Parental education background, social support, and preschool-aged children with obesity

Centre for Health Equity Studies
Master’s thesis in Public Health (30 credits)
Spring 2017

Name: Sha Di

Supervisors: Paulina Nowicka (Main)
Can Liu (Co-supervisor)

Examiner: Anthony Garcy
Abstract
Childhood obesity is a serious public health problem. The present study investigated the association of parental educational background and social support with children’s weight status, and assessed whether parental depression influences the association of educational background and social support with children’s weight status. The study included data from 175 children in Stockholm County aged 4–6 years with obesity and a mean body mass index (BMI) standard deviation score (SDS) of 3.2; 45% of the cohort were male. Data included information provided by 98 mothers and 93 fathers. Forty-four percent of mothers had a university education, 66% were overweight or obese, and 77% displayed minimal depression symptoms. Forty-six percent of fathers had a university education, 52% were overweight or obese, and 87% displayed minimal depression symptoms. The association between parental educational background and social support and child BMI SDS was investigated using regression analysis for mothers and fathers. Results showed that educational level reported by fathers was negatively associated with high BMI SDS among children. Even after controlling for covariates, a low level of paternal education remained associated with a high BMI SDS among the children. Neither social support nor parental depression modified the effect of parental education on child BMI SDS.

Key words
Educational background, Social support, Childhood obesity, Parental depression, Body mass index
# Table of contents

Abstract 2

Table of contents 3

Introduction 5

Background 5

Education and obesity 5

Educational background and obesity 6

Parents’ social support and childhood obesity 7

Social support and obesity 7

Gender differences in social support 8

Parental depression 8

Aim and research questions 9

Methods 9

The More and Less study 9

Variables 10

Statistical analysis 12

Results 13

Characteristics of the ML study participants 13

Discussion 21

Summary of the findings 21

Parental educational background, child BMI SDS, and social support 22

Parental social support and child BMI SDS 23

Parental socioeconomic status, social support, and depression 23

Strengths and limitations 24

Future studies 24

Conclusion 25

Acknowledgements 25

References 26

Appendices 33
Introduction

Childhood obesity has become a 21st-century global and critical health problem (Farpour-Lambert et al., 2015). Obesity is defined as an excess of body fat that compromises health (World Health Organization [WHO], 2016). Body mass index (BMI) is a commonly used measurement for classifying normal body weight and obesity (Forsum, Flinke Carlsson, Henriksson, Henriksson and Löf, 2013). In pediatric practice, child BMI standard deviation scores (SDS), which are adjusted for age and sex, are often used to compare the weight status of children of different age and sex groups (Must and Anderson, 2006).

WHO (2014) reported that there were 42 million children worldwide under the age of five who were overweight or obese in 2013. A number of researchers reported that childhood obesity often persists into adulthood (Whitaker, Wright, Pepe, Seidel and Dietz, 1997; Simmonds, Llewellyn, Owen and Woolacott, 2016). Childhood obesity increases the risk of other childhood health concerns, ultimately leading to increased adult morbidity and mortality (WHO, 2014).

Several environmental factors have been linked to childhood obesity (Farpour-Lambert et al., 2015). For instance, childhood obesity is closely associated with parental education (McLaren, 2007). Parental educational background was found to be negatively associated with child weight in Nordic countries (Magnusson et al., 2014). Similarly, a study performed in seven European countries found that the prevalence of childhood obesity was higher among children of low-education-background parents (Brug et al., 2012).

Background

Education background and obesity

Theoretical background

Education is the most commonly used indicator for measuring health inequalities (Shavers, 2007). People with a higher educational background may have more opportunities to become aware of the consequences of obesity and to access information on healthy eating and physical exercise than those with lower education (Sobal, 1991). In Europe, the prevalence of obesity is lowest among those with the highest educational background, and this tendency is most pronounced in women (Seidell, 1995; McLaren, 2007; Magnusson et al., 2014). However, obesity
may also adversely affect the educational attainment of an individual, thus creating a bidirectional relationship between educational background and obesity (Gortmaker, Must, Perrin, Sobol and Dietz, 1993).

The cultural dimension of education can also explain the relationship between educational background and obesity: People with more education are generally more willing to participate in physical activity (Wilson, 1980). Individuals with higher educational backgrounds are often predicted to obtain a high-prestige occupation in the labor market (Shavers, 2007). Sobal (1991) argued that in modern society, people in high-prestige occupations have more control over their free time, which promotes engagement in physical activity, than people in low-prestige occupations. Moreover, educational attainment may influence individuals’ energy and fat intake, promoting awareness of the consequences of a high-fat diet (Sobal, 1991).

Educational background and obesity
Sobal and Stunkard (1989) reviewed research on the relationship between educational background and obesity, and found that in the developed world, women with the highest educational background had the lowest prevalence of obesity. Among men, however, they found that the prevalence of obesity did not vary by education. More recently, McLaren (2007) reported the same patterns.

The parental education gradient in childhood obesity in developed countries has been identified. The majority of studies had used maternal education as a representative variable for parental educational background, and found that it was negatively related to childhood obesity (Shrewsbury and Wardle, 2008). Gibson et al (2007) and Matthiessen, Stockman, Fagt, Knudsen and Biltoft-Jensen (2014) confirmed the relationship in Australian and Danish families, respectively. The association between maternal educational background and childhood obesity may be attributable to mothers having more control over their children’s nutritional intake and spending relatively more time with their children than fathers (Brophy et al, 2009; Lamb, Pleck, Charnov and Levine, 1987). Shrewsbury and Wardle (2008) concluded that maternal education exerted a stronger influence on childhood obesity than paternal education. However, some studies have found that paternal educational background does have a strong and independent
effect on childhood obesity (Lamerz et al, 2005; Shackleton, 2014; Moraeus et al, 2012; Vliet, Gustafsson, Duch and Nelson, 2015). The mechanism and pathways by which parental educational background influences childhood obesity remain unexplained. Stratifying the association by mothers and fathers separately may explain these associations.

Parents’ social support and childhood obesity

Theoretical background of social support

“Social support is often used in a broad sense, referring to any process through which social relationships might promote health and well-being” (Cohen, Underwood and Gottlieb, 2000, p.4). Two main pathways are hypothesized to link social support to health. The first is buffering, in which social support buffers or protects an individual’s health in a stressful or harmful situation (Cohen and Wills, 1985). The second pathway is the main effect of social support (Cohen and Wills, 1985). This latter pathway suggests that individuals with higher levels of social support have better health outcomes than others (Cohen, 1988).

Social support is often measured using the following three major components. The first is interaction of individuals with their personal network (Holt-Lunstad, Smith and Layton, 2010). The second is support received when actually needed, and is only relevant in stressful situations (Uchino, 2009). The third is the self-assessed availability of social support, which may be influenced by satisfaction with interpersonal interactions (Cohen, 1988).

Social support and obesity

Previous studies have found a relationship between social support and obesity, weight loss, and health behaviors. Wing and Jeffery (1999) recruited American participants and their friends or family members into an obesity treatment program. On average, a greater number of participants who received support from friends or family members and the research team completed the treatment program and reported better outcomes than participants who received no support. An interview study by Sallis, Grossman, Pinski, Patterson and Nader (1987) found a relationship between social support, eating habits, and exercise behavior among American participants. In a British study, Conklin et al. (2014) found a relationship between social support and healthy eating behaviors among people living alone.
Although few studies have examined the relationship between social support and childhood obesity, previous studies have suggested that these factors are linked. A study by Gerald, Anderson, Johnson, Hoff and Trimm (1994) was one of the first to report a negative association between social support and childhood obesity. More recently, an American study found that social support for Spanish-speaking fathers was significantly negatively related to their children’s weight, (Watt, Martinez-Ramos and Majumdar, 2012). A Swedish study by Lindberg et al (2016) found that obese children whose fathers reported emotional support from their own parents had a relatively lower BMI SDS than children whose fathers reported no such emotional support. Social support affects the association between socioeconomic status (SES) and SES-related health problems (Taylor and Seeman, 1999; Turner and Noh, 1983; Ranchor, Bouma and Sanderman, 1996). Previous studies found that people with lower SES have fewer social support resources (Stringhini et al, 2011; House, Umberson, and Landis, 1988), indicating that these individuals had an increased risk of developing SES-related health concerns, including obesity (Hirschman, 2014).

Gender differences in social support

Gender differences in social support have been identified (Greenglass, 1982). Women tend to report a higher level of social support than men (Knoll and Schwarzer, 2002). Several associations have been identified between social support and parental health, leading to better health outcomes in children. Married mothers have a higher level of social support than single mothers, leading to a higher degree of mother-child interaction and a lower rate of childhood obesity (Weinraub and Wolf, 1983; Birch, Marlin, Kramer and Peyer, 1981). Researchers have also identified a relationship between social support and breastfeeding, which yields a lower risk of childhood obesity (Armstrong and Reilly, 2002; Raj and Plichta, 1998).

Parental depression

The transition to parenthood can be stressful (Ahlborg, Berg and Lindvig, 2013). New parents face changes in social role and lifestyle, which may lead to parental depression. Maternal stress is associated with psychological problems for mothers who lack adequate social support (Ahlborg, Berg and Lindvig, 2013). Social support can help new fathers to make the transition to
fatherhood and relieve stress (O’Brien et al, 2016). In a German study, Hein et al (2014) found an association between maternal depression and maternal SES.

Furthermore, parental depression is linked to child obesity. Benton, Skouteris and Hayden (2015) found that 15 of 19 studies on the association between maternal depression and child obesity showed a positive correlation. Parental depression negatively affects parental behaviors and increases the risk of child obesity. Lovejoy, Graczyk, O’Hare and Neuman (2000) reviewed 46 studies and found strong associations between negative maternal behavior and a lower quality of parent-child interaction among depressed mothers. An American study found that maternal depression moderated the association between parenting style and childhood obesity (Topham et al, 2010). Lower levels of parental social support in food-related behavior, such as inappropriate feeding, have been associated with childhood obesity (Mauskopf, O’Leary, Banihashemi, Weiner and Cookston, 2015). Maternal depression exacerbates this association by promoting inappropriate feeding practices and decreasing levels of maternal involvement in food choice guidance for children (El-Behadli, Sharp, Hughes, Obasi and Nicklas, 2015; Topham et al, 2010).

Aim and research questions

The purpose of this thesis is to examine the relationships between educational background, social support, and BMI SDS in a clinical sample of preschool-age obese children, and assess whether parental depression affects these associations.

The research questions are:

1. Are parental educational background and social support related to BMI SDS in preschool-age obese children?
2. Does parental depression modify the relationship between educational background, social support, and BMI of preschool-age obese children?

Methods

The More and Less study

The research in this thesis was performed at the Karolinska Institute as part of an ongoing clinical treatment project, the More and Less (ML). The main objective of the study was to evaluate the early treatment of preschool children (aged 4 to 6 years) with obesity (Ek et al,
Clinical nurses in primary care child healthcare centers recruited the majority of participants. When the nurses identified obese children, they provided parents with information regarding the ML study. If the parents were interested in participating, their contact information and the children’s weight and height chart were sent to the research group. The research group then offered to provide more information about the study to the parents by telephone, mail, or email. The study required consent forms signed by both parents before the family could be formally included in the study (Ek et al, 2015).

The present study consists of baseline data from obese preschoolers (aged 4–6 years) living in Stockholm County, Sweden. At the beginning of the ML study, 335 children were assessed for eligibility, and 159 were excluded (65 children did not meet inclusion criteria, 89 families declined to participate, and 5 families could not be contacted). By March 2016, the ML study finished its baseline data collection, with 176 children included in the study. However, one child was diagnosed with an illness and was excluded from the study. Both parents were asked to complete questionnaires in person at baseline. Ninety-eight mothers and 93 fathers completed all questionnaires. Their responses were used as primary data in the present study. The first questionnaire consisted of 35 questions on parental educational background and social support. The second questionnaire was the Beck Depression Inventory (BDI) II, which was used to assess parental depression in the present study.

**Variables**

**Dependent variable**

Child BMI SDS (BMI adjusted for age and gender) represents the dependent variable in the present study. Use of the BMI SDS permits comparison with national reference populations; a Swedish reference sample was established by Karlberg, Kwan and Albertsson-Wikland (2003).

**Independent variables**

Two independent variables were included in present study, parental education and is parental social support. Parental education was assessed from the highest level of education attained by the parents. The responses were categorized into four groups, and were coded as follows: “Elementary school” was coded as 1, “2-year high school” was coded as 2, “3-year high school”
was coded as 3, and “University” was coded as 4.

A composite social support index was computed to capture the social support levels received by each parent. Six measures of social support were included in the index: Contact with grandparents, grandparents’ daily support, grandparents’ economic support, grandparents’ emotional support, family and friends’ support, and child care support in an emergency (Berkman and Glass, 2000; Haber, Cohen, Lucas and Baltes, 2007; Tay, Tan, Diener and Gonzalez, 2013). The question “How often does the child see your parents?” measured contact with grandparents. Some parents reported that their parents were deceased, and for those parents the answers were coded as “Grandparents deceased” and given the number 1. Other options were coded as follows: “Once a year or less” was coded as 2, “One to two times a year” was coded as 3, “Every month” was coded as 4 and “Once a week or more” was coded as 5. Some parents reported that their parents lived in other countries, which were coded as children visiting with their grandparents once a year or less. The questions “Have you received financial support from your child’s grandparents?”, “Have you received emotional support from your child’s grandparents? and “Have you received daily support from your child’s grandparents?” were used to measure the levels of grandparents’ support. Parents selected one of four options, and the options were coded as follows: llows. Parents select “Sometimes” were coded as 2, “Often” were coded as 3, and “Yes” were coded as 4. Nine mothers and 10 fathers reported that their parents were deceased, which were coded as not receiving support from parents. Two statements assessed support from family and friends and child care support in an emergency: “My family/friends support me when I need it” and “I can get support with child care in emergency” (Haber, Cohen, Lucas and Baltes, 2007). Participants evaluated the statements and reported their level of agreement using the following response options: “Strongly disagree” were coded as 1, “Disagree” were coded as 2, “Neutral” were coded as 3, “Agree” were coded as 4, and “Strongly agree” were coded as 5. The social support questionnaire is presented in Appendix 1.

Control variables
Parental depression was evaluated using the BDI-II questionnaire, which is a standardized self-assessment consisting of 21 items for measuring the severity of depression symptoms with international consistency (Beck, Steer, Ball and Ranieri, 1996). In the present study, BDI-II
scores were used as continuous variables and reverse-coded to correspond to the direction of  
social support variables. Cutoff scores in the present study correlated with Beck cutoff scores as  
follows: The minimum cutoff scores, 64 to 51, represent minimal depression symptoms; scores  
ranging from 50 to 45 represent mild depression symptoms; scores of 44 to 36 indicate moderate  
(depression symptoms, and scores of 35 to 0 (maximum cutoff) indicate severe depression  
symptoms. Parental BMI and age, and child sex and age were also used as control variables.  
Parental BMI and age and child age were used as continuous variables. Child sex was coded as 0  
for male and 1 for female. Marital status was measured using the nominal categorical variables:  
“Single”, “Divorced”, “Separated”, “In a relationship but not living together”, “Living together  
but not married”, and “Married”.

Statistical analysis

Statistical analysis was performed in SPSS version 20.0. A standard linear regression model was  
used to examine associations of parental educational background and social support with child  
BMI SDS; the analyses were performed separately for mothers and fathers. The analyses were  
based on all participants with complete information (mothers = 98, fathers = 93), corresponding  
to 56% and 53% of mothers and fathers included in the study. P-values, beta coefficients, and  
adjusted R^2 values were reported. P-values are often used for testing significance (Levine and  
Hullett, 2002); beta coefficients indicate the variability of independent variable influences on the  
dependent variable.

Multiple linear regression analyses were performed to assess the associations between parental  
educational background and social support with child BMI SDS. The analyses consisted of three  
models performed for mothers and fathers separately. In the first model, the association between  
child BMI SDS and parental educational background was adjusted for child sex and age and  
parental BMI and marital status. In the second model, the association between child BMI SDS  
and parental social support was adjusted for child sex and age and parental BMI and marital  
status. The third model is a mutually adjusted model between parental educational background  
and social support, maintaining child sex and age and parental BMI and marital status as  
constants. To address does parental depression modify the association of parental social support,  
educational background and child BMI SDS interaction analyses were performed. The analyses
were constructed four models. The first model looks at parental educational background adjusted for child sex and age and parental BMI, marital status, and BDI score. The second model assesses parental social support adjusted for child sex and age and parental BMI, marital status, and BDI score. The third model was the association of parental social support, BDI scores, interaction term between parental social support and BDI scores adjusting for child sex and age and parental BMI and marital status. The fourth model was association of parental educational background, BDI scores, interaction term between parental educational background and BDI scores adjusting for child sex and age and parental BMI and marital status.

**Results**

*Characteristics of the ML study participants*

Maternal BMI ranged from 19.26 to 46.65, with a mean of 28.26. Paternal BMI ranged from 21.62 to 43.44, with a mean of 29.58 (Table 1). Maternal BDI scores ranged from 9.00 to 63.00, with a mean of 54.68. Paternal BDI scores ranged from 39.00 to 63.00, with a mean of 54.68. According to the BDI-II score classification in the present study, the median BDI scores for both mothers (57) and fathers (61) represented a minimal level of depression. The minimum maternal depression score was 9 (severe depression), while the minimum paternal depression score was 39 (moderate depression). The mean social support score reported was 15.91 for mothers and 14.93 for fathers.

<table>
<thead>
<tr>
<th>Table 1. Continuous variables.</th>
<th>Mothers (n = 98)</th>
<th>Fathers (n = 93)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Max.</td>
</tr>
<tr>
<td><strong>Child body mass index standard deviation score</strong></td>
<td>3.07</td>
<td>5.24</td>
</tr>
<tr>
<td><strong>Child age</strong></td>
<td>5.18</td>
<td>7.04</td>
</tr>
<tr>
<td><strong>Body mass index</strong></td>
<td>28.26</td>
<td>46.65</td>
</tr>
<tr>
<td><strong>Beck Depression Inventory II score</strong></td>
<td>54.68</td>
<td>63.00</td>
</tr>
<tr>
<td><strong>Social support</strong></td>
<td>15.91</td>
<td>24.00</td>
</tr>
</tbody>
</table>
The distribution of all three ordinal categorical variables is presented in Table 2. Approximately 70% of the parents had a 3-year high school education or higher. A slightly higher percentage of mothers had a 3-year high school education or higher than fathers. Over 60% of parents were married. More children were female.

### Table 2. Categorical variables.

<table>
<thead>
<tr>
<th></th>
<th>Mothers (n = 98) (%)</th>
<th>Fathers (n = 93) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school</td>
<td>7 (7.14)</td>
<td>7 (7.53)</td>
</tr>
<tr>
<td>Two-year high school</td>
<td>10 (10.20)</td>
<td>17 (18.28)</td>
</tr>
<tr>
<td>Three-year high school</td>
<td>37 (37.76)</td>
<td>26 (27.96)</td>
</tr>
<tr>
<td>University</td>
<td>44 (44.90)</td>
<td>43 (46.24)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>7 (7.14)</td>
<td>3 (3.23)</td>
</tr>
<tr>
<td>Divorced</td>
<td>4 (4.08)</td>
<td>4 (4.30)</td>
</tr>
<tr>
<td>Separated</td>
<td>5 (5.10)</td>
<td>3 (3.23)</td>
</tr>
<tr>
<td>In a relationship but not living together</td>
<td>5 (5.10)</td>
<td>4 (4.30)</td>
</tr>
<tr>
<td>Living together but not married</td>
<td>18 (18.37)</td>
<td>18 (19.35)</td>
</tr>
<tr>
<td>Married</td>
<td>59 (60.20)</td>
<td>61 (65.59)</td>
</tr>
<tr>
<td><strong>Child sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>38 (38.78)</td>
<td>41 (44.09)</td>
</tr>
<tr>
<td>Female</td>
<td>60 (61.22)</td>
<td>52 (55.91)</td>
</tr>
</tbody>
</table>

Table 3 presents the relationship between child BMI SDS and maternal education and social support, after adjusting for child sex and age and maternal BMI, marital status, and BDI score.
Table 3. Association of child body mass index standard deviation scores and maternal education and social support.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 0</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social support</td>
<td>-0.026</td>
<td>-0.014</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school</td>
<td>0.559</td>
<td>0.518*</td>
<td>0.519</td>
<td></td>
</tr>
<tr>
<td>Two-year high school</td>
<td>0.441</td>
<td>0.553*</td>
<td>0.554*</td>
<td></td>
</tr>
<tr>
<td>Three-year high school</td>
<td>0.223</td>
<td>0.204</td>
<td>0.205</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Beck Depression Inventory II score</td>
<td>-0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td>0.291</td>
<td>0.349</td>
<td>0.349</td>
</tr>
</tbody>
</table>

* p < 0.05.

Model 0 is unadjusted.

Model 1 adjusted for child sex and age and maternal BMI and marital status.

Model 2 adjusted for the same covariates as Model 1.

Model 3 adjusted for variables in Model 2 and also for maternal social support.

Model 0 shows the unadjusted relationship of maternal social support and educational background with child BMI SDS. There were no associations between maternal education, social support, and BDI and child BMI SDS. Models 1 and 2 addressed the first research question, of whether parental educational background and social support were related to child BMI SDS. In Model 1, after adjusting for child sex and age and maternal BMI and marital status, there was no association between maternal social support and child BMI SDS did not present. In Model 2, the
association between maternal educational background and child BMI SDS. Children whose mothers reported to have attained elementary (B=0.518, p < 0.05) and 2-year high school (B=0.553, p < 0.05) education had higher BMI SDS than children whose mothers reported having attained university education. In Model 3, maternal social support and educational background were included simultaneously while adjusting for child sex and age and maternal BMI and marital status. Maternal educational background was associated with child BMI SDS. In this model, children of mothers with a 2-year high school education had an increased risk for a higher BMI SDS compared with children of mothers with university education (p < 0.05).

Table 4 shows the relationship of paternal educational background and social support with child BMI SDS after adjusting for child sex and age and paternal BMI, marital status, and BDI scores.

**Table 4. Association of child body mass index standard deviation scores and paternal education and social support.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fathers (n = 93)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 0</td>
</tr>
<tr>
<td>Social support</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>−0.035</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Elementary school</td>
<td>1.082***</td>
</tr>
<tr>
<td>Two-year high school</td>
<td>0.452*</td>
</tr>
<tr>
<td>Three-year high school</td>
<td>−0.033</td>
</tr>
<tr>
<td>University</td>
<td>Reference</td>
</tr>
<tr>
<td>Beck Depression Inventory II score</td>
<td>0.011</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.265</td>
</tr>
</tbody>
</table>

* p < 0.05, ** p < 0.01, *** p < 0.001.
Model 0 is unadjusted.
Model 1 adjusted for child sex and age and paternal BMI and marital status.
Model 2 adjusted for the same covariates as Model 1.
Model 3 adjusted for variables in Model 2 and also for paternal social support.

Model 0 shows the unadjusted relationship of paternal educational background, social support, and BDI with child BMI SDS. In contrast with the unadjusted model for maternal data, children whose fathers reported to have attained elementary (B=1.082, \( p < 0.001 \)) or 2-year high school (B=0.452, \( p < 0.05 \)) education had higher BMI SDS than children whose fathers had attained university education. Models 1 and 2 addressed the first research question, of whether parental educational background and social support were associated with child BMI SDS. In Model 1, after adjusting for child BMI SDS by child sex and age and paternal BMI and marital status, paternal social support associated with child BMI SDS. The results showed that children whose fathers reported higher levels of social support had on average a 0.040- \( (p < 0.05) \) lower BMI SDS than children whose fathers reported lower levels of social support. The adjusted R\(^2\) value shows that 26.5% of the variation in child BMI SDS could be explained by paternal social support, BMI, and marital status and child sex and age. In Model 2, after adjusting for child BMI SDS by child sex and age and paternal BMI and marital status, paternal educational background was associated with child BMI. Children whose fathers reported having attained an elementary (B=0.883, \( p < 0.01 \)) or 2-year high school (B=0.425, \( p < 0.05 \)) education had higher BMI SDS than children whose fathers had attained university education. The adjusted R\(^2\) value showed that 35.3% of the variation in child BMI SDS could be explained by paternal educational background, BMI, and marital status and child sex and age. Model 3 presented the adjusted relationship between child BMI SDS and both paternal social support and educational background. The association between paternal education and child BMI SDS remained significant \( (p < 0.01) \). There was no association between paternal social support and child BMI SDS.

Table 5 shows the results of analyses the interaction between, maternal social support and maternal BDI scores.
Table 5, Interaction analyses between maternal Beck Depression Inventory (BDI) II scores and educational background on child body mass index standard deviation scores.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social support</td>
<td>-0.017</td>
<td>-0.035</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beck Depression Inventory II score</td>
<td>0.007</td>
<td>0.006</td>
<td>0.007</td>
<td>0.015</td>
</tr>
<tr>
<td>Social Support* Beck Depression Inventory II score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 year high school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 year high school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>Reference</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education* Beck Depression Inventory II score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school* Beck Depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 year high school* Beck Depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 year high school* Beck Depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University* Beck Depression Inventory II score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.297</td>
<td>0.354</td>
<td>0.396</td>
<td>0.475</td>
</tr>
</tbody>
</table>
* $p < 0.05$.

Model 1 adjusted for child sex and age and maternal Beck depression scores, BMI and maternal marital status.

Model 2 adjusted for the same covariates as Model 1.

Model 3 adjusted for child sex and age and maternal BMI and maternal marital status and also for interaction term between social support and Beck depression scores.

Model 4 adjusted for child sex and age and maternal BMI and maternal marital status and also for interaction term between educational background and Beck depression scores.

Interaction analyses were performed to investigate the second research question, did maternal BDI scores modify the relationship between educational background, social support, and child BMI SDS. In Model 1, the relationship between maternal social support and child BMI SDS was adjusted for maternal BDI scores, child sex, age, maternal BMI and marital status. There was no association between maternal social support and child BMI SDS. In Model 2, the relationship between maternal educational background and child BMI SDS was adjusted for maternal BDI scores, child sex, age, maternal BMI and marital status. Maternal educational background was still associated with child BMI SDS. More specifically, children whose mothers had a 2-year high school education had a 0.552-higher BMI SDS than children whose mothers had a university education ($p < 0.05$). The adjusted $R^2$ score showed that maternal educational background, BMI, BDI scores, and marital status and child sex and age could explain 35.4% of the variation in child BMI SDS. In Model 3, after adjustment for the interaction term between social support and BDI scores and holding child sex, age and maternal BMI and maternal marital status constant, results suggested that maternal depression did not modify the association between maternal social support and child BMI SDS. In Model 4, after adjustment for the interaction term between educational background and Beck depression scores and holding constant child sex, age, maternal BMI and maternal marital status, maternal depression did not modify the association between maternal educational background and child BMI SDS.

Table 6 shows the results of analyses the interaction between, paternal social support and paternal BDI scores.
Table 6, Interaction analyses between paternal Beck Depression Inventory (BDI) II scores and educational background on child body mass index standard deviation scores.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social support</td>
<td>-0.040</td>
<td>B</td>
<td>0.425</td>
<td>B</td>
</tr>
<tr>
<td>Beck Depression Inventory II score</td>
<td>0.016</td>
<td>0.007</td>
<td>0.136*</td>
<td>0.017</td>
</tr>
<tr>
<td>Social Support* Beck Depression Inventory II score</td>
<td></td>
<td></td>
<td>-0.008</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school</td>
<td>0.847**</td>
<td>2.984</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 year high school</td>
<td>0.419*</td>
<td>-1.849</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 year high school</td>
<td>-0.087</td>
<td>3.375</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>Reference</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education* Beck Depression Inventory II score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school* Beck Depression Inventory II score</td>
<td>-0.034</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 year high school* Beck Depression Inventory II score</td>
<td>0.038</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 year high school* Beck Depression Inventory II score</td>
<td>-0.059</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University* Beck Depression Inventory II score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adjusted $R^2$  
<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.279</td>
<td>0.356</td>
<td>0.495</td>
<td>0.601</td>
</tr>
</tbody>
</table>

* $p < 0.05$, ** $p < 0.01$.  

Model 1 adjusted for child sex and age and paternal Beck depression scores, BMI and paternal marital status.  
Model 2 adjusted for the same covariates as Model 1.  
Model 3 adjusted for child sex and age and paternal BMI and maternal marital status and also for interaction term between social support and Beck depression scores.  
Model 4 adjusted for child sex and age and paternal BMI and maternal marital status and also for interaction term between educational background and Beck depression scores.
Interaction analyses were conducted to investigate the second research question did paternal depression modify on the relationship between educational background, social support and child BMI SDS. In Model 1, the relationship between paternal social support and child BMI SDS was adjusted for paternal BDI scores, child sex, age, paternal BMI and marital status. There was no association between paternal social support and child BMI SDS. In Model 2, the relationship between paternal educational background and child BMI SDS was also adjusted for paternal BDI scores, child sex, age, paternal BMI and marital status. Paternal education was associated with child BMI SDS. Children whose fathers reported having attained elementary (B=0.847, p < 0.01) or a 2-year high school (B=0.419, p < 0.05) education had higher BMI SDS than children whose fathers had attained university education. The adjusted $R^2$ showed that paternal educational background, BDI scores, and marital status, child sex and age could explain 35.6% of the variance in child BMI SDS. In Model 3, adjusting for the interaction term between paternal social support and BDI scores holding child sex, age, paternal BMI and marital status, suggested that paternal BDI scores did not modify the association between paternal social support and child BMI SDS. Results from Model 4 suggested paternal depression did not modify the association between paternal educational background and child BMI SDS after holding child sex, age, paternal BMI and marital status constant.

Discussion

Summary of the findings

This study in preschool children investigated the associations between parental educational background, social support, and child BMI SDS, as well as the potential influence of parental depression. The findings indicate that children whose fathers have lower educational backgrounds have higher BMI SDS, and the association remains significant even after controlling for confounding factors ($p < 0.05$). Maternal educational background was significantly associated with child BMI SDS after controlling for confounding factors ($p < 0.05$). Paternal social support was significantly associated with child BMI SDS ($p < 0.05$), after adjusting for child sex and age and paternal BMI and marital status. In bivariate regression analyses, depression levels in both parents were not significantly associated with child BMI SDS ($p > 0.05$). Interaction analyses were performed to examine the modifying effect of parental
depression; however, the results suggested that parental depression did not modify the association of parental education, social support and child BMI SDS. Further interaction analyses of parental education and social support suggested that parental-reported social support did not modify the association between parental education and child BMI SDS.

**Parental educational background, child BMI SDS, and social support**

The first research question focused on the relationship between parental educational background and child BMI SDS. In the bivariate analyses, paternal education was negatively associated with child BMI SDS \((p < 0.05)\). Furthermore, children whose fathers had lower levels of education tended to have a higher BMI SDS than children whose fathers had higher levels of education. Although these findings are in line with those of previous studies which examined the relationship between parental education and childhood obesity, most of these studies (such as Vliet, Gustafsson, Duch and Nelson, 2015) were conducted in general populations, whereas the present study used data from obese children. The present study evaluated the association between parental education and child weight status separately for mothers and fathers, as had been done in prior work (such as Moraeus et al, 2012; Vliet, Gustafsson, Duch and Nelson, 2015). The present study found an independent effect of paternal educational background on child BMI SDS; other variables did not affect child BMI SDS to a greater extent than paternal educational background. Similar findings had been reported by studies performed among Swedish, German, and British children (Lamerz et al, 2005; Shackleton, 2014; Moraeus et al, 2012; Vliet, Gustafsson, Duch and Nelson, 2015). In contrast, a systematic review of 45 cross-sectional studies suggested that maternal education exerted a stronger effect on childhood obesity than paternal educational background (Shrewsbury and Wardle, 2008). The discrepancy may be explained by the different study design and parental education index used. It is not possible to conclude whether maternal or paternal education exerts a stronger impact on child BMI SDS. These associations require further investigation, and may be helpful in reducing health inequalities. In the present study, maternal education was significantly associated with child BMI SDS after adjusting for the potential confounders of child sex and age and maternal BMI and marital status. Finally, when parental educational background and social support were both included in the model, the association between parental education and child BMI SDS was still present, suggesting that parental education exerts a stronger effect than parental social support on
child BMI SDS. In contrast, one previous study found that social support buffers the negative effect of educational background, income, and occupation on individual health status (Cohen, Underwood and Gottlieb, 2000).

**Parental social support and child BMI SDS**

The first research question also looked at the association between parental social support and child BMI SDS. The study created a composite social support variable to capture all aspects of social support received by parents. Bivariate analyses showed that maternal and paternal social support was negatively but non-significantly associated with child BMI SDS. This finding is same trend with those of previous studies (Gerald, Anderson, Johnson, Hoff and Trimm, 1994; Watt, Martinez-Ramos and Majumdar, 2012; Lindberg et al, 2016), who observed that social support was negatively associated with child weight status. Lindberg and colleagues and the present study used the same assessment parameters of social support, but performed different statistical methods: The former study used only emotional support received by fathers as the measure of social support, while the latter used a composite of multiple variables of social support. In the present study, after controlling for child sex and age and paternal BMI and marital status, social support reported by fathers was significantly associated with child BMI SDS. Watt, Martinez-Ramos and Majumdar (2012), Lindberg et al (2016), and the present study all found that social support reported by fathers was associated with child BMI SDS. Although several previous studies have suggested that maternal social support was associated with a lower risk of childhood obesity (Weinraub and Wolf, 1983; Birch, Marlin, Kramer and Peyer, 1981), few studies have examined the relationship between paternal social support and childhood obesity (Watt, Martinez-Ramos and Majumdar, 2012; Lindberg et al, 2016).

**Parental socioeconomic status, social support, and depression**

The second research question focused on whether parental depression modifies the association between parental educational background, social support, and child BMI SDS. In bivariate analyses, parental depression was non-significantly associated with child BMI SDS. Furthermore, the association between maternal depression and child BMI SDS was similar to the study by Benton, Skouteris and Hayden (2015), who suggested that children with less-depressed mothers had lower body weight. In multiple regression analyses, although statistically significant
associations were not found, the relationship between parental depression and child weight status was positive, which suggests lower BMI SDS in children of less depressed parents. This contrasts with the higher prevalence of obesity in children whose parents reported symptoms of depression found by Benton, Skouteris and Hayden (2015); that review, which found a positive association between parental depression and obesity, was based on longitudinal studies. Although the ML study had a follow-up component, the present analyses were based only on the baseline data. The interaction analyses did not find a modification effect. A study by Topham et al (2010) found that parental depression did modify the association between parenting style and child BMI SDS. Several differences between that study and the present study may explain why the present study found that parental depression did not modify the association. The present study did not look at parenting style, and was based on data from a Swedish clinical study where participants were obese; Topham et al (2010) looked at a general population in the United States.

Strengths and limitations
The major limitation of our study was its small sample size, which reduced the statistical power to detect potentially important associations. Interaction analyses found that parental depression did not modify the association between parental educational background and social support and child BMI SDS, and this may be due to the small sample size. The strength of the present study is in its stratified analysis of the association between maternal and paternal education and child BMI SDS; few previous studies have included both maternal and paternal education in the analyses.

Future studies
A previous study suggested that perceived social support was affected by parents’ early childhood experiences (Uchino, 2009). Thus, future studies should include questions regarding early childhood experiences, such as “When you think back on your childhood, do you think you received enough attention from your parents?” Furthermore, Cohen and Wills (1985) suggested that perceived and received social support might be influenced by an individual’s current conditions, such as stress. Thus, it is important to consider the effect of stress on social support. Finally, the present study found that paternal education was associated with child BMI SDS; this finding requires explanation. Future studies should include the educational background of both
parents. In addition, the present study found that social support reported by fathers was associated with child BMI SDS, but the effect of paternal social support on child BMI SDS disappeared after paternal educational background was included in the analyses; this finding should be validated in future work.

Conclusion

In the present study, paternal education was negatively associated with child BMI SDS. Thus, children whose parents had high educational backgrounds had, on average, lower BMI SDS than children whose parents had low educational backgrounds.

This study contributes to the theoretical understanding of how parental educational background and social support are related to obesity in preschool-aged children. Hopefully, this study will prompt further research into the association between parental social support and child weight, with a view toward designing obesity treatment programs for children. The present study also draws attention to the modifying effect of parental depression on the association of parental education, social support and child BMI SDS; understanding this aspect may contribute to solving this complex public health problem.

To date, few published studies have examined the relationship between parental social support and child BMI SDS. The findings of the present study are consistent with those of previous studies, which reported that education and social support were associated with obesity. Understanding how parental education influences the risk for child obesity and how parental social support affects rates of childhood obesity is important for identifying solutions to this urgent, pervasive, and multidimensional public health problem.

Acknowledgements

I would like to thank my supervisor, Paulina Nowicka of the Karolinska Institute, for her support and consistent guidance; my co-supervisor, Can Liu, for her suggestions and guidance with my thesis; Ylva B. Almquist, Olof Ölof, and Susanna Toivanen for their support and feedback, and Anna Ek and Louise Lindberg for information on the More and Less study. Finally, I would like to thank Anthony Garcy for the comprehensive recommendations that were given concerning the
revision of this thesis.

References


http://scholarworks.gsu.edu/sociology_theses/49


Matthiessen, J., Stockman, A., Fagt, S., Knudsen, V. K., & Biltoft-Jensen, A. (2014). Danish children born to parents with lower levels of education are more likely to become overweight.
Acta Paediatrica, 103(10), 1083-1088.


Appendices

Appendix 1

Social support questionnaire
Structural social support:
1. Are you (select all that applies)?
   (1) Single
   (2) Divorced
   (3) Separated
   (4) In a relationship but nor living together
   (5) Living together but not married
   (6) Married
2. How often does the child see your parents?
   (1) Once a year or less
   (2) One to two times a year
   (3) Every month
   (4) Once a week or more
   (5) Other, please describe_____
3. How many people live in your household?

Functional social support:
Do you receive support from your parents?
a) Economic support
   (1) No
   (2) Sometimes
   (3) Often
   (4) Yes
b) Emotional support
   (1) No
   (2) Sometimes
   (3) Often
   (4) Yes
c) Daily support
   (1) No
   (2) Sometimes
(3) Often
(4) Yes

Perceived social support:
Thinking about your family support, do you agree with the following statement?
a) My family/friends support me when I need it
   (1) Strong disagree
   (2) Disagree
   (3) Neutral
   (4) Agree
   (5) Strong agree
b) I can get support with child care in an emergency
   (1) Strong disagree
   (2) Disagree
   (3) Neutral
   (4) Agree
   (5) Strong agree

Socioeconomic status questionnaire:
1. Which of the following options best describes the highest level of education you attained?
   (1) Elementary school
   (2) Two-year high school
   (3) Three-year high school
   (4) University
2. What is your average monthly income after taxes?
   (1) Less than 10,000 SEK
   (2) 10,000–less than 20,000 SEK
   (3) 20,000–less than 30,000 SEK
   (4) 30,000 or more.
3. Recalling the past 12 months, which option best describes your financial situation at the end of each month?
(1) Not enough money to make ends meet
(2) Just enough money to make ends meet
(3) Some money left over
(4) More than enough money left over and I am able to save some money

4. Where do you reside?
   (1) I rent an apartment
   (2) I own my apartment
   (3) I own my house

Covariates:
1. Were you born in Sweden?
   (1) No, in another country
   (2) Yes, in Sweden

2. Do you speak Swedish at home?
   (1) No, another language
   (2) Yes, Swedish.