent encouragement at age 16. Another longitudinal study reported that child-reported parent encouragement to be physically active was associated with more physical activity, five years later, after controlling for baseline physical activity (Bauer et al., 2008). The measure of parent encouragement by child report may account for the different findings observed in the current study. Thus, methodological differences may explain the inconsistent nature of the findings observed in this study. Further longitudinal studies examining family-function indicators and parent support behaviors are necessary to clarify the nature of this association among this age group.

The non-significant, indirect effect of marital conflict on child physical activity via parent encouragement was contrary to the study hypothesis, and likely due to the non-significant influence of parent encouragement at age 11 on child physical activity at age 15 years (which was inconsistent with previous literature and hypothesized associations). The direct association between marital conflict and child physical activity may be mediated by other variables. For example, marital conflict is reported to influence multiple psycho-social variables in children, such as self-esteem (Siffert et al., 2012), which also demonstrates associations with child physical activity. In attempting to understand the influence of family-function indicators on child physical activity, there is value to exploring alternative variables (child- and parent-related) as potential mediators and/or moderators of the positive association observed in this study.

Limitations of this study include the spacing of the first two time points which may not have allowed enough time to elapse for change or influence on downstream variables to occur. In addition, we were not able to examine the influence of father-reported variables. The literature suggests that mothers and father have unique influence on sons and daughters (Schoeppe et al., 2016; Zahra et al., 2015), and this is worthy of further exploration. In addition the measure used to assess parent encouragement of physical activity was only one item. While other studies have also used one-item measures to assess parental encouragement (e.g., Dowda et al., 2007), there are more extensive measures available which may have gathered richer data and potentially provided different results. Strengths of this study include the analysis of a full-longitudinal mediation model, which permitted controlling for prior levels of both mediator and outcome variables. In addition, the use of accelerometers to assess physical activity increases the validity of the findings. The examination of family variables and child physical activity in a full longitudinal mediation model makes a valuable contribution to the literature examining family

influences on child physical activity. This study provides initial evidence of longitudinal relationships among these variables, which can inform future research efforts regarding how change in family variables may influence youth physical activity levels over time.

Conclusions

While this study's mediation hypothesis was not supported, the current findings provide novel information on associations among family variables, parent physical activity support behaviors and youth physical activity, as well as the differential effects among male and female youth. The positive effect of marital conflict on female physical activity was unexpected and the results require replication. The examination of alternative mediators and potential moderators may help clarify the dynamics of the association. The current literature examining variables which mediate associations between family variables and child physical activity have mostly been child psycho-social factors, for which there is stronger evidence of a mediating influence. Exploring child mediators of the association between marital conflict and child PA may provide valuable information on the dynamics of the direct association between marital conflict and child physical activity observed in this study. This study supports the continued exploration of the associations between indicators of family function and child physical activity, as well as family function variables and physical-activity specific parenting behaviors.

CHAPTER 5: SUMMARY AND CONCLUSIONS

The purpose of this dissertation was to examine the potential role of family function variables in relation to child physical activity. Family and parents are known to assert a salient influence on children's behavior development, yet examination of the role of family/parents in relation to children's physical activity habits is currently limited to physical activity-specific parenting practices and parenting styles. The equivocal findings reported by studies on parenting practices/styles and physical activity indicate the value of exploring the direct and indirect associations between other family- or parent-related variables and child physical activity, as well as the potential moderating effect of family-function variables on the associations between child physical activity and parenting practices/styles.

The literature on obesity and child nutrition behaviors, and family-focused theories suggests the value of examining indicators of family function (e.g., family cohesion, parent distress, and work-family conflict) in relation to child physical activity. To date, only 11 studies have explored child physical activity and family function variables. Across these studies, there are limitations pertaining to the measurement of physical activity and the family-function indicator, a lack of use of family theory to guide research questions and hypotheses, no studies considering the role of the father, and few studies testing hypotheses of mediation by parenting when mediation is consistently suggested as an explanatory mechanism for a direct link between family variables and child physical activity. This dissertation addressed these limitations and extends previous research by (1) examining family-function indicators in relation to physical activity, (2) examining the separate associations of mother- and father-reported family and parenting variables with physical activity among male and female youth, (3) using more robust statistical analysis strategies to assess the notion of parenting mediation between family variables

and child physical activity (a longitudinal, indirect effects model), (4) using data with physical activity measured by accelerometry, (5) using family theories to drive the research questions, variable selection, and hypotheses, and (6) using a moderation statistical analysis strategy to explore the equivocal associations reported in the parenting styles and child physical activity literature.

The results of these dissertation manuscripts provide several insights in regard to the associations between, and influence of, family variables on children's physical activity habits. Firstly, family variables appear to assert small, significant influences on the physical activity of youth. The small effect sizes are consistent with the notion that more general/global family variables assert more distal influences on child health behaviors than behavior-specific parenting practices (Power et al., 2013). Marital conflict has not been previously examined in relation to child physical activity, and while parent depression has been negatively associated with child physical activity, it has not been considered as a moderator of the association between parenting style and child physical activity. Further, the specific statistical analyses used in this dissertation have not been previously used to examine the relationships between family variables and child physical activity. As such, this information provides novel information regarding the associations between, and influence of, family variables on child health behaviors. Marital conflict and the interaction between harsh parenting and maternal depression demonstrated small associations with physical activity in youth. The significance of the findings supports the future consideration of family-function indicators in relation to child physical activity.

Secondly, parent and child sex matter when examining family variables in relation to youth physical activity and should be considered as potential moderators of relationships between measures of parenting and physical activity in children. No significant interaction

effects were observed when father variables were examined in relation to child physical activity, whereas such effects were observed for mother variables. This suggests that mothers and fathers influence youth physical activity in different ways. Other investigations report the salient role of the father in influencing child physical activity (Schoeppe et al., 2016) and the results from the moderation analysis in this dissertation should not be interpreted as an indication that fathers are not important to child physical activity. It is possible that the way fathers influence physical activity was not captured by the parenting and depression variables examined in this project. The different findings for mothers and fathers have implications for future research and the design of physical activity interventions: parent-specific intervention strategies may be more effective than implementing the same strategies among mother and father. Research implications include the importance of recording the nature of the parent-child relationship of the parent participating in a study (e.g., mother or father), and adjusting for or stratifying data analyses by parent sex when analyzing the data.

Results of both studies also differed by sex of the child. These findings are consistent with evidence that the determinants of physical activity are different for male and female youth (Fuemmeler et al., 2011). The results suggest that child sex can be an important moderator of relationships between family/parenting variables and child physical activity and should (a) be adjusted for during data analysis in future research, and (b) be considered in the design of intervention strategies for early adolescents. The results suggest that sex-specific intervention strategies may be more effective than strategies aimed at both boys and girls. The significant results observed for female participants, but not male participants, indicate that girls in particular may be influenced by family dynamics and psycho-social characteristics of the parents. This may be explained by the greater sensitivity of females when compared to males (Crawford et al.,

2001; Emery et al., 1982). The results of the moderation study (chapter 3) suggest the potential benefit of a positive-parenting focused intervention (to reduce harsh parenting) and/or depression support for the mother to promote physical activity among female youth. The results of the mediation study (chapter 4) do not indicate a reasonable strategy for promoting physical activity among female youth (more marital conflict predicted more physical activity); however, the significant results reported for females from the two studies suggest the value of further exploring family variables as determinants of female physical activity. Identifying additional family factors which are associated with physical activity in female youth may reveal viable intervention strategies.

Thirdly, the statistical analysis strategies used in this dissertation (moderation and a full mediation model) have not yet been used to explore the relationships between family variables and child physical activity. The results from the moderation study (chapter 3) support the small, moderating influence of family variables on relationships between parenting styles and child physical activity. Considering the mixed findings currently reported regarding the direct relationship between parenting styles and child physical activity, these findings indicate the value of exploring the moderation effects of alternative family variables to gain a comprehensive understanding of the association between parenting styles and child physical activity. The longitudinal mediation model did not indicate a significant indirect effect of family variables on child physical activity and as such, the notion of parent-related mediation forwarded by studies examining direct associations between family variables and child physical activity remains unsupported. Few studies have explored this mediation suggestion and as such, the use of this statistical analysis strategy and the results make a valuable contribution to the literature. Full longitudinal indirect effects models have rarely been used to examine research questions related

to physical activity (likely due to the need for longitudinal data with at least three time points) and have not been used to explore associations between family variables and physical activity. As such, the completion of a longitudinal mediation study and the associated discussion of the strengths and limitations of the statistical model may help increase awareness of some of the limitations of cross sectional work, as well as the types of research questions that can be addressed regarding family variables and child physical activity, beyond cross-sectional, direct associations. Thus, the statistical analysis strategies used in these dissertation studies provide new information on the dynamics of family and parenting variables in relation to child physical activity. Only one family/parenting moderator and mediator were examined in these studies, and additional studies are warranted to explore the greater range of family variables for which there is a theoretical hypothesis and/or empirical support for an association with physical activity.

Fourthly, the use of longitudinal data provides novel insights into the prediction of parent physical activity support behaviors and physical activity by an indicator of family function. The indirect effects model revealed inconsistency in the significance of the cross-sectional and longitudinal associations between variables. For example, parent encouragement in 5^{th} grade demonstrated significant, positive, cross-sectional associations with physical activity in 5^{th} grade, but non-significant associations with physical activity over time (e.g., parent encouragement in 6^{th} grade to physical activity at 15 years). The significant, positive, cross-sectional findings regarding parent encouragement and child physical activity are consistent with the majority of literature examining this association. There are only a few longitudinal studies examining the relationship between parent encouragement and physical activity over time, and while these studies report longitudinal, positive effects there are some methodological differences which limit the ability to make direct comparison with the current findings (Verloigne et al., 2013;

Bauer et al., 2008). While the cross-sectional findings endorse the use of strategies to increase parental encouragement of physical activity during the early adolescent years in the endeavor to increase youth physical activity, the results from the current longitudinal study do not. Thus, the indirect effects study (chapter 4) indicates that caution that must be used when interpreting cross sectional findings, especially if the aim of the study is to inform the design of interventions, which typically have the goals of long-term behavior change. It is important to note that the results of this longitudinal study are specific to the timeframe under examination and may differ if a shorter or longer time-frame was explored.

Finally, the findings reported from these studies are both consistent and inconsistent with the predictions of family-focused theories. The results regarding the small, additive, negative influence of a harsh maternal parenting style and maternal depression on physical activity among female youth are consistent with the tenets of Resource Drain Theory, Family Systems Theory and the Family Stress Model, which suggest that a happier, more psychologically-stable family system is associated with positive parenting and favorable child outcomes (greater engagement in physical activity can be considered a favorable child outcome). Other findings from this dissertation are inconsistent with these hypotheses. For example, before controlling for covariates, the results of the moderation paper (chapter 3) suggested that harsh maternal parenting (in the presence of lower depressive symptoms) was positively associated with physical activity in male youth, and the results of the indirect effects study (chapter 4) indicated that greater marital conflict predicted greater parental encouragement of physical activity among female youth one year later, and greater physical activity among female youth five years later. Examination of the extant literature regarding parent/child, sex-specific responses to the family variables (marital conflict and depression), reveals that the findings are plausible. For example,

in response to marital conflict, children can adopt a 'conflict avoidance' strategy (i.e., distancing oneself from the site of conflict). Among adolescents this avoidance strategy may manifest in leaving the home, e.g., to visit peers, go to a calmer/quieter place, which could result in more physical activity. Thus, some of the findings from the studies in this dissertation do not support the ability of family-focused theories to predict youth physical activity. However, the findings from ten of the eleven, currently published studies examining family function indicators and physical activity are consistent with the hypotheses forwarded by family-focused theories regarding child outcomes (i.e., happier, psychologically healthy families promote optimal child outcomes) and support the use of family-focused theories for predicting associations between family variables and child physical activity. Evidence form this dissertation suggests that this apparent inconsistency in the ability of family theories to predict physical activity behaviors may be due to the observation that physical activity can be a response to both optimal and sub-optimal parenting/family dynamics (as seen for the marital conflict variable in chapter 4). As such, it can be suggested that while family-focused theories can provide a framework for identifying potentially salient variables to explore in relation to child physical activity, careful consideration of the literature surrounding specific family-function variables is necessary in order to predict how the family variables may influence child physical activity.

Limitations

The use of the archived data set for this dissertation meant that the structure of the indirect effects model was influenced by the data that were available at the pre-determined time points. This is a common limitation when using longitudinal data and must be considered alongside the strengths afforded by the use of large, longitudinal datasets. The one year time lag between the

first and second time points in chapter 4 may not have been long enough for sufficient change to occur for the variables under study.

Another limitation of this dissertation is that the potential bi-directional nature of parenting and child characteristics/behaviors was not examined. Evidence supports that child characteristics can influence parenting behaviors and styles, yet child characteristics were not examined in this dissertation (Bell, 1968; Gubbels et al., 2011; Taylor et al., 2011). Similarly, it is possible that there is a bi-directional relationship between parenting styles and family function variables (Macfarlane et al., 1995). The potential bi-directional relationships between child characteristics and parenting and family variables represent areas for future research.

The SECCYD sample is racially homogenous and as such the current findings apply primarily to those identifying their racial/ethnic group as 'White'. Future research examining how relationships between family and parenting variables and child physical activity vary by ethnicity would provide valuable insights into the ethnic differences in child-rearing and their influence on child health behaviors. Additionally, this dissertation did not control for sibling effects. Siblings have been shown to have a salient influence on child physical activity and are an important family-related influence on youth (Edwards et al., 2015; Blazo et al., 2014). Future research incorporating sibling-related variables into the examination of these associations, such as number of siblings in a family, and sibling physical activity, could provide valuable information regarding how family-function variables operate to influence physical activity among youth.

A further limitation is that the Freedson equation (Freedson et al., 2005) used to calculate MET values for moderate-vigorous intensity physical activity, uses a moderate-intensity physical activity MET value cutoff of three METs. Research indicates that a four-MET cut-off value is

more appropriate among children (Trost et al., 2011). The archived nature of the data meant that re-analysis of the accelerometer data was not an option. The physical activity values reported in the current study are comparable to those of other U.S. samples using the Freedson equation and a moderate-intensity cut-off value of three-METs (McClain et al., 2007), although also similar to those reported from studies using the Freedson equation and a moderate-intensity cut-off value of four-METs (Adams et al., 2013). Research studies have highlighted the substantial differences in estimates of physical activity levels and percentage of a sample meeting physical activity guidelines when the three vs. four MET cut-off values are used (Adams et al., 2013). Based on recent recommendations (e.g., Trost et al., 2011), the four MET cut-off value should be used to identify moderate-intensity physical activity in children; researchers should continue to be aware of the influence of such data processing decisions on their results. Another measurement-related limitation is that self-report measures of family function and parenting variables were used when observational data are preferable, due to the reduced likelihood of reporting bias (Patterson and Forgatch, 1995).

Strengths

The use of data from the SECCYD sample permitted examination of a large, nationally representative sample, and the subsequent sub-group analyses by parent and child sex, while retaining sufficient power. In addition, the longitudinal nature of the data set meant that a robust, full-longitudinal mediation model could be examined. A full longitudinal mediation model is the optimal way to assess mediation and obviates the issues of bias associated with not controlling for previous levels of variables, which is a limitation of cross-sectional mediation studies.

The use of the SECCYD data set also permitted examination of family variables which have not been well explored in relation to physical activity, as well as the examination of

association between family variables and physical activity assessed by accelerometer. The majority of larger data sets which have assessed physical activity have used a self-report measure to assess child physical activity. Self-report instruments incur validity issues when used among youth and the use of objective measures of physical activity is preferable.

This dissertation examined family variables which have been relatively unexplored in relation to youth physical activity and parenting styles and behaviors and as such the results provide novel insights and contributions to the literature on antecedents of youth physical activity. In addition, direct, moderating and mediating influences were examined, drawing attention to the various ways that family, parenting and child activity variables may be associated.

Future Research

Several of the limitations outlined above indicate important areas for future research. Exploring the role of siblings, racial differences, and the potential bi-directional influences of child characteristics, parenting styles and family variables in the relationships between family variables and child physical activity will provide valuable information on the influence of family on youth physical activity. In addition, future studies should use the four-MET cutoff value to identify moderate-intensity physical activity, when analyzing youth accelerometer data.

The current study suggests the value of examining additional, potential moderators of the association between parenting style and child physical activity. Existing research supports the moderating effect of parent variables such as depression and BMI on the relationship between parenting style and health indicators/outcomes (Topham et al., 2010; Sterrett et al., 2013), and the current study provides initial evidence of the role of moderators in the association between

parenting style and child physical activity. Only one moderating variable (parent depression) was examined in this dissertation, and there are a variety of other family and parent-related variables highlighted in Belsky's (1984) framework and in the extant literature that are worthy of examination in future research, e.g., other positive and negative parenting characteristics and personality traits, employment factors, life stress, and adult social support.

While the moderation study (chapter 3) did not identify a significant influence of paternal variables on child physical activity, the role of the father in the development of children's activity behaviors remains an understudied area that is worthy of further exploration. Further to this, the moderation study in this dissertation examined the separate relationships of mother and father variables and child physical activity behaviors, but did not consider differences in physical among youth with parents with concordant (i.e., mother and father adopting/exhibiting the same parenting style) vs. discordant parenting styles (i.e., mother and father adopting/exhibiting different parenting styles). It is plausible that the positive or negative effects of a parenting style on youth physical activity would be exaggerated among concordant families. In the endeavor to clarify the influence of parenting style on youth physical activity, this may be an area worthy of further research.

Results from both the mediation and moderation studies in this dissertation support the further examination of family variables in relation to child physical activity. The literature examining indicators of family function and child physical activity has been growing since 2007, although limited in size. Additional studies on a greater variety of family variables will make valuable contributions to the literature and current understanding of the influence of family on child physical activity. The results from this dissertation support the existence of direct and moderating influences of family variables on child physical activity. The notion of the mediating

effect of parenting variables on association between family-function indicators and child physical activity remains unsupported.

Finally, this dissertation used adult (parent) reports of marital conflict, parenting style, depression and encouragement of child physical activity. Child perceptions of parent variables can be salient to child outcomes (Loprinzi et al., 2012), and a valuable future research direction may be the examination of associations among child-reported family variables and child physical activity.

Summary

This dissertation addresses existing gaps in the literature on family/parenting and child physical activity by examining understudied family-function variables (marital conflict and parent depression) in relation to child physical activity, using a full longitudinal model to explore the notion of parenting mediation between family function indicators and child physical activity, demonstrating the role of moderators on the association between parenting style and child physical activity, and performing all data analyses using a data set with physical activity measured by accelerometry.

The results of this dissertation support the small yet significant role of family variables in directly predicting child physical activity and asserting a moderating influence on relationships between parenting style and child physical activity. The findings draw attention to the different types of relationships (i.e., moderation and mediation) that can be considered as the literature regarding the influence on family function variables on child physical activity grows. The findings provide some clarity to the currently equivocal influence of parenting styles on child physical activity. The demonstration of a direct, positive effect of marital conflict on child

physical activity, and the associated discussion offer new insights in the field of kinesiology and may encourage further interdisciplinary work.

The findings of this dissertation imply the importance of parent and child sex when considering the influence of family on child physical activity, and in particular, the importance of mothers' to daughters' physical activity. Family theory was successfully used to identify variables which were salient to child physical activity, although findings of this dissertation were not always consistent with the over-arching hypotheses forwarded by these theories (i.e., that a better functioning/more psychologically healthy family would predict more physical activity among youth).

The results of this dissertation support the continued examination of family function variables in relation to child physical activity, and encourage the further exploration of moderation and mediation effects among family, parenting and child physical activity variables. Future work examining the role of family factors in relation to child physical activity should be guided by the broader family theories (e.g., Family Systems Theory and the Family Stress Model) as well as careful consideration of the research surrounding the family variables to be explored. The important moderating role of parent and child sex should be considered in future research in this area, in the endeavor to design effective public health interventions which will increase physical activity, health and wellbeing among youth.

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