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MATERNAL WORK HOURS: EFFECTS ON MOTHERS' AND DAUGHTERS' WEIGHT STATUS AND DAUGHTERS' FOOD INTAKE AWAY FROM HOME

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ABSTRACT

Background: A small body of research reveals that maternal work hours are positively related to both mothers' and children's weight. However, little is known as to the longitudinal mechanisms at work in this relation. In particular, it is unclear whether variables related to employment, such as food eaten away from the home (FAFH), mediate the relation between maternal work hours and family weight status by contributing increased calories to the family diet.

Objective: The aims of the current study were to 1) examine the associations between maternal employment and mothers' weight status; 2) examine the association between maternal employment and daughters' weight status; 3) determine the quality of food eaten away from home by daughters; and 4) assess whether daughters' food eaten away from home mediated the effects of mother work hours on daughter weight status.

Methods: Subjects include 167 girls and their mothers from the Girls' NEEDS Study. Participants were enrolled in the study at age 5 and followed biennially for 10 years, until age 15. Primary outcomes of this current study were mothers' BMI and daughters' BMI-for-age percentiles (BMIp) obtained biennially through laboratory measures of height and weight. Other measures included the proportion of daughters' meals eaten away from home (FAFH) and macronutrient composition of those meals, as measured through 24-hour dietary recalls. Mothers' work hours was measured via self-report. Repeated measures analysis of variance (PROC MIXED) was used to assess the effects of maternal work hours and FAFH on maternal and daughter BMI change over 10 years. A mediation model tested whether the effect of maternal work hours on daughter BMIp was mediated by FAFH at ages 5 and 15.

Results: Maternal work hours increased over the 10-year period. At each time point, mothers who worked more hours had daughters with lower BMIp. Women whose work hours increased over time tended to have children who ate more FAFH over time, before but not after adjusting for covariates. FAFH was not a significant predictor of daughter BMIp or of increases in BMIp across waves, indicating that FAFH is not a mediator of the relation between work hours and daughters' weight. However, meals eaten away from home were found to be higher in energy density, total and added sugars, and total fat. Greater work hours did not predict greater maternal BMI across waves.

Conclusions: As daughters developed from childhood into adolescence, maternal work hours increased. Work hours predicted daughters' BMI percentiles after controlling for family demographics. There was a trend for an interaction between work hours and wave in predicting daughters' FAFH intake, before but not after adjusting for covariates including maternal educational attainment. Maternal work hours were not predictive of maternal BMI, nor was daughters' FAFH intake predictive of daughters' BMI percentiles. While the mediation model could not be tested, FAFH foods were of lower dietary quality than foods eaten at home or school, indicating an opportunity to intervene in the diets of daughters of working mothers.

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Chapter 1

Introduction

During recent decades, obesity rates among children and adults have increased dramatically (Flegal, Carroll et al. 2012; Ogden, Carroll et al. 2014). Obesity is a multifactorial problem and the family environment has been implicated in the development of childhood obesity (Cutting, Fisher et al. 1999; Patrick and Nicklas 2005). One aspect of the family environment receiving attention has been mothers' participation in the workforce. The rise in childhood and adult obesity in the United States (Cunningham, Kramer et al. 2014) has paralleled increases in the prevalence of mothers working outside the home (Bureau of Labor Statistics 2009) and consumption of foods prepared away from home (Economic Research Service 2014). The prevalence of mothers working outside the home has increased from 47% in 1975 to 71% in 2008 (Bureau of Labor Statistics 2009) and traditionally, mothers in the U.S. have had the responsibility of preparing and serving meals to their families. Increases in hours mothers work away from home has also coincided with increases in the food eaten away from home (FAFH), and FAFH has been linked with increased energy consumption and risk for obesity (Economic Research Service 1999). In the current paper, the relations among maternal work hours and mothers' and children's weight status over a 10-year period are examined and the potential mediating effect of changes in daughters' FAFH on the relation between maternal work hours and children's weight status is explored.

The first aim of the current review is to discuss the public health importance of obesity prevention in both adults and children. Being a disease with epidemic proportions increases the need for early intervention and prevention particularly as obesity in childhood tracks into adulthood. The second aim is to summarize current findings on the role of employment and the workplace on the health of employees and the families of employed mothers.

An Overview of Obesity: Causes and Consequences

Obesity is a multifactorial disease, with many social, behavioral, and ecological influences on its development. Simply put, obesity is caused when there is energy imbalance between food and beverage intake (energy intake) and physical activity, exercise, and the metabolic effects of daily living (energy expenditure). However, exactly *how* this energy imbalance occurs is subject to influences on different levels, including the individual, family, community, and society. For the purpose of this current study, attention will be focused on the role that workplaces and the family eating environment play in the development of adult and childhood obesity and overweight.

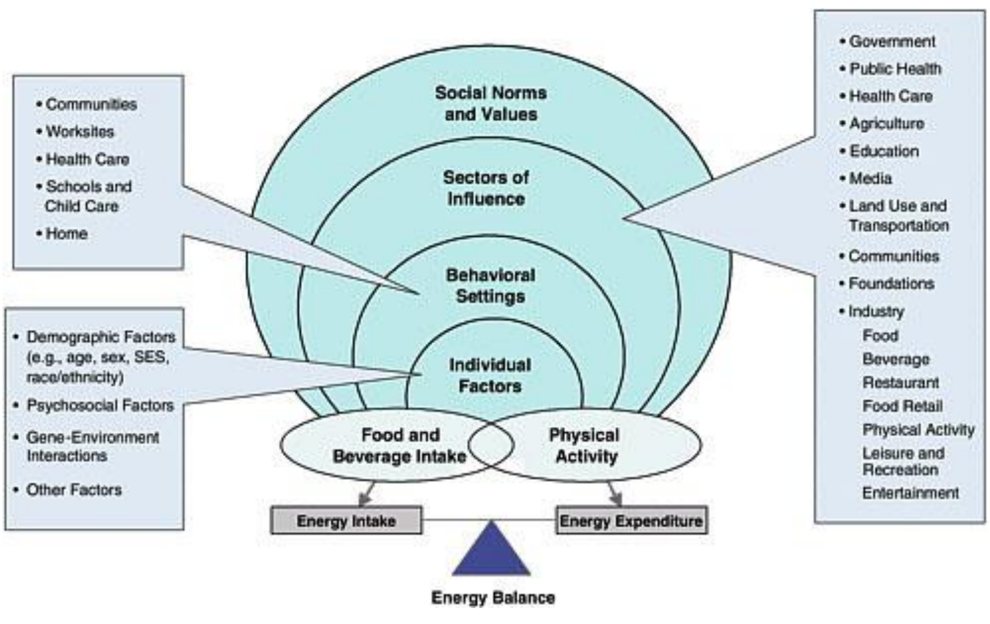

Figure 1-1. A comprehensive ecological systems framework perspective of factors affecting the development of obesity (Committee on Progress in Preventing Childhood Obesity 2007).

On one end of the energy balance equation is food intake, and an often-cited source of excessive calories in the American diet is the intake of food eaten outside the home. While the number of daily meals has stayed stable (2.6/day in 1987 to 2.7/day in 1995), snacking has increased from less than once a day to 1.6 times per day during the same period (Lin, Guthrie et al.). The same data reveal that total calorie, fat, cholesterol, and sodium densities are all higher in foods eaten at restaurants or fast food establishments than schools and homes (Lin, Guthrie et al.). Many studies have replicated such findings, including similar patterns over time in children and adolescents (Nielsen, Siega-Riz et al. 2002), less time spent preparing meals for families (Neumark-Sztainer, Hannan et al. 2003), and increasing portion sizes (Nielsen and Popkin 2003). The relationship between food away from home and childhood obesity has been studied predominately in cross-sectional studies of body weight and food intake. A sample of patients in a pediatric obesity clinic consumed more food away from home than their normal weight counterparts, and greater FAFH predicted higher body fat percentage (Gillis and Bar-Or 2003). Pizza is one particular food often eaten outside the home, and is one of the top six sources of "empty" calories in children's diets (Reedy and Krebs-Smith 2010), along with sugar-sweetened beverages. Sugar-sweetened beverages were most commonly purchased at school vending machines and fast food restaurants in a cross-sectional observational study (Wiecha, Finkelstein et al. 2006); however, recent school meal program regulations have dramatically reduced the availability of such beverages in schools. A longitudinal cohort study found that adolescents who ate more fried food away from home had greater body weights, greater total calorie intake, and poorer diet quality, as measured by fruit, vegetable, and low-fat dairy intake (Taveras, Berkey et al. 2005).

Classification of Obesity and Overweight

In 2013, the American Medical Association classified obesity as a disease due to its significant health implications for patients (2013). Obesity is defined by the presence of excess body fat (Bray and Gray 1988). Body mass index was a measure developed as a ratio of height and weight (Keys, Fidanza et al. 1972) and has expanded to international use (World Health Organization 1998). In adults, obesity is defined by having a body mass index (BMI) above 30.0 kilograms per square meter (kg/m^2), based on findings from nationally representative data in the United States (Kuczmarski and Flegal 2000). While BMI is not without limitations (Frankenfield, Rowe et al. 2001), for most individuals it provides a marker of body fatness compared to more invasive and expensive body composition measures like bioelectrical impedance analysis or air plethysmography.

What is Childhood Obesity?

Because children are growing, obesity in children ages 2-18 is classified differently than in adults. Rather than measuring BMI with height and weight only, children's BMI is converted to percentiles using reference data to place participants' weight statuses in the context of normative data specific to their age and sex (Kuczmarski, Ogden et al. 2000; Kuczmarski, Ogden et al. 2002). The percentiles are based on the proportion of children in a representative sample of the United States at each BMI point when the growth charts were developed. Obesity in children is classified as having a BMI-for-age and sex percentile greater than the 95^{th} percentile. Overweight in children is classified as having a BMI-for-age percentile equal to the 85^{th} but less than the 95^{th} percentile.

Treating childhood obesity is of particular public health importance because there is a strong link between overweight and obesity in childhood and obesity in adulthood. Recent estimates predict a 40-59.9% probability that a child who is in the 85^{th} BMI-for-age percentile or higher (classified as overweight) will become an obese adult (Guo, Wu et al. 2002). For children with BMI-for-age percentiles of or greater than the 95^{th} percentile, the probability of becoming an obese adult rises it greater than 60%. Aside from the increased body weight, children who are overweight or obese are more likely to develop the comorbidities of obesity, as well as experience those diseases earlier and more severely than their leaner counterparts who gain excess weight later in life (Must and Strauss 1999).

Health Effects of Obesity

Obesity is a particularly important disease to prevent and treat due to the numerous and significant co-morbid conditions associated with it. A recent meta-analysis found significant links between obesity and overweight with the incidence of type II diabetes, all cancers except esophageal and prostate cancer, all cardiovascular diseases (except congestive heart failure in overweight), asthma, gallbladder disease, osteoarthritis, and chronic back pain (Guh, Zhang et al. 2009). Obesity is second to tobacco use as the leading preventable cause of death in the United States, and with a continual decline in tobacco use and increase in obesity, it will not be far into the future that obesity takes the lead (Danaei, Ding et al. 2009).

The cardiovascular system effects of obesity include increased rates of cardiovascular disease (CVD) of all sorts (Hubert, Feinleib et al. 1983), myocardial infarction (Yusuf, Hawken et al. 2005), congestive heart failure (He, Ogden et al. 2001), hypertension (Aneja, El-Atat et al. 2004), stroke (Winter, Rohrmann et al. 2008), and dyslipidemia (Klop, Elte et al. 2013). Dyslipidemia is both a direct result of obesity and a contributor to comorbid conditions, specifically the insulin resistance associated with type II diabetes and the increased circulating lipids found in coronary artery disease. While many of these diseases have origins with each other, their true cause can be found in increased body weight and adiposity.

Additional effects of obesity include increased rates of sleep apnea (NHLBI Obesity Education Initiative Expert Panel on the Identification Evaluation and Treatment of Obesity in Adults), asthma (Beuther, Weiss et al. 2006), osteoarthritis (Losina, Walensky et al. 2011), infertility (Pasquali, Patton et al. 2007), liver disease (Marchesini, Moscatiello et al. 2008), gallbladder disease and gallstones, cancer, mental health conditions, and type II diabetes mellitus. Both obesity and weight gain have been found to be contributors to gallbladder disease and gallstones (Sahi, Paffenbarger et al. 1998), which is one of the most expensive, non-malignant digestive tract disorders (Everhart 1994). Epidemiological studies have found links between obesity and cancers of the colon, breast (in postmenopausal women), endometrium, kidney, esophagus, stomach, pancreas, gallbladder, and liver (Calle and Kaaks 2004). In all, overweight and obesity may contribute to 15-20% of all cancer deaths in the United States (Calle, Rodriguez et al. 2003). Mental health conditions are considered both a cause and a consequence of obesity. Binge eating disorder, body image issues, self-esteem, and mood disorders have been found to contribute to weight gain, which may result in obesity (Talen and Mann 2009). Conversely, stigmatization and physical limitations brought about by obesity are related to reduce health-related quality of life (Larsson, Karlsson et al. 2002) and put patients with obesity at greater risk for developing major depressive disorders (McElroy, Kotwal et al. 2004). As discussed previously, obesity is strongly linked with the development of type II diabetes mellitus due to microvascular changes causing insulin resistance (Felber and Golay 2002). The strong relation between obesity and diabetes can be seen in bariatric surgery patients with non-insulin-dependent diabetes, where 40-100% of patients undergoing such procedures are effectively cured of their diabetes (Greenway, Greenway et al. 2002).

Prevalence of Obesity

The focus of this section will be on data from the United States, but many developed countries are experiencing the same disease burden as the U.S. Information on the current estimates of the rates of overweight and obesity come from the National Health and Nutrition Examination Survey (NHANES). NHANES is conducted by the National Center for Health Statistics, part of the Centers for Disease Control and Prevention, in order to learn about health and nutrition in representative samples of the United States, starting in the 1960s (CDC National Center for Health Statistics 2014).

Current Estimates

From data collected by NHANES, obesity is considered to have reach "epidemic" proportions as rates have of obesity in U.S. children and adults have more than doubled, from 13.4% obesity in 1962 to 35.7% in 2010 (Flegal, Carroll et al. 2012). At the same time, the percent of the population who are classified as overweight has remained stable, around 32%. While overweight status still carries some health risks, the health burden associated with obesity is both more widespread and more severe. In adults, men are more likely than women to be overweight or obese (74% versus 64%); in children, slightly more boys than girls are considered overweight or obese (33.0% versus 30.4%). Children ages 2-5 have the lowest prevalence of obesity (26.7%) compared to children ages 6-11 (32.6%) and adolescents (33.6%). However, these percentages do not accurate show the increased burden of obesity in racial and ethnic minorities, as more than 3 in 4 Hispanics and non-Hispanic Blacks are overweight or obese. Additionally, obesity rates are linked with socioeconomic status, with lower-income children, on average, having higher obesity rates than their higher-income peers (Ogden, Lamb et al. 2010) and lower-educated women having higher obesity rates than their higher-educated peers (Ogden, Lamb et al. 2010).

Future Projections

According to 2011-2012 NHANES data, there were no significant changes in obesity in 2-18 year olds or adults, as well as a decrease in obesity in 2-5 year old children, indicating a deceleration to the progression of the obesity epidemic in the U.S. population (Ogden, Carroll et al. 2014). However, as the population ages and overweight and obese children transition into adulthood, the burden of obesity will continue to rise. One estimate approximates that there will be 65 million more obese adults in the U.S. by 2030; in turn, this would result in an additional 6-8 million cases of diabetes, 5-6.8 million cases of coronary heart disease and stroke, and 0.4-0.5 million cases of cancer (Wang, McPherson et al. 2011)

Economic Costs of Obesity

The medical costs associated with obesity have increased along with the rising obesity prevalence, from $78.5 billion in 1998 to $147 billion in 2008 (Finkelstein, Trogdon et al. 2009). This translates into an additional $247 spent per overweight patient and $732 per obese patient, as an average per capita annual medical cost (Finkelstein, Fiebelkorn et al. 2003). Much of that cost has been shouldered by Medicaid and Medicare (Finkelstein, Fiebelkorn et al. 2004). While general health care costs have increased as well, obesity alone is responsible for 12% of the increase in health spending in the U.S. (Thorpe, Florence et al. 2004). Obesity is a particularly expensive disease to treat because there are few clinically effective treatments that are low-cost. Bariatric surgery is more effective for weight loss than non-surgical treatments, but is also an expensive route saved for patients with severe obesity (Picot, Jones et al. 2010). Turning again to the projected obesity rates, the cost to treat obesity and associated diseases is expected to increase by 48-66 billion dollars per year in the U.S. by 2030 (Wang, McPherson et al. 2011).

The Role of the Workplace on Health

Approximately 62.9% of people aged 15-64 in the U.S. are currently employed, with about 121.9 million people working 35 hours or more per week (Bureau of Labor Statistics 2015). Employed persons age 25-54 years old with children spend approximately 8.7 hours per day working and on related activities (Bureau of Labor Statistics 2014). According to a 2014 sample, 88.7% of the 34.4 million families with children under the age of 18 in the US had at least one employed family member (Bureau of Labor Statistics 2015). Women work less than men (35.8 hours per week versus 40.8) and at lower rates of full-time employment (60% versus 71%), although the financial contribution to family income and percent of women working full-time has increased over time from 41% in 1970 to 58% in 2012 (Bureau of Labor Statistics 2014).

Employers are one of the major providers of health insurance, and facing rising healthcare costs, employers may turn to public health approaches to prevent and intervene with current health conditions. Additionally, the Affordable Care Act provided funding to small businesses to create health promotion programs and tasked government agencies with evaluating existing program offerings (Koh and Sebelius 2010). Obesity, affecting the majority of Americans, is a prime target for employer concern due to its high cost to treat and associated comorbidities, as previously discussed. A recent analysis found that obesity directly contributed 8.8% of total annual employer healthcare expenditures and good nutrition and eating habits contributed -1.9%, as in, its presence reduced expenditures (Goetzel, Pei et al. 2012). Obesity also effects employers due to absenteeism, with obese individuals in one study more than twice as likely to experience high-level absenteeism of 7 or more absences due to illness in the 6 months prior (Tucker and Friedman 1998). Presenteeism, or health-related limitations at work, is also strongly linked to obesity, with a 4.2% loss in productivity that translated into $506 lost annually per employee (Gates, Succop et al. 2008). Large corporations may be self-insured, running their own health insurance programs rather than contracting it to a health insurance company, and are particularly sensitive to the healthcare costs associated with obesity. Their higher insurance costs post a competitive disadvantage in determining their product or service pricing, affecting profitability through higher overhead costs.

Because full-time employees spend approximately one-quarter of their week at their jobs, and often eat meals and snacks in the context of the workday, it is a location ripe with opportunities for obesity prevention. There have been many successful workplace wellness programs targeting overweight/obesity and other modifiable health risks. Most companies who offer health promotion programs use multiple components to increase employee health, including smoking cessation support, providing on-site fitness centers or reimbursing costs for off-site memberships, conducting biometric screenings, creating walking or pedometer programs, and using data from health risk assessments/appraisal to identify health needs and monitor improvement. Many of these companies are self-insured, but health insurance companies are beginning to offer similar services to their corporate clients, providing an economy of scale to starting up such programs. Screening and follow-up to appropriate care and basic health education resulted in $4.56-$4.73 return on investment in a commercialized service from Healthtrac, Inc. at Citibank (Ozminkowski, Dunn et al. 1999), showing that even a small program can be impactful. Weight Watchers At Work Program extends the successful weight-loss program to include meetings at the worksite during the lunch hour, eliminating a barrier to attending weekly meetings and providing social support, resulting in an average weekly weight loss of 1.2 pounds, comparable to their standard meetings (Frankle, McIntosh et al. 1986). Live for Life is a comprehensive program used at companies such as Johnson & Johnson and Duke University what includes environmental prompts and changes to promote health (Wilbur 1983). Dow Chemical Company had modest treatment effects on a predominately obesity-focused program affecting environmental and leadership changes to support health (Goetzel, Baker et al. 2009). Looking at companies that sponsored fitness programs alone, Chevron Corporation saw a significant reduction in pharmacy and inpatient expenditures in employees who used the fitness center at least twice weekly over 2.5 years (Goetzel, Dunn et al. 1998). Taken together, employers need to take steps to manage obesity rates in the workplace and there are successful templates for which to do so.

Chapter 2

Are Maternal Work Hours Related to Family Weight Status and Diet?

The increase in maternal employment concurrent to the rise in obesity and overweight rates begs the question of the potential role of the family eating environment. In this manuscript, the effect of work hours on mother's weight status will be determined using longitudinal data to identify the potential for a causal relation between employment and obesity. Second, the relation between maternal work hours and daughters' weight status and whether this relation is mediated by daughters' food eaten away from home (FAFH) will be explored. While current findings in the literature point to a link between greater maternal work hours and higher mother and child weight status, the role of food eaten away from home has not been explored in the same context.

Specific Aim 1: Effect of maternal work hours on mothers' BMI over a 10-year period

The first aim was to assess whether change in mothers' work hours over time, across waves, had an effect on mothers' BMI across a ten-year period of data collection.

Hypothesis 1.

As mentioned, multiple cross-sectional studies have shown that increased work hours for mothers are associated with increased weight and risk for obesity (Hawkins, Cole et al. 2008; Courtemanche 2009; Au, Hauck et al. 2013). In this study, it is hypothesized that maternal work hours would be predictive of mothers' BMI and weight status. A strong association would suggest that mothers' work hours have an impact on changes in mothers' weight over time across waves, whereas a weak association would suggest that maternal work hours play a minimal role in mothers' weight.

Specific Aim 2: Effect of maternal work hours on daughters' BMI percentiles over a 10 year period (age 5 to 15 years)

The second aim was to assess whether changes in mothers' work hours predicted changes in daughters' BMI percentile over a ten-year period from when daughters' were age 5 to age 15. Daughters had their height and weight measured in the laboratory using standardized procedures (Lohman, Roche et al. 1991).

Hypothesis 2.

As previously discussed, multiple cross-sectional and short longitudinal data have shown that increased work hours for mothers is associated with increased weight and risk for obesity in their children. In this study, it is hypothesized that increases in maternal work hours would be predictive of increases in daughters' BMI and weight status. A strong association would suggest that mothers' employment has an impact on changes in daughters' weight across waves, whereas a weak association would suggest that maternal work hours play a minimal role in daughters' weight. This analysis will not explore the role of maternal work hours in sons because the larger study from which this data are drawn only included girls.

Specific Aim 3: Effect of maternal work hours on daughters' diet (FAFH) over 10 years (age 5 to 15 years)

The third aim was to assess whether increases in mothers' work hours were associated with changes in daughters' proportion of meals eaten outside the home (FAFH) across a ten-year period. The measure used to estimate daughters' diet was the proportion of meals eaten outside the home, as determined through three 24-hour dietary recalls collected every two years.

Hypothesis 3.

This study hypothesizes that maternal work hours would be predictive of daughters' greater proportion of meals eaten away from home. While there is little literature from which to draw the basis of this hypothesis, there is evidence that employed mothers are eating more meals outside the home, which may translate into their daughters eating more meals away from home.

Specific Aim 4: Longitudinal effect of daughters' food away from home on daughters' BMI percentiles

The fourth aim was to assess whether increases in daughters' FAFH, as measured in the proportion of meals eaten away from home, had an effect on change in daughters' BMI-for-age percentile across a ten-year period.

Hypothesis 4.

Given the evidence that foods eaten away from home are higher in calories and energy density, which may contribute to obesity, it is hypothesized that a greater proportion of food eaten outside the home would be predictive of daughters' BMI-for-age and weight status. In addition, it is hypothesized that meals eaten away from home will be comprised of more calories, total and added sugar, total fat, and energy density than meals eaten at home or at school.

Specific Aim 5: Mediation effect of daughters' FAFH on the longitudinal effect of maternal work hours on daughters' BMI percentiles

The fifth aim was to assess whether change in mothers' work hours had an effect on change in daughters' weight across a ten-year period of data collection in the context of daughters' food eaten away from home (FAFH) using a mediational model.

Hypothesis 5.

To address this question, a mediation model will test whether the effect of daughter's FAFH consumption mediates the relation between maternal work hours and daughters' weight. There is evidence for mediation when the association between FAFH and daughters' weight is statistically significant after controlling for maternal work hours. If maternal work hours become non-significant when FAFH is controlled for in the model, it will support a full mediation effect of FAFH. If maternal work hours remain significant but the magnitude of the effect declines when included in the same model with FAFH, then partial mediation is suggested.

Chapter 3

Methods

Participants

Data from this current study comes from a prospective longitudinal study with the aim of identifying factors associated with early dieting and disordered eating in girls age 5-15 living in Central Pennsylvania. At entry into the study, participants included 197 5-year-old girls (mean age 5.4 ± 0.4) and their parents. The majority of families were non-Hispanic White, representative of the racial composition of the geographical area where the study was conducted. Eligibility criteria for the families' participation at the time of recruitment included living with two biological parents, the absence of severe food allergies or chronic medical problems affecting food intake, and the absence of dietary restrictions involving animal products. Girls completed laboratory tasks and parents completed survey measures every 2 years, when daughters were 5, 7, 9, 11, 13, and 15 years old. Data collection (age 5) started in 1996-1997 and the last wave (age 15) was collected in 2006-2007. The final assessment included 167 families, representing an 85% retention rate. Families were excluded only if they did not participate in data collection activities at age 15. All study procedures were approved by and conducted in accordance with the standards of The Pennsylvania State University Institutional Review Board.

Measures

Demographic information

At each wave of data collection (daughter age 5, 7, 9, 11, 13, and 15), mothers reported the number of hours per week that they were at work (not including travel to and from work) as part of a self-reported demographic questionnaire. Additional information collected in the demographic questionnaire was the mother's age, highest level of formal education, and approximate range of the family's total or combined income.

Anthropometrics

Mothers' weight was measured in duplicate in kilograms to the nearest 0.1 kilogram using a platform beam balance at every wave of data collection visits (Allison 1995). Mothers' height was measured in duplicate in meters to the nearest 0.5 centimeters using a stadiometer at waves 1, 2, and 3 of data collection. Mothers were measured in light clothing without shoes. BMI was calculated as weight divided by squared height (kg/m^2). In accordance with current recommendations, a BMI ≥ 25 was defined as overweight and a BMI ≥ 30 was defined as obese (NHLBI Obesity Education Initiative Expert Panel on the Identification Evaluation and Treatment of Obesity in Adults 1988).

Daughters' heights and weights were measured in triplicate at each wave. Daughters' weight was in kilograms to the nearest 0.1 kilogram using an electronic scale balance; daughters' height was measured in meters to the nearest 0.1 centimeters using a stadiometer at waves 1, 2, and 3 of data collection. Daughters were measured in light clothing without shoes. Daughters' BMI percentiles were calculated using the 2000 CDC Growth Charts designed to nationally representative of children in the United States (Kuczmarski, Ogden et al. 2000); BMI percentiles of ≥ 85th were used to classify girls as overweight and BMI percentiles of ≥ 95th were classified as obese. BMI percentile scores can range from 0-99 and are age- and sex-specific to account for differences in puberty status.

Proportion of Food Away From Home (FAFH)

Data on daughters' of food eaten away from home were obtained from three 24-hour diet recalls collected when daughters were 5, 7, 9, 11, 13, and 15 years old. Recalls were obtained on two randomly selected weekdays and one weekend day over a 2-3 week period during the summer and fall months (Thompson and Byers 1994). Interviews were conducted by trained staff at Diet Assessment Center at The Pennsylvania State University using computer-assisted Nutrition Data System for research (NDS-R, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN). This software allows for a multiple pass approach to reduces the likelihood of omitting items and detailing amounts and preparations of foods (National Center for Health Statistics Division of Health Examination Statistics 1994). Mothers have been shown to have good accuracy at reporting food intake in young children (Basch, Shea et al. 1990). At ages 5, 7 and 9, the mother was the primary reporter of the daughter's intake, and the daughter is there to help and verify. At age 9, some of the daughters became more responsible for the reporting, but the mothers still helped with the cooking and preparation details. At 11, 13 and 15, the daughters were the primary reporters with the mothers participating in the interview as needed.

Meal location was recorded for each eating occasion and classified using three mutually exclusive categories: at home, at school, or away from home ("FAFH"). Locations of meals eaten away from home included work, deli/take-out/store, restaurant/cafeteria/fast food, friend's home, community meal program, party/reception/sporting event, and other. FAFH was calculated as the proportion of the meals eaten away from home from total meals eaten in all locations (home, school, other) to account for individual and daily differences in meal patterns. The energy density, grams of total and added sugars, and grams of total fat of FAFH meals was compared to foods eaten at home and at school when girls were age 5 and 15. The energy density calculation does not include beverages.

Statistical Analyses

Data were analyzed with the use of the SAS software (version 9.4; SAS Institute Inc., Cary, NC). Descriptive information was generated from all variables of interest. Each outcome variable was assessed for normality (see Table 4-1 and Figures 4-1 to 4-4).

Specific Aim 1: Work Hours as a Predictor of Maternal BMI

To test Aim 1, a repeated measures analysis of variance model (PROC MIXED) was used to assess the effects of maternal work hours on maternal BMI change over 10 years. This method is an analytical approach appropriate for longitudinal data with continuous data (Singer 1998; Raudenbush and Bryk 2001). In Model 1, the main effects of wave, maternal work hours (a continuous variable), and a maternal work hours-by-wave interaction were regressed on maternal BMI over 10 years (age 5 to 15), before and after adjusting for covariates. Covariates included mothers' age and years of education, collected at the baseline visit.

Review of Statistical Methods for Aims 2-5

The application of mediation models within growth curve modeling is a relatively new technique to answer questions about mediation in developmental research (Selig and Preacher 2009). A mediation model seeks to explain the relationship between an independent variable and a dependent variable through the addition of a third, related explanatory variable called the mediator. To create a mediation model, first the association between the independent variable (maternal work hours) and the dependent variable (daughter BMI percentile) is tested. Second, the association between the independent variable (maternal work hours) and the mediator variable is tested (daughter FAFH) is tested. Third, both the independent variable (maternal work hours) and the mediator variable (daughter FAFH) are entered into the same model predicting the dependent variable (daughter BMI percentile). In a full mediation model, evidence for the mediation of FAFH exists when the inclusion of FAFH in a regression of maternal work hours on daughters' BMI percentiles reduces the relationship between work hours and weight, as determined by the change in coefficients for maternal work hours (Baron and Kenny 1986). Full mediation exists when the difference between the coefficients is zero, and partial mediation exists when there is any change between the coefficients but the change does not fully negate the value of the difference.

Specific Aim 2: Work Hours as a Predictor of Daughters' BMI Percentiles

For Aim 2, a repeated measures analysis of variance model (PROC MIXED) was used to assess the effects of maternal work hours on daughters' BMI percentile change over 10 years, from age 5 to 15. In Model 2, the main effects of wave, maternal work hours (a continuous variable), and a maternal work hours-by-wave interaction were regressed on daughters' BMI-for-age percentile over 10 years (age 5 to 15), before and after adjusting for covariates. Covariates included mothers' age and years of education, collected at the baseline visit, and mothers' BMI, which as a continuous and time-varying variable.

Specific Aim 3: Work Hour as a Predictor of Daughters' FAFH

For Aim 3, a repeated measures analysis of variance model (PROC MIXED) was used to assess the effects of maternal work hours on the change in daughters' proportion of food eaten away from home (FAFH) over 10 years, from age 5 to 15. In Model 3, the main effects of wave, maternal work hours (a continuous variable), and a maternal work hours-by-wave interaction were regressed on daughters' FAFH intake over 10 years (age 5 to 15), before and after adjusting for covariates. Covariates included mothers' age and years of education, collected at the baseline visit and mothers' BMI, which as a continuous and time-varying variable.

Specific Aim 4: FAFH as a Predictor of Daughters' BMI Percentiles

For Aim 4, a repeated measures analysis of variance model (PROC MIXED) was used to assess the effects of daughters' food away from home (FAFH) intake on daughters' BMI percentile change over 10 years, from age 5 to 15. In Model 4, the main effects of wave, proportion of meals eaten away from home (not at home or at school, a continuous variable), and a FAFH-by-wave interaction were regressed on daughters' BMI-for-age percentile over 10 years (age 5 to 15), before and after adjusting for covariates. Covariates included mothers' age and years of education, collected at the baseline visit, and mothers' BMI, which as a continuous and time-varying variable. In addition, the amount of energy density (kcal/gram), intake of added sugars (grams), intake of total sugars (grams), and intake of total fat (grams) for FAFH meals will be compared to meals eaten at home and at school (which are not included in the FAFH variable) using a t-test (PROC TTEST in SAS 9.4), separately for when daughters are age 5 and 15.

Specific Aim 5: Work Hours and FAFH Effects on Daughters' BMI Percentiles

For Aim 5, a repeated measures analysis of variance model (PROC MIXED) was used to assess the effects of both maternal work hours and daughters' food away from home (FAFH) intake on daughters' BMI percentile change over 10 years, from age 5 to 15. In Model 5, the main effects of wave, proportion of meals eaten away from home (not at home or at school, a continuous variable), and maternal work hours and a FAFH-by-wave interaction and a work hours-by-wave interaction were regressed on daughters' BMI-for-age percentile over 10 years (age 5 to 15), before and after adjusting for covariates. Covariates included mothers' age and years of education, collected at the baseline visit. The results from this analysis will be compared to those from Aims 2 and 3 to determine the extent of the mediation effect of FAFH on the relation between maternal work hours and daughters' BMI-for-age percentile.

Chapter 4

Results

At age 5, approximately 20% of daughters' and 50% of mothers were overweight or obese (for daughters, BMI-for-age percentile ≥ 85^{th}; for mothers, BMI ≥ 25 kg/m^2). By age 15, the number of mothers and daughters who became obese increased across waves (from 6.1% to 9.6% in daughters, from 17.9% to 38.2% in mothers). In addition, overall the proportion of mothers categorized as not working decreased (from 43% to 14%) while the proportion of mothers working full-time increased across waves (from 37% to 71%). The average number of work hours increased from 18.1 hours (SD ± 17.6 hours) at 5 y to 30.3 hours (± 15.0) at 15 y. At study entry, 29% parents reported family incomes < $35,000, 35% were in the $35,000-$50,000 range, and 36% were > $50,000. Because the income values were expanded at later stages of data collection, this variable cannot be used as a covariate. At study entry, mothers had a mean age of 35.3 years (± 4.7) and 14.5 years (± 2.3) of education.

On average, daughters consumed a similar number of meals over the 10-year study, but the percent of meals that qualify as FAFH increased from 20.3% when daughters were age 5 to 26.4% when daughters were age 15 ($p < .01$). Compared to meals eaten at home and at school, those meals eaten away from home were higher in energy density (mean ± sd, 2.32 cal/g ± 1.83), total sugar (7.45 g ± 10.74), added sugar (5.82 g ± 10.96), and total fat (3.58 g ± 5.24) at age 5 (p-values < .05); similar findings were found at age 15, except for total fat which did not emerge as statistically significant ($p > .05$). In addition, added sugar and total fat were higher in FAFH meals compared to meals eaten at school when girls were 5 years old; no difference was found between FAFH and school meals on energy density, total and added sugars, and total fat when girls were 15 years old (p-values > .05).

Table 4-1. Sample descriptives (mean ± standard deviation).for demographic, dietary intake, and weight status variables when daughters were age 5 (wave 1) and age 15 (wave 6).

Measures	**Daughter Age 5**	**Daughter Age 15**
Mother work hours, in hours per week	18.1 ± 17.6	30.3 ± 15.0
Mother age, in years	35.3 ± 4.7	45.7 ± 4.7
Mother education, in years	14.5 ± 2.3	14.8 ± 2.3
Daughter FAFH, in meals per day	1.0 ± 0.8	0.9 ± 0.7
Daughter FAFH, in percent of meals eaten	20.3 ± 15.9	26.4 ± 19.3
Daughter BMI percentiles	60.6 ± 26.3	61.5 ± 25.0
Mother BMI, in kg/m^2	26.6 ± 6.3	28.4 ± 6.5
Percent of overweight daughters, %	13.7	11.4
Percent of obese daughters, %	6.1	9.6
Percent of overweight mothers, %	34.7	23.0
Percent of obese mothers, %	17.9	38.2

FAFH = Proportion of food eaten away from home, not including meals eaten at home or school

Preliminary Analyses

To determine how the variables of interest varied with study wave, growth curve models were used to test the linear and quadratic main effects of wave (representing time). Mothers' work hours increased linearly ($\beta = 3.83$; $p < .0001$) but not quadratically ($p = .13$). Mothers' BMI increased linearly ($\beta = .61$; $p < .001$) but not quadratically ($p = .22$). Daughters' BMI-for-age percentile increased both linearly ($\beta = 3.07$; $p < .009$) and quadratically ($\beta = -.37$; $p < .05$). Daughters' FAFH intake increased both linearly ($\beta = .07$; $p < .0001$) and quadratically ($\beta = -.009$; $p < .0001$). All models will be analyzed using a linear change in wave.

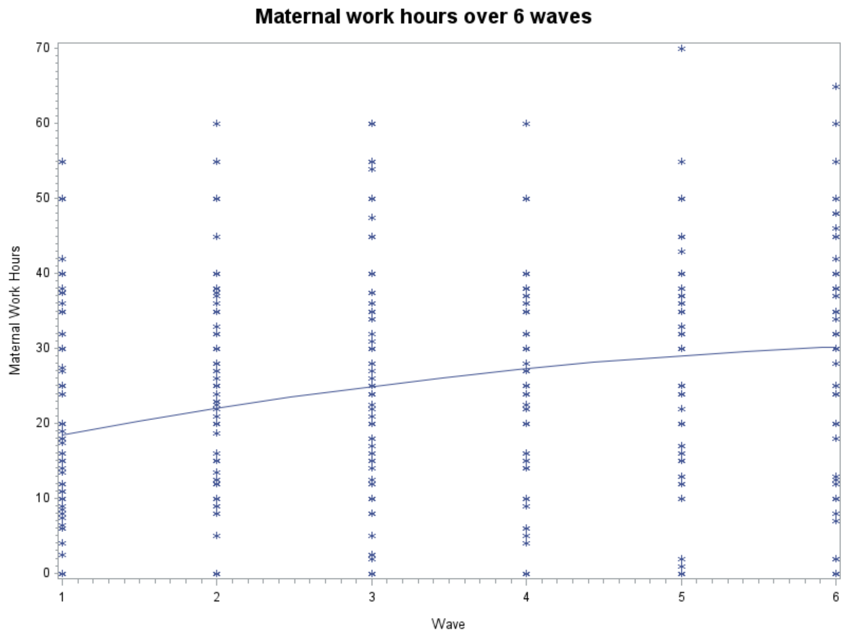

Figure 4-1. Plot of the distribution of maternal work hours by wave of data collection, starting when daughters were age 5 and collected every two years until age 15.

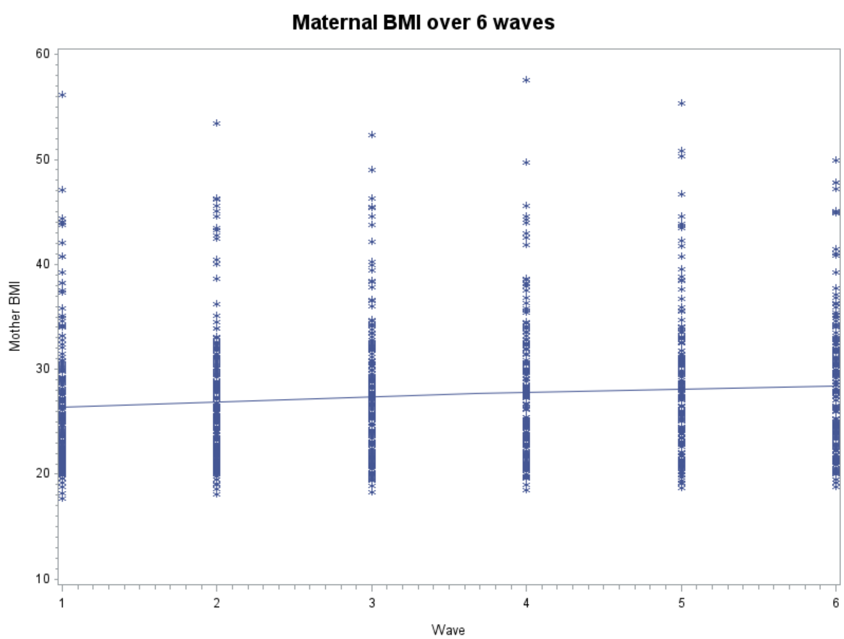

Figure 4-2. Plot of the distribution of maternal BMI by wave of data collection, starting when daughters were age 5 and collected every two years until age 15.

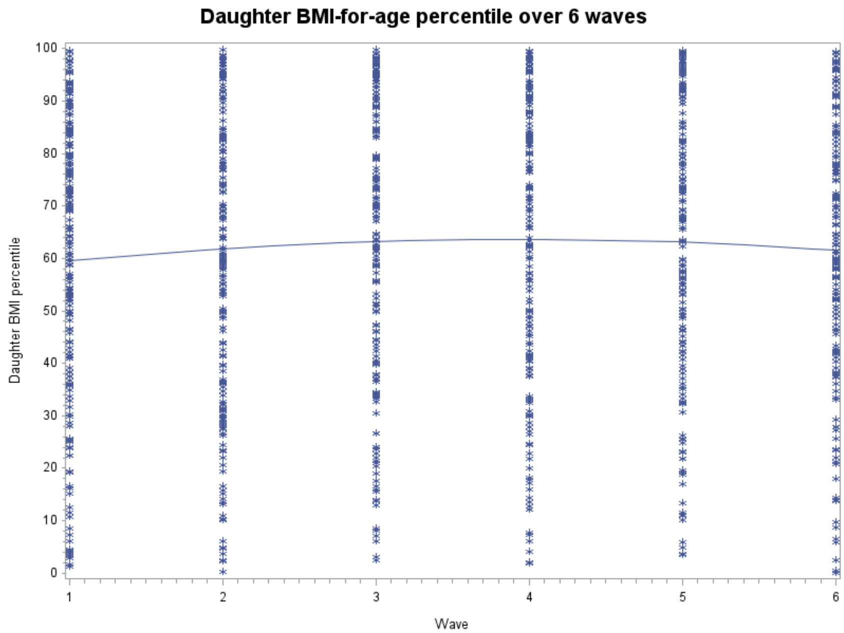

Figure 4-3. Plot of the distribution of daughter BMI-for-age percentile by wave of data collection, starting when daughters were age 5 and collected every two years until age 15.

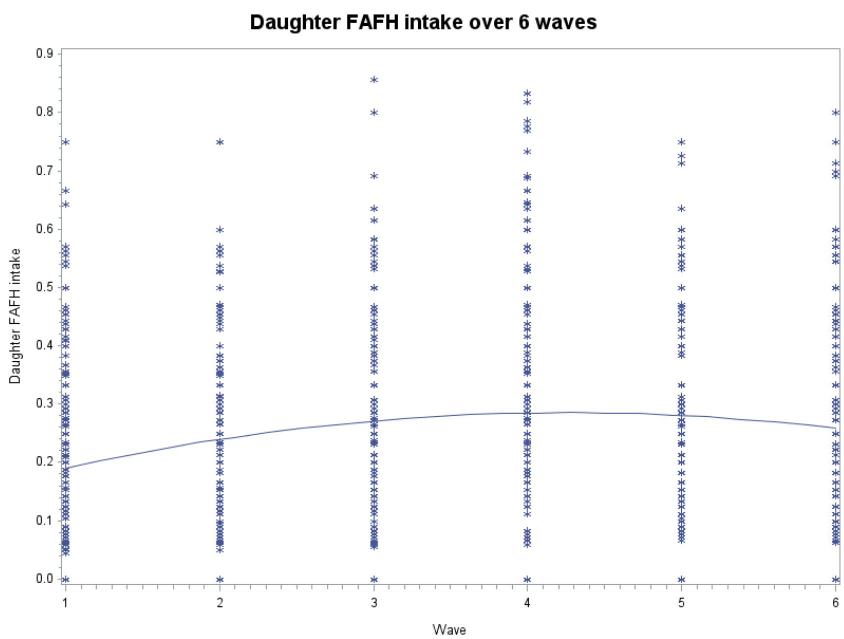

Figure 4-4. Plot of the distribution of daughter proportion of meals eaten away from home (FAFH) by wave of data collection, starting when daughters were age 5 and collected every two years until age 15.

Specific Aim 1: Work Hours as a Predictor of Mothers' BMI

To answer the first aim, Model 1 predicted changes in maternal BMI over 10 years by examining how increases in maternal work hours predicted changes in maternal BMI (see Table 4-2). However, the interaction between maternal work hours and wave was not significant and therefore, the model was reduced to only consider the main effects (β = .002, p = .71), without adjustment for covariates (data not shown). Considering only the main effects, there was also no main effect of the work hours (β = -.0004, p = .96) on maternal BMI, after adjusting for covariates. However, there is a significant effect for wave of data collection (F-value = 6.32, p < .0001) and years of education at study entry (β = -.73, p < .001), indicating a general trend for mothers to gain weight across waves and that BMI decreased with higher educational attainment. There is no significant effect of mother's age on her BMI. Similar results emerged when covariates were removed from the model (data not shown).

Table 4-2. Parameter estimates and standard errors of the repeated measures analysis of variance using maternal work hours to predict mothers' BMI (Model 1) over a 10-year period.

Model 1: work hours → mothers' BMI

Term		*Estimate*	*Standard Error*	*P-value*
Intercept		32.56	3.68	< *.0001*
Work hours		.0004	.006	*.94*
Mother's education (yrs)		-.73	.21	*.0005*
Mother's age		.13	.10	*.20*
Wave (Age 5 is reference	Age 7	.52	.15	*.0008*
category)	Age 9	1.03	.19	< *.0001*
	Age 11	1.49	.21	< *.0001*
F-value = 6.16	Age 13	1.90	.22	< *.0001*
p-value = < .0001	Age 15	2.12	.23	< *.0001*

Specific Aim 2: Work Hours as a Predictor of Daughters' BMI Percentiles

Model 2 predicted changes in daughters' BMI-for-age percentiles over 10 years by examining how increases in maternal work hours predicted changes in daughters' BMI percentiles (see Table 4-3). However, after including the main effects, there was no significant interaction between maternal work hours and wave (F-value = 1.18, $p = .32$) on daughters' BMI. Thus, the model was reduced to only consider the main effects revealing that there was a significant main effect for maternal work hours ($\beta = -.08$, $p < .05$), after adjusting for covariates. In other words, greater maternal work hours predicted lower daughters' BMI percentiles at the concurrent wave. There is a significant effect for wave of data collection (F-value = 6.16, $p < .0001$) and years of education at study entry ($\beta = -2.09$, $p < .01$), indicating that daughters' BMI percentiles increased across waves and that daughters' BMI percentiles decreased with mothers' higher educational attainment. Additionally, there was a significant effect of mothers' BMI ($\beta = .40$, $p < .05$), indicating that mothers with higher BMIs were more likely to have daughters with higher BMI percentiles. Lastly, there is no significant effect of maternal age on daughters' BMI percentiles nor does adding maternal BMI to the existing list of covariates change the significance of the main effects (data not shown).

Table 4-3. Parameter estimates and SEs of the repeated measures analysis of variance using maternal work hours to predict daughters' BMI-for-age percentile (Aim 2) over a 10-year period.

Model 2: work hours → daughters' BMI-for-age percentile

Term		*Estimate*	*Standard Error*	*P-value*
Intercept		82.35	14.07	< *.0001*
Work hours		-.08	.04	*.03*
Mother's education		-2.09	.79	*.008*
Mother's age		.29	.38	*.44*
Mother's BMI		.40	.18	*.03*
Wave (Age 5 is	Age 7	.0006	1.01	*.99*
reference category)	Age 9	5.43	1.37	< *.0001*
	Age 11	5.29	1.61	*.001*
F-value = 6.16	Age 13	3.54	1.80	*.05*
p-value = < .0001	Age 15	2.58	1.97	*.19*

Specific Aim 3: Work Hours as a Predictor of Daughters' FAFH

Model 3 predicted changes in daughters' proportion of food eaten away from home (FAFH) over 10 years by examining how increases in maternal work hours predicted changes in daughters' FAFH intake. Before including covariates (see Model 3A, Table 4-4), there was a marginally significant interaction between maternal work hours and wave (F-value = 2.15, p = .06), indicating a trend that increases in maternal work hours influence the rate of change in daughters' FAFH intake across waves. As shown in Model 3B in Table 4-5, when adjusting for covariates in the interaction model, the addition of the covariates to the model changed the significance of the interaction variables, reducing the significance of the interaction from p = .06 to p = .14 when mothers' years of education is added to the model. In Model 3B, there is a significant effect for wave of data collection (F-value = 6.18, p < .0001), indicating that daughters' FAFH intake increased across waves. There is no significant effect of maternal age or years of education on daughters' BMI percentiles. Maternal BMI was a significant predictor of daughters' FAFH intake (β = .002, $p < .05$).

Table 4-4. Estimates and standard errors of the repeated measures ANOVA using maternal work hours to predict daughters' FAFH intake (Aim 3) over a 10-year period without covariates.

Model 3A: work hours → daughters' FAFH

Term		*Estimate*	*Standard Error*	*P-value*
Intercept		.17	.02	*< .0001*
Work hours		.002	.0007	*.02*
Waves (Age 5 is	Age 7	.02	.02	*.41*
reference category)	Age 9	.10	.03	*.0001*
	Age 11	.15	.03	*< .0001*
F-value = 6.89	Age 13	.12	.03	*.0002*
p-value = < .0001	Age 15	.07	.04	*.05*
Work hours * wave	Age 7	-.0008	.0009	*.38*
(Age 5 is reference)	Age 9	-.002	.001	*.03*
	Age 11	-.001	.001	*.21*
F-value = 2.15	Age 13	-.003	.001	*.003*
p-value = .058	Age 15	-.001	.001	*.40*

Table 4-5. Estimates and standard errors of the repeated measures analysis of variance using maternal work hours to predict daughters' FAFH intake (Aim 3) over a 10-year period with covariates included in the model.

Model 3B: work hours → daughters' FAFH

Term		*Estimate*	*Standard Error*	*P-value*
Intercept		.07	.08	*.35*
Work hours		.001	.0007	*.56*
Mother's years of education		.005	.004	*.20*
Mother's age		-.0009	.002	*.62*
Mother's BMI		.002	.001	*.048*
Waves (Age 5 is	Age 7	.02	.03	*.49*
reference category)	Age 9	.10	.03	*.0003*
	Age 11	.15	.03	< *.0001*
F-value = 6.18	Age 13	.11	.03	*.0008*
p-value = < .0001	Age 15	.07	.04	*.06*
Work hours * wave	Age 7	-.0005	.001	*.57*
(Age 5 is reference)	Age 9	-.002	.001	*.33*
	Age 11	-.001	.001	*.33*
F-value = 1.57	Age 13	-.003	.001	*.01*
p-value = .16	Age 15	-.0009	.001	*.44*

Specific Aim 4: Daughters' FAFH as a Predictor of Daughters' BMI Percentiles

Model 4 predicted changes in daughters' BMI-for-age percentiles over 10 years by examining how increases in daughters' FAFH intake predicted changes in daughters' BMI percentiles (see Table 4-6). However, after including the main effects, there was no significant interaction between FAFH and wave (F-value = .60, p = .70) on daughters' BMI. Thus, the model was reduced to only consider the main effects. Considering only the main effects, there was also no main effect of the FAFH (β = .69, p = .75) on daughters' BMI percentiles. When adjusting for covariates, there is a significant effect for wave of data collection (F-value = 5.45, p < .0001) and years of education at study entry (β = -1.79, p < .05), indicating that daughters' BMI percentiles increased across waves and that daughters' BMI percentiles decreased with mothers' higher educational attainment. Additionally, there was a significant effect of mothers' BMI (β = .41, p < .05), indicating that mothers with higher BMIs were more likely to have daughters with higher intakes of FAFH meals. Lastly, there is no significant effect of maternal age on daughters' BMI percentiles nor does adding maternal BMI to the existing list of covariates change the significance of the main effects.

Table 4-6. Parameter estimates and standard errors of the repeated measures ANOVA using daughters' FAFH intake to predict daughters' BMI-for-age percentile (Aim 4) over 10 years.

Model 4: daughters' FAFH → daughter BMI %ile

Term		*Estimate*	*Standard Error*	*P-value*
Intercept		67.35	15.04	< *.0001*
FAFH		.66	2.18	*.76*
Mother's years of education		-1.79	.78	*.02*
Mother's age		.23	.37	*.53*
Mothers' BMI		.41	.18	*.02*
Wave (Age 5 is reference category)	Age 7	-.60	1.00	*.55*
	Age 9	4.52	1.36	*.0009*
	Age 11	3.82	1.61	*.02*
F-value = 5.45	Age 13	1.88	1.77	*.29*
p-value = < .0001	Age 15	1.16	1.90	*.76*

Specific Aim 5: Mediation model of the longitudinal effect of maternal work hours on daughters' BMI percentiles in the context of FAFH

Because there is no statistically significant effect of daughters' FAFH intake on daughters' BMI-for-age percentile, the mediation model was not tested.

Chapter 5

Discussion

Using longitudinal data, there were modest, negative associations between change in maternal work hours and daughters' BMI over a 10-year period. Increases in mothers' work hours predicted slight decreases in daughters' BMI percentile at each wave, suggesting that mothers who increased work hours outside the home tended to have had daughters with lower BMI percentiles at each wave. Increases in maternal work hours were associated with a change in the proportion of meals eaten outside the home by daughters over the 10-year period, but that effect was negated by the addition of covariates into the model, specifically mothers' years of education. There was not a significant association between daughters' FAFH intake and daughters' BMI percentiles, and thus the hypothesis that FAFH would mediate the relation between maternal work hours and daughters' BMI could not be tested. In addition, there was no relationship found between maternal work hours and maternal BMI.

Higher levels of maternal work hours did not predict greater maternal BMI over a 10-year period. This finding is inconsistent with other longitudinal studies indicating that greater amounts of time spent working outside the home, such as working full-time or more (defined as greater than 35 hours/week), is predictive of accelerated weight gain, compared to women who worked part-time or did not work (Au, Hauck et al. 2013). As suggested by Courtemanche (Courtemanche 2009), there are multiple mechanisms that may explain this relationship. First, additional hours worked might be associated with greater FAFH intake by mothers, which may independently predict weight gain. Additionally, mothers who work may have less time for leisure activities such as exercise and spend additional time in sedentary activities (e.g. sitting at desk) than women who are not employed, as well as spend less time sleeping. Because those behaviors were not assessed as part of the larger study, the potential effects of these variables on maternal BMI cannot be explored in the sample.

Greater maternal work hours predicted a small but significant decrease in daughters' BMI percentiles. In the current sample, transitioning into greater work hours did predict concurrent changes in daughters' BMI percentiles, meaning that a greater number of maternal work hours predicted lower BMI percentiles in daughters at a given wave. This finding is inconsistent with previous cross-sectional and longitudinal studies linking maternal work hours to greater obesity risk in children (Anderson, Butcher et al. 2003; Hawkins, Cole et al. 2008; Courtemanche 2009; Brown, Broom et al. 2010), However, the small effect size ($\beta = -.08$) may be less clinically significant as each additional hour a mother works predicts a decrease in .08 BMI percentiles in her daughter at a given wave.

Maternal work hours were marginally predictive of daughters' FAFH, in that mothers who increased their work hours have daughters who consumed more food away from home over the 10-year period. However, this effect became null in the context of mothers' years of education at study entry. Daughters' FAFH did not predict their BMI percentile, a finding inconsistent with a previous longitudinal study examining the effects of maternal work hours on 8-19 year old girls' weight (Thompson, Ballew et al. 2004). Results of that study revealed that more frequent FAFH was positively correlated with increased BMI z-scores in girls. This finding may point to a measurement issue with the dataset that this FAFH score was not nuanced enough to capture increases in actual FAFH and changes in the dietary quality of FAFH foods. Future studies could focus on the energy density of foods consumed in different contexts to identify those settings where FAFH haves the highest levels of intake of high-energy dense foods by daughters of working mothers to create avenues for intervention to lessen the effects of this relationship.

Study Limitations and Strengths

The main limitation of the current study is the limited generalizability of its findings due to sample demographic characteristics. The sample is comprised of two-parent household with fathers who work full-time, which may fail to capture the additional financial and leisure time burdens felt by single parents (Minnotte 2011). In addition, the majority of families were non-Hispanic White, an ethnic group that has lower rates of overweight and obesity than other groups in the United States, which may deflate the obesity risk in this sample compared to a more nationally representative sample. Finally, because the purpose of the larger study from which this data was drawn was to specifically look at sociocultural effects on girls, there is no data on boys to determine if boys and girls experience the effects of maternal employment differently.

However, in the face of these limitations, this study does contribute to the existing literature as many of the studies reviewed in this manuscript were cross-sectional, which limits the ability to determine the causal link between maternal work hours and family weight status and diet. The 10-year period of data collection also allows for the development of girls from early childhood to adolescence, allowing for the natural course of physical and emotional development to be captured in both the weight and dietary data. While the sample is smaller than other studies, the high retention rate (85%) is impressive for the length of the study. Additionally, the use of laboratory measured height and weight is much preferred to self-reported, as adults tend to overestimate height and underestimate weight (Gorber, Tremblay et al. 2007) and parents may overestimate childhood overweight compared to measured anthropometrics (Akinbami and Ogden 2009), both salient factors which could skew the results in studies with small samples.

Conclusion

This study shows relations between maternal work hours and daughters' weight status across a 10-year period. The measure of food eaten away from home (FAFH) in daughters did provided evidence that maternal work hours had a trend to be a significant predictor of FAFH and showed that FAFH meals had poorer diet quality than meals eaten at home or at school (Lee, Young et al. 2012). Although the amount of time mothers' work would be difficult to change, FAFH may be more modifiable through promoting healthy alternatives to FAFH in families with working mothers. Future studies should investigate alternative hypotheses such as reduced physical activity time as a mediator between maternal work hours and weight status/gain to suggest possible points of intervention to reduce the apparently adverse effects of maternal work hours on family members' weight status. Interventions focusing on improving work-life balance or the carry-over effects of workplace stress and schedule constraints on the family should consider including weight and diet measures to test changes to these proximal effects of maternal employment. Maternal employment is often reduced to covariate status in analyses of childhood obesity, yet these results show that it merits further study as a risk factor. Additional research should focus on which groups may be at highest risk for weight gain related to maternal employment in order to inform future interventions.

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