THE DANISH
NATIONAL CENTRE
FOR SOCIAL RESEARCH

05:2008 WORKINGPAPER

Jane Greve

NEW RESULTS ON THE EFFECT OF MOTHERS' WORKING HOURS ON CHILDREN'S OVERWEIGHT STATUS

DOES THE QUALITY OF CHILDCARE MATTER?

RESEARCH DEPARTMENT OF CHILDREN AND FAMILY

New Results on the Effect of Mothers' Working Hours on Children's Overweight Status:

Does the Quality of Childcare Matter?

Jane Greve

Aarhus School of Business,

University of Aarhus, Denmark

April 2008

Abstract

During the last 30 years almost all developed countries have experienced an increase in the number of overweight children. Existing empirical research derives mainly from the U.S., Canada, Australia and the UK, and points at maternal employment as an explanation for the increasing trend in child weight. This paper uses the Danish Longitudinal Survey of Children (DALSC) merged with Danish register data from 1995 to 2002 to explore whether a causal relationship exists between maternal working hours and Danish children's overweight status at age 7½. The instrumental variables technique is used in exploring possible bias due to omitted variable bias. In contrast to the existing literature this paper shows that an increase in mothers' working hours has a reducing effect on child weight. Subgroup analyses on formal and informal daycare suggest that the quality of childcare determines the effect, as results show that maternal employment has a reducing effect on children's overweight status in formal daycare (kindergarten). For children in informal daycare (family daycare), maternal employment has no significant effect.

JEL classification: I12, J13, J22

Keywords: child obesity, overweight, maternal employment, maternal working hours, childcare

Acknowledgement: I thank the Danish National Centre of Social Research for data supply. I thank Nabanita Datta Gupta, Jan Høgelund, Paul Bingley, Henrik Jürges, Dean Lillard, Janet Currie, Carol Devine, Stephanie von Hinke Kessler Scholder, and Tor Erikson for their comments. An earlier version of this paper has been presented at SOFI, Stockholm University and I thank the seminar participants for their comments.

1. Introduction

Recent research shows that the well-documented general increase in the tendency towards being overweight and obese in both developed and less developed countries particularly afflicts children. Some researchers even speak of childhood obesity as a global epidemic with its persistence into adulthood posing an ever-growing threat to health all over the world (WHO, 2000). The categorization of the obesity trend as an epidemic carries an implicit assumption that obesity is something one gets "infected by"—and consequently a situation for which the individual cannot be entirely blamed for. While both genetic and social factors are indeed underlying explanations for obesity, they are particularly so for children's overweight status. In general children neither purchase their own food nor decide what to have for dinner; decisions like these are mostly in the domain of parents. As children do not choose their own parents and as obesity runs in families, overweight children should be a natural subject of concern for social research.

Denmark has no systematic monitoring of the prevalence of weight problems. Although several systematic studies of the development of the fraction of overweight and obese people in the population exist, these are only for selected groups according to gender, age, ethnicity, and region. Therefore projecting the accurate prevalence of overweight persons in the Danish population is not possible. Still, given substantiated indicators such as a general increase in birth weight, weight of pregnant women, and weight of men liable for military service Danish experts predict a significant increase in the prevalence of overweight and obese individuals (Sørensen et al., 2008).

Recently, international social research has started to look for explanations for the increase in children's overweight status. Some papers have pointed to the problem of high availability of cheap and calorie-dense food and beverages (Ebbelin et al., 2002), some have pointed to the high availability of and easy access to passive activities such as to television viewing and computer use (Gortmaker et al., 1996), some examine fast food restaurant advertising on television (Chou et al., 2005), and some focus on school food (Anderson and Butcher, 2005). While all these factors may play a role for the individual child's weight gain, they also depend on the parents' behavior (at least for children up to a certain age). If children are going to spend more hours watching television and playing computer games, while eating more unhealthy food at both fast food restaurants and in school, the parents to a certain extent must be aware of and give at least tacit approval to this behavior. Thus, the environment that both parents and their children face in their everyday life may play a significant role in explaining child obesity.

Various labor market aspects are relevant when we bring the relationship between parents' labor market situation and children's overweight status into focus. This paper looks at the relationship between mothers' labor market outcome and children's overweight status (why I focus on mothers and not both parents or fathers will shortly become clear). I consider how mothers' working *time* can affect children's weight through its effect on children's eating patterns and levels of exercise.

Previous international studies show that fathers' working time has no impact on their children's body weight (Phipps et al., 2006; Courtemanche, 2007). This paper confirms this relationship, as I find that fathers' working hours has no impact on the children's overweight status even when I factor in the correlation between fathers' and mothers' working time. Furthermore, although international comparative studies show that compared to other nationalities, Danish fathers are among those who spend most hours in the household (Lausten and Sjørup, 2003; Knudsen and Wærness, 2008), a Danish time study (Deding and Lausten, 2006) also shows that the mother's working hours has no significant effect on the number of hours the father works in the household. As these findings indicate that fathers' contribution to child health has a limited relevance in this setting, I focus only on the impact of mothers' working time on children's overweight status.

When parents' total work hours increase, time spent on the household is reduced. A recent study from the U.S. by Cawley and Liu (2007) explore changes in the mother's allocation of time (when she starts working) to activities related to child diet and physical activity. They find that employed mothers spend significantly less time playing and eating together with their children than non-employed mothers. Moreover, employed mothers cook less and purchase more ready-made food.

Similar studies of the effect of mothers' time on child health do not exist in Denmark. However, one Danish time study shows that when the mother's time spent on paid work increases, time spent on housework (including preparing food, cleaning, shopping) and childcare (including active childcare, educating the child, playing with the child, accompanying the child to child-related activities) remains unchanged (Deding and Lausten, 2006).

Most of the economic literature on overweight children and maternal employment comes from the U.S. and Canada, where the increase in the fraction of children who are overweight has been relatively high compared to the rest of the world. North America has seen an increase in the labor market participation among women parallel to the increase in the fraction of overweight children. The economic literature on children's overweight status, apparently inspired by this observed correlation, hypothesizes that increased labor market participation leads to less time spent on the household (e.g. cooking, supervising the children, taking them to activities) and results in more time during which the children remain unsupervised by the parents (Anderson et al., 2003; Chia, 2006; Ruhm, forthcoming). The relevant literature consistently finds that an increase in maternal employment increases children's weight (Anderson et al., 2003; Ruhm, 2004; Liu et al., 2005; Fertig, 2006; Chia, 2006; Garcia et al., 2006; Courtemanche, 2007; Scholder, 2007; Zhu, 2007).

In Denmark, while the female employment rate has been high and constant since the 1980s the prevalence of overweight children has increased. In addition, from 1996 to 2002 the number of actual hours worked increased 13 percent among women (Statistics Denmark, 2003a), primarily because more women began to work full time as opposed to part time. Accompanying the relatively high female labor market participation rate in Denmark, there has been well-developed municipality-provided childcare. In 1999, 95 percent of all three-to-five-years-old children were in public childcare. An international study characterizes Danish daycare institutions as having highly educated personnel, few children per staff member, good facilities, and a larger share of the GDP (OECD, 2001a; Datta Gupta and Simonsen, 2007). This institutional framework is thought to create a stimulating environment in which children are not only supervised but also able to enhance their motoric development, language expression, and development of social skills.

This paper is the first to analyze the relationship between mothers' employment and children's overweight status in a structural framework in which most women participate in the labor market and in which mothers starting work after one year of maternal leave is the norm. Most importantly, this study analyzes the effect of maternal employment in an environment in which public childcare institutions are of relatively high quality. Consequently, whether the change in time mothers spend with their children is the cause of the increase in child weight becomes open to question.

To elucidate the effect of maternal employment on children's overweight status, I set up a theoretical model based on a child health production function. This theoretical model not only clarifies the interpretation of the parameters in the model but also explains the problem of failing to control for potential bias that may arise as a result of omitting unobserved characteristics of both mother and child. I use the instrumental variables technique to explore this potential bias in both mothers' employment and income. The results in this paper show that if a mother works more hours the child is *less* likely to be overweight. This result contradicts the results found in all existing relevant comparable literature.

I also test the importance of the type of replacement for non-maternal childcare, i.e. the quality of different types of public childcare. Subgroup analyses on formal (kindergarten) and informal daycare (family daycare) suggest that among children in informal daycare maternal employment has no effect on children's overweight status, whereas among children in formal daycare (kindergarten)—a type of daycare considered of higher quality than family daycare—maternal employment has a reducing effect on children's overweight status. This latter result suggests that what matters is the quality of daycare, and this explains in part why the Danish results differ from the result found previously in the literature.

The paper is organized as follows: Section 2 gives an overview of the previous literature. Section 3 presents the theoretical framework. Section 4 describes the Danish institutional setting, and Section 5 describes the data used to test the relation of maternal employment and children's overweight status. Section 6 describes the methodology. Section 7 shows the empirical results, and Sections 8 and 9 discuss and conclude.

2. Previous literature

Since 2003 there has been a growth in the economic literature on the relationship between children's overweight status and maternal employment. Table 1A presents an overview of the existing literature on this subject. These studies on maternal employment and children's overweight status contain the implicit assumption that the mother's decision to work outside home leads to several changes in the household, all of which may affect the weight of a child. First, the mother spends less time with her children, thereby reducing parental control over the child's intake and expenditure of energy. Second, as the mother has less time to buy and prepare food, she therefore she might serve more fast food, which is often considered less healthy than homemade "slow" food. Third, the mother increases the family income. The first two factors may lead to an increase in child weight, whereas higher income can lead both to more healthy living but also more eating out and to unhealthier eating.

All previous relevant studies (see table A1) look at different age groups and use different definitions of what is considered overweight and what is considered obese. These differences in definition to some extent explain the differences in the magnitude of the results. Furthermore, different studies use different sets of control variables and use different methods for identifying the relationship between child overweight status and maternal employment. Nonetheless, all the studies in Table A1 consistently show that when the mother starts working (more hours) her child is more likely to be overweight or obese.

2.1 Different measures on maternal employment

As a measure of maternal employment, most papers on the effect of maternal employment on children's overweight status use information on average work hours per week since the child's birth (Anderson et al., 2003; Ruhm, 2004 and forthcoming; Chia, 2006; Fertig et al., 2006; Phipps et al., 2006; Courtemanche, 2007). A few studies on cross-sectional data look at mothers' current work hours (Takahashi et al., 1999; Liu et al., 2005; Zhu, 2007), one paper looks at mothers' work time at different ages of the child (Scholder, 2007), and one paper examines mothers' current employment status (Garcia et al., 2006). As Section 4 will cover in detail, current employment is a less appropriate measure for maternal employment than a measure of work hours since the child's birth. Because children's weight status constitutes a stock of net calories consumed over lifetime, maternal employment over the child's lifetime will influence it.

2.2 Problems when estimating the relationship between maternal employment and children's overweight status

When estimating the causal effect of maternal employment on children's overweight status we have to take into account the problem of unobserved heterogeneity of both mothers and children. The details in the econometric problem when unobserved heterogeneity is present are discussed in

Section 4. At this stage we need to consider the scenario in which high-ability mothers work more hours and have more healthy children compared to low-ability mothers.[1] Failing to control for the unobserved ability among mothers gives us downward biased and inconsistent estimates in the relationship between children's overweight status and mothers' employment.

Previous studies have used different methods to overcome the problem of unobserved heterogeneity (see table A1); including a full range of observed characteristics (Anderson et al., 2003; Scholder, 2007; Courtemanche, 2007; Ruhm, forthcoming), (long difference) fixed effects (Anderson et al., 2003; Ruhm, 2004 and forthcoming; Scholder, 2007), sibling fixed effects (Anderson et al., 2003; Chia, 2006), average treatment effects (Ruhm, 2004 and forthcoming; Liu et al., 2005), and instrumental variables (Anderson et al., 2003; Garcia et al., 2006; Zhu, 2007).

In Anderson et al. (2003), Ruhm (forthcoming), and Scholder (2007) an extensive list of controls measures characteristics of both the child and the mother. For example Andersen et al. (2003) and Ruhm (forthcoming) include mothers' AFQT (Armed Forces Qualifications Test) score. In Scholder (2007) a Mundlak-like specification includes the mother's mean work status at all ages of the child. While including different measures for unobserved factors is important, testing whether a rich set of control variables eliminates all unobserved heterogeneity is impossible. For that reason most papers also try to identify the causal effect between maternal employment and children's overweight status through other econometric techniques.

A fixed effects approach is useful because it cancels out constant unobserved child characteristics that may be correlated with maternal employment. But several general problems arise in the use of a fixed effects approach. First, there may be unobserved variables that influence both the child's body weight and the mother's employment, and these unobserved variables may vary over time. Second, the presence of any measurement errors will bias fixed effects estimates. Third, a considerable number of observations may lack the relevant information for one of the years, leaving the sample with selection problems.

Anderson et al. (2003) estimate household fixed effects, using 4,471 children with siblings from the National Longitudinal Survey of Youth (NLSY). The use of sibling differences has the advantage of

[1] High-ability mothers may have more healthy children than low-ability mothers because they have more health knowledge (Kenkel, 1991) and are more efficient in producing good health (Grossman, 1972).

allowing us to examine the impact of mothers' employment while leaving out the unobserved household (or mother) fixed effects. That these household fixed effects are considerably important when the dependent variable is children's overweight status is plausible, as these effects include underlying shared lifestyle habits in the family. However, the use of sibling fixed effects does not eliminate the child fixed effect. If the mother makes time compensations depending on the child's unobserved abilities (child's preferences for food/exercise and genetic disposition to obesity), sibling fixed effects does not eliminate the endogeneity problem.

To solve the problem of omitted variable bias, Ruhm (2004) and Lui et al. (2005) estimate average treatment effects. The main drawback of the use of this method is the conditional independence assumption. The group of working mothers must be comparable to the control group of non(or less)-working mothers when we have controlled for all observed characteristics. Whether this assumption is fulfilled in this context is questionable.

The use of instrumental variables in identifying a relationship between two endogenous variables requires that three conditions hold; intuitive relevance (the effect is only identified by the compliers), exogeneity (the instrumental variable must be related to the endogenous control variable and only be related to the dependent variable through the control variable instrumented), and redundancy (identification requires more than one instrument). These conditions make finding a good and relevant instrument difficult.

Three studies use instrumental variables to estimate the effect of maternal employment on children's overweight status. These studies are Anderson et al. (2003), Garcia et al. (2006), and Zhu (2007). Anderson et al. (2003) use the local unemployment rate, childcare regulations, wages of childcare workers, welfare benefit levels, and the status of welfare reform in each state as instruments for the mother's average hours per week and average weeks per year from the child's birth. However, the results from the first stage regression reveal that the power of this instrument is rather weak as regards the cumulated measure for hours per week. Garcia et al. (2006) use mother's civil status, mother's age, number of children and the age of youngest child in household to identify causal effects in a probit model. While first stage results and tests of over-identifying restrictions are not shown, these three variables are family-related variables that may be correlated with children's weight status. Thus, these instruments do not fulfill the conditions for suitable instruments.

Zhu (2007) uses "if the mother is a native English speaker" and "if the mother did volunteer work" as instrumental variables in the first part of the paper. However, whether these variables are good instruments, even though they fulfill the requirements for formal tests in the first stage, is questionable. Mothers who are not native English speakers may differ from those who are, in the sense that knowledge regarding child health may more easily be required from native English speakers or be related to unobserved factors that influence child weight. Doing voluntary work is a choice of the mother, a choice that cannot be separated from the mother's choice of working hours.

The estimation of the relationship between maternal employment and children's overweight status is also complicated by the mother's selection into the labor market. When different unobservable variables motivate the mother to participate in the labor market and to work an extra hour, sample selection is a potential problem. However, women who do not work may have different reasons for their choice than do women who choose between part-time and full-time employment. In the relevant literature discussed so far, only one article (Zhu, 2007) deals with the problem of mothers selecting into the labor market, with the use of a mixture model. However, when Ruhm (forthcoming) and Anderson et al. (2003) use the mother's cumulated hours of work over the child's life, sample selection is a minor problem as almost all women worked at some point in time during the child's life (in Ruhm, forthcoming, 93 percent of mothers work at some point). Both Anderson et al. (2003) and Ruhm (forthcoming) leave mothers with zero working hours out of the sample, whereas e.g. Phipps et al.(2006), for example, include mothers with zero working hours.

3. Theoretical framework

The standard framework for looking at child health outcomes, such as being overweight or obese, is a child health production function (see Ruhm, 2004; Scholder, 2007; Davis and You, 2007). The model presented here draws from a model on child cognitive development (Bernal and Keane, 2007).

An important aspect of the child health production function is that a child's health at a given time, t, is a product of a cumulative health process since birth, t=0. Those responsible for the child (most likely parents and those responsible for the child in different types of non-parental childcare) are also those responsible for this cumulative health process.

Let H_{it} be child i's health stock t periods after birth. The child health production function can be written by:

(1) $$H_{it} = H\left(\widetilde{T}_{it}, \widetilde{C}_{it}, \widetilde{G}_{it}, \omega_i\right)$$

In equation (1) $\tilde{T}$ is maternal time input in each period, $\tilde{C}$ is day-care time input, $\tilde{G}$ is goods, such as healthy food and a membership in a sports club, which enhance the child's health, and ω_i is child i's endowments, which include both genetic, prenatal and environmental factors.

Several difficulties arise estimating the child production function. The first problem is it requires a huge number of parameters when we want to estimate equation (1) (e.g. if different inputs at different ages have a different impact on the child's health). Thus we will need to simplify the variables and look only at cumulative variables of the input, such as the cumulative maternal time over the child's life, and assume that the effect of the unobserved genetic part, ω_i, is constant over time.[2]

The second fundamental problem in estimating the child production function is that inputs in the production function are not directly observable. The key variable in this model is the mother's time without her child. In most studies the actual time the mother spends with and without her child is unobserved, with the common assumption that maternal time spent on non-working activities is spent on childcare. Moreover, goods input, G, are not directly observed. Collecting information on all important goods, such as input in the child health production function is difficult. For that reason studies often use family income as a proxy variable. However, a general problem with the use of proxy variables is that interpreting them is not easy. A thorough discussion of the variables and their interpretation is therefore necessary when one estimates a child production function.

[2] The child's endowment, ω, could also vary over time. In that case the child's endowment depends on both time and impact of environmental factors at different ages. In this paper I choose to simplify the model and assume that the child's endowment is constant over time thereby focusing on the effect and interpretation of maternal employment.

The third problem when estimating the child health production function is the issue of selection and endogeneity. This problem will be clarified later in this section.

Having in mind all these necessary precautions the child health production function can be written as:

(2) $$H_{it} = \alpha_0 + \alpha_1 \hat{T}_{it} + \alpha_2 \hat{C}_{it} + \alpha_3 \ln \hat{G}_{it} + \omega_i$$

In equation (2) T_{it} , C_{it} and G_{it} with circumflexes are the cumulative input from t=0 until t, e.g. $\hat{C}_{it}= \Sigma_{\tau=1,t}\hat{C}_{it}$. Thus the child's health at time t is a linear and additive function of cumulative maternal time, cumulative time in childcare, cumulative goods, measured in log form, and a constant child endowment.

Mothers' time can be used for activities without the child (work and leisure), on housework while e.g. the child is playing by itself or watching television, or quality time with the child. In this model I assume that the child spends time either with its mother or in childcare, and that time spent with the mother is on average of a certain quality. If T is the total time within a period we then have:

(3) $$T = T_{it} + C_{it}$$

Furthermore, because I do not have information on mothers' leisure (or time spent without the child) I assume that when the child is in childcare the mother is at work, $C_{it} = W_{it}$.
Substituting (3) into (2) and W_{it} into C_{it} gives the following equation:

(4) $$H_{it} = \alpha_0 + (\alpha_2 - \alpha_1)\hat{W}_{it} + \alpha_1 T \cdot t + \alpha_3 \ln \hat{G}_{it} + \omega_i$$

Equation (4) shows that the estimated parameter on mothers' working time is measured relative to mothers' time with the child.

As I do not have exhaustive information on goods spent on child health, I follow Bernal and Keane (2006) and include a conditional demand function in the production function. The conditional demand for goods originates from an optimization process where the mother in the first stage chooses time spent on the child and time spent on work, and in the second stage chooses goods, G. The conditional demand function for goods can be written as:

(5) $$\ln \hat{G}_{it} = \gamma_0 + \gamma_1 E_i + \gamma_2 \hat{\omega}_i + \gamma_3 \hat{C}_{it} + \gamma_4 \ln \hat{I}(W,S) + \gamma_5 t + \varepsilon_{it}^{g}$$

Given that the mother has decided how to allocate time with and without the child, equation (5) shows that goods she buys for child health depend on this maternal decision. Whereas time in childcare, C_{it}, and income, I_{it}, affect the demand function linearly, income depends on working hours and social income when not working, S.

The demand for child health goods depends on mothers' education, E, which in the Grossman model (Grossman, 1972) also plays a significant role in producing health. An indicator for the child's endowment, ω, also enters the conditional demand function for child health goods. Two opposite factors determine the parameter for this variable. On the one hand, a child born with some health problems (or a genetic higher disposal for obesity) may induce the mother to demand more healthy products as a compensatory mechanism. On the other hand, healthy children may demand more healthy goods (e.g. children good at sports may spend time at a lot of different sports clubs). The time trend, t, captures the growth of cumulative input over time, and the error term, ε, captures the mother's idiosyncratic tastes for investment in goods enhancing child health.

Substituting W_{it} into C_{it} and (5) into (4) yields the following equation:

(6) $$H_{it} = (\alpha_0 + \alpha_3\gamma_0) + (\alpha_2 - \alpha_1 + \alpha_3\gamma_3)\hat{W}_{it} + (\alpha_1 T + \alpha_3\gamma_5)t + \alpha_3\gamma_4 \ln \hat{I}_{it} + \alpha_3\gamma_1 E_{it} + (1 + \alpha_3\gamma_2)\omega_i + \alpha_3\varepsilon^g_{it}$$

(7) $$H_{it} = \varphi_0 + \varphi_1\hat{W}_{it} + \varphi_3 t + \varphi_4 \ln \hat{I} + \varphi_5 E_{it} + \varphi_6 Z_{it} + \varphi_7\omega_i + \varphi_8\varepsilon^g_{it}$$

Equation (6) is the structural model for child health. However, the model I estimate is the reduced form model in equation (7). Equation (7) shows that the effect of maternal employment that is estimated is φ_1. This effect includes the effect of the mother's time at work (α_2) relative to the effect of the child's time with the mother (α_1) plus the effect of any change in goods inputs that the mother may choose as a result of being away from the child (α_3*γ_3).

It seems fair to assume that mothers' time with their children has a non-negative effect on child health, $\alpha_1 \geq 0$. The demand for goods when the mother is away from the child (α_3*γ_3) can be both positive and negative. Descriptive results on the relationship between maternal hours worked when the child is 7½ years old and a list of variables indicating health input (whether the child exercises, eats healthily etc.) do not show a clear relationship in this regards (these results are available upon request). For that reason I will assume that $\alpha_3*\gamma_3$ is small and approximately zero in Denmark.

Maternal working hours will then have a positive effect on child health only if the effect of maternal time away from the child—when the mother is at work and the child in childcare—is larger than the effect of maternal time with the child, $\alpha_2>\alpha_1$. If regulations in non-parental childcare restrict the child's options for unhealthy food and physically inactive activities, such as playing computer games and watching television, then the positive impact of time in non-maternal childcare might exceed the positive impact of time in mother's care.

In equation (7) child health also depends on income. Income depends on wages, hours worked, and non-working income. As working hours also enter the income variable, income is potentially endogenous.

In equation (8) Z is a vector of known characteristics of the mother and the child characteristics, that are correlated with the child's health endowment, such as information on birth weight, breast feeding, parents' height and weight, etc. The terms ω_i and ε_i are some (unobserved) characteristics of the child and mother. Both the term ω_i, which reflects some unobserved genetic endowments, and ε_i, the idiosyncratic taste for investment in goods enhancing child health, may correlate with the mother's choice of working hours. These correlations invalidate the use of ordinary least squares (OLS), when ω_i and ε_i are unobserved, and bias the estimate of the mother's working hours. Section 5, presents the empirical strategy I use to handle the problems resulting from this sort of endogeneity.

4. The institutional setting in Denmark

The relationship between maternal employment and children's overweight status is likely to be influenced by the institutional setting in the country under review. In Denmark two institutional factors related to maternal employment and child health are important: female labor market participation and childcare facilities. This section briefly describes these factors.

Female labor market participation in Denmark is known to be one of the highest among the OECD countries (OECD, 2001b). From 1989 through present—during which period medical research has identified a significant increase in childhood weight problems in most developed counties, including Denmark—75 percent of all women in Denmark participated in the labor market.

In Denmark more than 80 percent of women in families with a child under the age of 6 are employed (OECD, 2001b). International comparisons show that in Denmark the average time spent at work does not differ between women with children above and below 7 years of age (Lausten and Sjørup, 2003). This result is very different from the other countries in the comparative study (Norway, Great Britain, Hungary, Finland, France, and Holland), where women with children below 7 years of age work significantly less than women with children at or above 7 years of age. The high labor market participation rate among Danish mothers with young children has been possible primarily because of corresponding welfare policies related to childcare. Among children aged 3-5, 94 percent are covered by public daycare institutions that are highly subsidized, i.e., parents' contribution does not exceed 30-33 percent of the actual costs (Ministry of Social Affairs, 2000).

According to Datta Gupta et al. (2008) the quality of childcare in Denmark is relatively high compared to most other OECD countries. In Denmark 2.7 percent of GDP is spent on publicly provided childcare and the average staff-to-child ratio in public provided childcare institutions is 1:6 in kindergarten (which is only for children aged 3-6) and 1:3 in day nursery for children aged 0-3. [3] In most other OECD countries less than 1 percent of GDP is spent on childcare and staff-to-child ratios are 1:10 in kindergarten. Furthermore, childcare coverage and requirements of qualifications of childcare staff in Denmark are far above the OECD level (see Datta Gupta and Simonsen, 2007, on the quality of daycare in Denmark compared to other OECD countries).

In Denmark, although the Law of Service (*Serviceloven*) places the overall responsibility of supply and supervision of daycare on the municipalities, it establishes guidelines for such things as educational activities and opportunities for playing and having food served. Two types of childcare exist for children in the age group 0 to 5: municipal caregiver arrangements (family daycare) and institutional childcare facilities (day nursery and kindergarten). The Law of Service requires

[3] Private daycare exists, but only 1 percent of all children enrolled in daycare are enrolled in private daycare (OECD, 2001).

municipalities to monitor family daycare, day nursery, and kindergarten for factors such as playgrounds safety, sleeping facilities, hygiene, and staff qualifications.

Family daycare most often takes place in private homes. The children are cared for in the caregiver's home together with up to 4 other children and the caregiver's own children. Most often the caregiver has no training in educational approaches or techniques (Datta Gupta and Simonsen, 2007). In some rural municipalities, caregiver arrangements and private childcare are the only childcare facilities that the local authorities offer for children under the age of 2-3.

In 1999 family daycare covered 41 percent of all children aged 0-2, whereas day nursery only covered 10 percent. In day nursery there are on average 3.2 children per staff member often including educated kitchen staff. When the children turn 3 they go to kindergarten. The Law of Service requires permanent staff in day nursery and kindergarten to have a formal education in pedagogy (in Denmark this means a bachelor's degree in social education and social work).

Kindergarten is the most common type of childcare for children aged 3-6. On average there are 6 children per staff member. At age 4 most children have left family daycare and day nursery, and are enrolled in kindergarten.

Daycare facilities for children aged 0 to 3, day nursery and family daycare usually serve food. In day nursery a kitchen worker serves the food, whereas in family daycare the care giver has to cook while taking care of the children. Kindergartens do not usually provide food. In 86 percent of all kindergartens children bring their own food. No formal regulations on food exist for public daycare. However, 50 percent of all kindergartens have a written food policy, and an analysis of daily food in Danish kindergartens finds that the food children bring is generally nutritionally balanced (Sørensen, 2004).

5. Data and descriptive statistics

5.1. Data

The data I use to investigate the relationship between children's overweight status and maternal employment is a combination of survey and register data. The survey data, which provides information on the child's height, weight and early childhood characteristics, is the Danish Longitudinal Survey of Children (DALSC), a nationally representative longitudinal survey of 6,011 children born between 15 September and 31 October 1995. The first interview took place in spring 1996, when the children were approximately 6 months old (5,428 mothers, i.e., 90 percent participated).[4] The second interview took place in spring 1999, when the children were approximately 3½ years old (5,288 mothers participated), and the third interview in spring 2003, when the children were approximately 7½ years old (4,971 mothers, i.e., 83 percent, participated).

Administrative register data from 1995 to 2002 have been merged with DALSC for the whole sample of 6,011 observations. The administrative registers include information on socio-demographic variables, education, public transfers, income, employment history, and birth weight, making possible a thorough study of attrition in the sample. Inspection of the attrition rate unfortunately shows that compared to the full sample of 6,011 children, families with low socioeconomic status are under-represented in the 2003 sample.

To investigate the effect of maternal employment on children's overweight status, I selected a sample of mothers of DALSC. Only cases where the biological mother is present in the household are included in this study. Children who live with their father, as well as adopted children, are left out of the sample. Of all the children in the 2003 survey, 98 percent live with their biological mother.

Mothers undergoing training have been left out of the sample. Technically full-time study may leave them just as much time with a child as full-time work. But because the exact amount of hours spent on studying is uncertain and because many students also work part-time, mothers who were in a formal education program in one or more of the relevant years have been left out of the sample (this information is available from the register data). The mothers interviewed in 2003 are aged 16 to 46 in 1996, and many of them are still in education between 1996 and 2003 (895 observations). Although leaving these mothers out of the sample is advisable, as I want to estimate the impact of maternal time away from the child, a legitimate concern may be that leaving out approximately 20 percent of the mothers for reasons of training and education results in a selected sample of relatively

[4] Although primarily the mother was interviewed, in a few cases the father answered the questionnaire if the mother was not available.

older mothers. However a simple t-test of the mean age with and without those in education shows no significant difference in age.[5]

Selection into the labor market may be an important factor in analyzing the impact of mothers' working hours on child overweight status. However, this issue is of lesser importance in Denmark because 80 percent of the women participate in the labor market. Furthermore, all children in Denmark are eligible for public childcare, including children of unemployed mothers and of mothers not in the labor force[6] and 94 percent of all children go to public childcare (see section 4). As the group of non-working mothers consists not only of homemakers, but also of disabled or temporarily unemployed women, and as the number of daily hours this group spends with their children is uncertain, interpretation of the effect on child obesity for this group is complicated. In this paper I have thus left out mothers who report no working hours. Depending on the measure for maternal working hours, the number of observations left out differs (see section 5.3 for a discussion of the various measures for mothers working hours).[7]

Survey data often suffer from the problem of missing variables. Clearly, a measure of mothers' working hours over longer periods may suffer from missing observations in one or more of the years. In this study I can use the register data to complete the work history of the mothers, because it gives information on all public transfers each month. If a mother in the survey has missing information on working hours, her working hours are set to zero if she receives a public income transfer in all 12 months during that year.[8] I therefore reduce the number of missing observations on mothers' self reported working hours in 1999 to 59. In section 5.3 I discuss the use of a register-based variable of actual hours working 1997-2002.

If a mother does not work November 1999 or is self-employed, there is no information on the industry code. Therefore 21 mothers with no industry code are left out of the sample, leaving 3,530 observations in the main estimations.

[5] Mean age in the sample rises from 29.37 to 29.73 when the mothers in education are left out of the sample. The difference is tested with a t-test (t value=3.7) and found insignificant (p value=0.0002).
[6] Only if one of the parents is on a formal public-supported child leave, the child in question cannot occupy a spot in the public childcare system.
[7] When a measure on average hours worked in 1999 is used, 413 observations report no working hours. Furthermore, two observations report a very high number of average weekly working hours. These two observations are also left out of the analysis.
[8] Only public income transfers where the mother is not working are included, i.e., if a mother receives unemployment benefit, but is in an active labour market program, she will not be characterized as not working.

Among the 3,530 interviewees that responded to the questionnaire in 2003 and that I selected for this study, 293 (8 percent) did not report height and weight for the children. This data selection is described and tested in section 7.1.

The survey data includes some important questions on early childhood characteristics that a significant number of the mothers do not answer. For dummy variables, such as if the child was breastfed, missing observations are assigned to the omitted category. If the dummy variable for such missing information is insignificant, non-responders' outcome is affected in the same way as the responders' and including the dummy for missing information has increased the sample size without biasing results. If the dummy variable for missing information is significant, then the variable affects responders and non-responders in different ways. Including the dummy variable for missing observations now allows us to estimate the effect of the variable (e.g., if the child was breastfed) with unbiased estimates but only for the group of responders.

5.2 How many children are overweight in Denmark?

Compared to the U.S. the number of overweight children in Denmark is relatively low. According to Lissau et al. (2004), among the 13-year-old Danish boys and girls, 10 and 12 percent, respectively, were defined as being overweight in 1999.[9] With similar definition methods, 26 and 27 percent of American boys and girls, respectively, were defined as being overweight in the U.S. in 1999. Still, while Sanz-de-Galdeano (2005) shows that Denmark ranks among the two least obese countries in Europe for men and women aged 45 or older, she finds that among younger people (i.e., 15-29 years old), Denmark has one of the largest fractions of obese (a BMI above 30) compared to other EU countries. Furthermore, Ekholm et al. (2006) finds that recent development in obesity rates among the younger population in Denmark has shown an increasing trend. Among the 16-24-year-old in Denmark the obesity rate has increased from 1 to 5 percent from 1987 to 2005.

---

[9] In the U.S. the term "overweight" is used for children with a BMI at or above the 95th centile. The term "risk of overweight" is used for children with a BMI between the 85th and 95th centile. In Europe the term "obese" is used for children with a BMI at or above the 95th centile while the term "overweight" is used for children with a BMI between the 85th and 95th centile. This paper uses the European terms.

Although the general picture in the U.S., Europe, and Denmark shows an increasing trend in the fraction of overweight children (Flodmark et al., 2004; Lissau et al., 2004) the exact number of affected children for each country varies depending on the definitions and measurements of weight increases. Most social research uses the body mass index (BMI, weight in kilograms divided by the square of height in meters) to measure overweightness and obesity. But BMI has limitations, as it does not distinguish between body fat and muscles, and BMI can therefore only be used as a proxy measurement for body fat.[10] Furthermore many studies rely on self-reported weight and height numbers that may include measurement errors compared to objective measures of height and weight.

Quite clear cutoff points exist on BMI values for overweight and obese adults. When BMI is above 30, an adult is categorized as being obese. When BMI is between 25 and 30, an adult is categorized as being overweight. The categorization into BMI above 25 and 30 rely on medical research showing that these thresholds correlate with certain lifestyle diseases. Similar thresholds in BMI for being overweight and obese do not exist for children. First, children have fewer diseases related to being overweight than adults. Second, constant changes in body composition during growth mean that the weight-for-height during childhood depends on gender, age, ethnicity, and of maturation state. Because of gender differences in maturation state, the BMI for children is plotted on gender-specific growth charts. Each gender specific growth chart contains a series of curved lines indicating specific percentiles. The Danish growth chart appears in Figure A1 and A2.[11]

Several different growth charts exist. The growth chart in Denmark is based on approximately 35,000 children aged 0-21 (Nysom et al., 2001). To produce the Danish growth chart, Nysom et al. (2001) used five different samples of children with measured height and weight from 1965-1994. For international comparisons, the International Task Force on Child Obesity (IOTF) has published a paper with a growth chart based on measured height and weight of children aged 0-25 from two European countries (UK and the Nederlands), two Asian countries (Hong Kong and Singapore), Brazil, and the U.S. (Cole et al., 2000). The times that these datasets span vary from 1963-1980 (the

[10] Obesity can be identified by other anthropometric measures, such as skin-fold and waist circumference, but these measures are not available in data.

[11] For children, BMI increases from birth until age 1. Then BMI decreases until age 3-7. After a certain point between ages 3-7, BMI starts to increase again. The second dip in the growth curve is called the adiposity rebound (AR). An early AR is known in the medical literature to predict later childhood obesity (Whitaker et al., 1998). In the data in this paper, only about 1000 out of all observations report height and weight for the children in all years. Therefore, looking more closely into AR as a child obesity measure has not been possible.

U.S.) to only one year 1993 (Singapore and Hong Kong). Because different growth charts are in use in the literature, many different cut-off points for identifying the overweight children for different age and gender groups have been drawn (see e.g. Flodmark et al. 2004 for an illustrative description). Still, cut-off points for each age and gender group are drawn such that children with a BMI above the threshold for being overweight are more likely to be overweight when they grow up than children below this threshold.

In this study I look at different measures for being overweight among children aged 7½ in 2003, all based on mothers' reported height and weight of their children. First, I use a binary indicator for a BMI above the 97^{th} percentile at age 7½ in the Danish growth chart. The cut-off points are 18.5 for boys and 19.2 for girls. Second, I use a binary indicator for BMI above the 85^{th} percentile at age 7½ in the international growth chart (Cole et al., 2000). These cut-off points are 18.16 for boys and 18.03 for girls. To examine the sensitivity of the threshold in BMI, I show quantile regressions.

Figure A3 depicts BMI densities for girls and boys in the sample. This figure shows that the density for boys and girls is very similar, thus justifying pooling these two groups, but with gender-specific cut-offs.

5.3 Measures of Maternal employment

Previous literature on the relationship between maternal employment and children's overweight status has looked at both current and accumulated employment as a measure for mothers' working status. In this paper I look at two different measures:

First, I look at mother's working hours in 1999, when the child is 3½ years old. This information exists for almost everyone in the sample. The average weekly working hours for mothers with a child at 3½ years can indicate the impact of the parent's workload. Nonetheless, this measure is a timing effect, and not a cumulated measure of maternal working hours, as prescribed in the theoretical model.

Second, following the theoretical model, I use information from the Danish registers on actual hours worked from 1997 to 2002 a measure of the mother's cumulated hours away from her child.[12] The measure on actual hours worked during all years is very precise, as firms in Denmark are obliged to report the number of hours each employee work every year.[13] However, several exceptions exist. Larger firms within the agriculture and fishing industries can avoid reporting working hours for their employees, and no firm has to report working hours for apprentices, people in active labour market programs, and people in special jobs, i.e. sheltered employment and vocational training. Firms with fewer than 10 employees have the option of not reporting working hours for their employees. As Denmark has many small firms (87% have fewer than 10 employees and 36 percent of all employees are employed in firms with fewer than 10 employees), this option creates a lot of missing information for this variable. For that reason, the results based on this variable appear in the appendix.

5.4 Descriptive statistics

Table A2 contains a detailed description of the variables used. Table 1 contains the main descriptive statistics of these variables.

When I use the cut-off points based on the 97th percentile in the Danish growth chart, 8 percent of the children are categorized as overweight.[14] When I use the cut-off point based on international standards, 11 percent of the children are categorized as overweight.

On average the mothers in the sample work 35 hours a week when the children are 3½ years old. Forty percent of the mothers work part-time, which is defined as working fewer than 37 hours a week. The average age of the mothers at the children's birth is 29.9. The average age among all mothers giving birth in Denmark in 1997 was 29.4 (Statistics Denmark, 2003b). Only 5 percent of the mothers live alone with the child when the child is 3½ years old.

---

[12] Unfortunately, actual hours of work have only been registered from 1997 and on.

[13] Firms that refuse to report working hours will be fined.

[14] Notice that the cut-off point based on the 97th percentile in the Danish growth chart is benchmarked for a reference group population at a specific time (1965-1994), suggesting that more than 3 percent of the children measured in 2003 lie above this threshold.

Table 1: Mean statistics. Mean and standard deviance (std. dev.). N=3,237.

	Mean	Std. dev.
Child overweight (DK)	0.08	0.26
Child overweight (INT)	0.11	0.32
Hours 1999 (in units of 10)	3.49	0.63
Cum. hours 1997-2002 (in units of 100)	44.66	31.55
Girl	0.48	0.50
Low birth weight	0.04	0.20
High birth weight	0.04	0.19
Breastfed	0.92	0.27
Mis. Breastfeeding	0.04	0.20
Mother smoked	0.20	0.40
Mis. Mother smoked	0.14	0.35
Mother’s age	29.88	4.32
Siblings	1.27	0.74
Younger siblings	0.60	0.49
Lone mother	0.05	0.23
Basic schooling	0.22	0.42
Vocational training	0.53	0.50
Further education	0.24	0.43
Metropolitan	0.31	0.46
Urban	0.34	0.47
Rural	0.35	0.48
Mother’s mental health	0.11	0.31
Mother obese	0.06	0.24
Mother overweight 2003	0.18	0.39
Mis. Mother’s BMI	0.18	0.38
Father obese 2003	0.06	0.24
Father overweight	0.34	0.47
Mis. Father’s BMI	0.24	0.43
Income (in units of 1000)	5.08	0.23
Home	0.06	0.24
Family daycare	0.20	0.40
Kindergarten	0.74	0.44
Part time	0.40	0.49
Full time	0.45	0.50
Over time	0.15	0.36

Unfortunately, a significant number of the parents in the survey do not give information on their height and weight, possibly explaining why only 6 percent of the fathers and mothers are categorized as obese and 18 (24) percent of the mothers (fathers) are categorized as overweight. Data from the OECD health data base shows that in 2000 9 (10) percent of all adult women (men) are categorized as obese, and that 25 (40) percent of all women (men) are categorized as overweight. These figures indicate that to few fathers and mothers in the sample are categorized as being overweight or obese due to missing information.

At the age of 3½, 6 percent of the children are cared for at home (either by relatives, friends or parents), 20 percent of the children are in family daycare, and 74 percent of the children are in kindergarten.

Table A3 shows some descriptive differences on overweight and healthy weight children. These descriptive results show that overweight and healthy weight children differ for early childhood characteristics, such as their birth weight, whether they were breastfed, and whether their mother smoked during pregnancy, and the father's and mother's BMI. Furthermore, mothers of overweight children tend to have lower education, live in rural areas, and have lower income compared to mothers of healthy weight children.

6. Methodology

The outcome I investigate in this paper is whether or not the child in DALSC was overweight. I use probit models and linear probability models (LPM) to estimate equation (7) (see section 3), but with reversed expected signs of equation (7), as being overweight can be seen as a reversed health outcome. I use cross-section setup to identify the effect of mothers' employment on children's overweight status, i.e., I use mothers' average hourly wages in 1999 to explain weight problems among 7½ year old children in 2003. In addition I test a cumulative measure of maternal hours worked (from 1997 to 2002), as suggested in the theoretical model.

Since maternal employment is potentially related to the unobserved components in equation (7), I use instrumental variables methods to test for endogeneity. A good instrument needs to be both valid and relevant. To control for exogeneity, the instrument variable needs to fulfill two requirements: First, the variable has to be exogenous to mother's working hours and, second the variable has to be uncorrelated with the child's weight-for-height.

In this paper I use the average hours of work among women in each industry (37 categories) as an instrumental variable for mothers' working hours.[15] The information on average hours worked in each industry comes from the Danish Labor Force Survey 2002. First, I examine the relationship between the instrument and mothers' working hours. The average hours of work in each industry is likely to be a good instrument, as there is variation in labor demand conditions and therefore in working hours between industries, and the variation is positively correlated with the average working hours for mothers in the sample. Correlation between the instrument and mothers' working hours are tested in a first-stage regression.

Next, I examine the relationship between the instrument and child overweight status in 2003. However, with only one instrument the exclusion restriction cannot be tested and the validity of the instruments therefore relies on pure argumentation. In equation (7) two omitted factors were found included in the error term: the unobserved characteristics of the child and a measure of the mother's taste for investment in child health. The average hours of work among women in each industry reflects some structural norms regarding working hours and demands in different industries; therefore assuming that this variable is uncorrelated with the individual child's overweight status or the error term in the structural equation makes sense. However, mothers who work in the health care sector may have more health knowledge and work longer hours, and these factors may be correlated with the omitted variables. I have therefore tested whether leaving out mothers working in the health care sector changes the results.

In addition, I test the income variable for potential endogeneity. The income measure I use is an average of family disposal income from 1998 to 2002.[16] The instrument I use to test the exogeneity of income is information on local taxes in each of the 271municipalities.

Analysis on cross-section data often raises the question of heteroscedasticity. To handle this problem, I estimate all models with robust standard errors. The 2SLS estimation has been tested for heteroscedasticity, which does not affect the consistency of the IV estimates but produces

[15] Industries are grouped in to 27-digit NACE-classes. But some industries, in particular within the public sector where 70 percent of all Danish women work, follow the 111-digit NACE-classification.

[16] The theoretical model prescribes a cumulated income measure. However, this variable is not available. The measure of disposal income comes from the register data. A problem with this variable is that self-employed people may report a negative disposal income if, e.g., their business had a large deficit one year. Thus, I define self-employed parents' income as missing if they are self employed and had a negative income, i.e., that year's income for the self-employed father or mother does not count in the average income measure.

inconsistent standard errors that may affect the test for endogeneity (Baum et al., 2003). Therefore, I have tested for heteroscedasticity in the IV estimation with the use of the Pagan and Hall test and choose to use the IV-GMM estimator.[17]

7. Results

7.1 Estimation results of the baseline specification

Table 2, columns 1 and 3, shows the results obtained from an estimation of equation (7) where income is left out. Both the LPM and the probit model indicate that a child is less likely to be overweight if its mother works more hours.[18] This result contradicts results previously found in the relevant literature (see table A1). The marginal effect in the probit model for an average mother and child shows that an increase from 27 hours work per week to 37 hours work per week (full time) reduces by 2 percent the likelihood of a child's being overweight.[19]

In the theoretical model income might be endogenous because it depends on mothers' working hours and wages (see section 4). In Table 2, columns 2 and 4, income is included in the LPM and the probit model. On the one hand, controlling for income in the relationship between parental hours worked and children's weight problems is important, because, given the same amount of working hours, parents with higher income can, say, buy more healthy food or hire a nanny to take the children to sports events. On the other hand, as more hours worked means higher income, these two variables may be highly correlated. When income is included in the model the reducing effect of maternal working hours on child overweight status becomes less significant. As expected, a child is less likely to be overweight if the family income increases.

To control for endogeneity I apply the method of instrumental variables to equation (7). Unfortunately, with the data available, controlling for simultaneous endogeneity in mothers' working hours and income is not possible, because controlling for simultaneous endogeneity requires at least two instrumental variables that are strongly correlated with both endogeneous

[17] The Pagan-Hall test statistic is 132 and this high value clearly rejects the hypothesis of constant variance.
[18] The negative relationship between maternal working hours and children overweight status holds when I include the group of mothers in education, but the result becomes insignificant.
[19] The characteristics for an average mother and child are: the child is a boy, breastfed with normal birth weight and one younger sibling. The mother is 30 years old, living in a couple, normal body weight, her highest education is vocational training, and she is living in rural area. Father is overweight.

variables and exogenous to the error term. Although I tested several different instrumental variables none of them had enough power to instrument both endogeneous variables simultaneously.[20] However, each endogenous variable has a single strong instrument. For that reason I test each endogenous variable stepwise.

Table A7, column 1, shows the results from the first stage regression. In this regression the potential endogenous variables, mothers working hours in 1999 and income are regressed against the instrumental variable and other exogenous variables. The linkage between average working hours in each industry and the mother's workings hours is positive, as expected. The linkage between local tax rate and income is negative. Both instruments are highly significant and have a t-statistic at 4.6 and 6.2, both exceeding the suggested threshold for power (Staiger and Stock, 1997).

Table 3, column 1 and 3, shows mothers' working hours tested for endogeneity with an IV-GMM model and an IVPROBIT model. The parameter on mothers' working hours in both the IVPROBIT and the IV-GMM model when hours are treated as endogenous is positive but insignificant. The parameter on maternal working hours has been tested with a Davidson and MacKinnon test in the linear model and a Wald test in an IVPROBIT model. Both tests clearly reject the hypothesis that maternal working hours are endogenous in equation (7); therefore, the LPM or regular probit model estimates should be used, as they are likely to have smaller standard errors.[21, 22]

Table 3, column 2 and 4, shows income tested for endogeneity with the assumption that mothers' hours of work is exogenous. The IV-GMM results show that the parameter estimate on mothers' working hours does not change from those in Table 2, when I control for endogeneity in income. Furthermore, the Wald test and Davidson-McKinnon tests clearly show that I can reject income being endogenous.

---

[20] Several instrumental variables have been tested (e.g. information on local unemployment and a cut-off point in the income distribution in each municipality). However, the Hansen test, which is used to test the over-identifying restriction in GMM, rejects the orthogonality conditions at 10 percent, regardless of how the instruments are included in the model.

[21] The result in Table 3, column 1 and 3 has also been tested with income included, and these results are virtually the same.

[22] To obtain the coefficient estimates in the IVPROBIT model, I used Newey's efficient two-step estimator. The coefficients of the two-step estimation are not directly comparable to the probit estimates.

To test whether mothers' work in the health sectors obfuscates the results (because mothers working in this sector often have notably longer working hours but also and a health knowledge that may be correlated with the mothers' idiosyncratic taste for child health), I have left out mothers working in the health care sector. The results do not differ from the results shown in Table 2 and 3 (these results are available upon request).

Several prenatal and birth variables are relevant in analyzing overweight children (see table 2). If the mother smoked during pregnancy or if the child had high birth weight, either factor increases the probability of the child's being obese. This result is consistent with results found in relevant medical research (von Kries et al., 2002). Parents' body weight also has a significant influence on child overweight status. The positive association between the parents' and the child's body weight denotes not only a genetic component, as obesity is genetically inherited (Comuzzie and Allison, 1998), but also family habits and lifestyle. Indeed, parents' BMI might be endogenous if for example families with mothers working full time eat more fast food and high calorie-dense food—and thus have higher body weight—than families with mothers working part-time. When I omit the variables on parents' BMI, the parameter estimate on hours worked by the mothers does not differ from the comparable results in Table 2. However, when I leave out information on parents' BMI, the explanatory power of the model is reduced (these additional results are available upon request).

If the mother had a mental problem when the child was aged 3½—an indicator for mothers' unobserved abilities—this factor increases the likelihood of the child's being overweight; however the parameter estimate is insignificant at 10 percent. Mothers' education is negative, but insignificant, related to the probability that her child is overweight. However, a subgroup analysis by education group shows that while mothers' working hours have no effect for mothers with basic education, they have a reducing effect on the children's overweight status among mothers with vocational and further education. These results are also available upon request.

Table 2: The impact of mothers' working hours on whether or not the child is overweight (DK definition), coefficients, robust standard errors in parentheses, N=3,237.

	1 LPM	2 LPM (+income)	3 PROBIT	4 PROBIT (+income)
Hours 1999 (in units of 10)	-0.014 (0.007)**	-0.013 (0.007)*	-0.105 (0.049)**	-0.094 (0.049)*
Girl	-0.041(0.009)***	-0.041(0.009)***	-0.321(0.070)***	-0.321 (0.070)***
Low birth weight	-0.044 (0.019)**	-0.045 (0.019)**	-0.366 (0.219)*	-0.369 (0.220)*
High birth weight	0.088 (0.034)***	0.088 (0.034)***	0.493 (0.145)***	0.486 (0.144)***
Breastfed	-0.008 (0.027)	-0.006 (0.027)	-0.025 (0.170)	-0.019 (0.172)
Miss. Breastfeeding	0.029 (0.038)	0.027 (0.038)	0.204 (0.221)	0.191 (0.223)
Mother smoked	0.022 (0.013)*	0.019 (0.012)	0.169 (0.087)*	0.147 (0.087)*
Miss. Mother smoked	-0.022 (0.034)	-0.023 (0.033)	-0.101 (0.176)	-0.113 (0.176)
Mother's age	0 (0.001)	0.001 (0.001)	-0.003 (0.009)	0.002 (0.009)
Siblings	-0.013 (0.006)**	-0.011 (0.006)*	-0.091 (0.051)*	-0.076 (0.051)
Young sibling	0.001 (0.011)	0.002 (0.011)	-0.01 (0.077)	-0.014 (0.076)
Lone mother	-0.013 (0.019)	-0.011 (0.019)	-0.124 (0.154)	-0.105 (0.155)
Vocational training	-0.012 (0.012)	-0.009 (0.012)	-0.087 (0.081)	-0.066 (0.082)
Further education	-0.02 (0.014)	-0.017 (0.014)	-0.163 (0.103)	-0.133 (0.104)
Urban	-0.014 (0.011)	-0.019 (0.011)*	-0.119 (0.089)	-0.163 (0.089)*
Rural	0.012 (0.012)	0.005 (0.013)	0.078 (0.085)	0.03 (0.086)
Mother's mental health	0.026 (0.017)	0.026 (0.017)	0.183 (0.104)*	0.183 (0.104)*
Mother obese	0.052 (0.025)**	0.049 (0.025)**	0.37 (0.132)***	0.353 (0.132)***
Mother overweight	0.035 (0.013)***	0.033 (0.013)**	0.279 (0.089)***	0.271 (0.090)***
Miss. Mother BMI	0.086 (0.034)**	0.085 (0.034)**	0.567 (0.191)***	0.558 (0.192)***
Father obese	0.11 (0.028)***	0.109 (0.028)***	0.647 (0.130)***	0.639 (0.130)***
Father overweight	0.029 (0.010)***	0.029 (0.010)***	0.254 (0.086)***	0.249 (0.086)***
Miss. Father BMI	0 (0.017)	-0.002 (0.017)	0.056 (0.154)	0.051 (0.154)
Income (in units of 1000)		-0.053 0.021)***		-0.411 (0.184)**
Constant	0.133 (0.058)**	0.379 (0.112)***	-1.051 (0.408)**	0.845 (0.954)
R^2 / Pseudo R^2	0.04	0.03	0.07	0.08
% overweight children correctly predicted			0.21	0.19

Notes: Reference categories are basic education and metropolitan area. Standard errors adjusted for clustering on the mother's identification code because also twin pairs are included in the sample (3,186 clusters).
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: The impact of mothers' working hours on whether or not the child is overweight (DK definition), coefficients, robust standard errors in parentheses. IV-GMM and IVPROBIT models with and without income. Hours treated as endogenous in column 1 and 3. Income included and treated as endogenous in column 2 and 4. N=3,237.

	1 IV-GMM (hours treated as endogenous)	2 IV-GMM + income (income treated as endogenous)	3 IVPROBIT (hours treated as endogenous)	4 IVPROBIT (income treated as endogenous)
Hours 1999 (in units of 10)	0.019 (0.080)	-0.011 (0.008)	0.229 (0.562)	-0.084 (0.062)
Girl	-0.042(0.009)***	-0.041(0.009)***	-0.318(0.070)***	-0.32 (0.071)***
Low birth weight	-0.042 (0.019)**	-0.046 (0.019)**	-0.335 (0.222)	-0.373 (0.210)*
High birth weight	0.085 (0.035)**	0.086 (0.034)***	0.449 (0.173)***	0.479 (0.145)***
Breastfed	-0.007 (0.027)	-0.004 (0.028)	-0.021 (0.169)	-0.007 (0.178)
Miss. Breastfeeding	0.03 (0.038)	0.024 (0.038)	0.213 (0.220)	0.173 (0.230)
Mother smoked	0.02 (0.013)	0.013 (0.015)	0.152 (0.093)	0.117 (0.116)
Miss. mother smoked	-0.022 (0.033)	-0.025 (0.033)	-0.091 (0.172)	-0.122 (0.179)
Mother's age	0 (0.001)	0.002 (0.003)	0 (0.010)	0.009 (0.020)
Siblings	-0.011 (0.007)	-0.007 (0.009)	-0.077 (0.058)	-0.057 (0.069)
Young sibling	0.001 (0.011)	0.002 (0.011)	-0.013 (0.076)	-0.011 (0.076)
Lone mother	-0.016 (0.020)	-0.006 (0.021)	-0.143(0.155)	-0.081 (0.176)
Vocational training	-0.013 (0.013)	-0.004 (0.015)	-0.095(0.081)	-0.039 (0.107)
Further education	-0.018(0.015)	-0.012 (0.017)	-0.135 (0.114)	-0.104 (0.130)
Urban	-0.014(0.011)	-0.029 (0.022)	-0.121 (0.088)	-0.215 (0.162)
Rural	0.013(0.013)	-0.008 (0.026)	0.091 (0.086)	-0.036 (0.191)
Mother's mental health	0.026(0.017)	0.026 (0.017)	0.183 (0.103)*	0.184 (0.104)*
Mother obese	0.048(0.026)*	0.045(0.026)*	0.329 (0.153)**	0.329 (0.144)**
Mother overweight	0.034 (0.014)**	0.031 (0.014)**	0.263 (0.096)***	0.257 (0.097)***
Miss. Mother BMI	0.086 (0.034)**	0.084 (0.035)**	0.553 (0.190)***	0.55 (0.189)***
Father obese	0.11(0.028)***	0.108 (0.028)***	0.637 (0.136)***	0.632 (0.127)***
Father overweight	0.028 (0.011)***	0.029 (0.010)***	0.237 (0.094)**	0.248 (0.088)***
Miss. Father BMI	-0.003 (0.019)	-0.004 (0.018)	0.031 (0.159)	0.036 (0.156)
Income (in units of 1000)	0.009 (0.306)	-0.156 (0.186)	-2.261 (2.034)	-0.942 (1.378)
Constant		0.854 (0.864)		3.303 (6.385)
R^2 / Pseudo R^2		0.03		
Wald test of exogeneity			$\chi^2(1)=0.34$ p value=0.56	$\chi^2(1)=0.15$ p value=0.70
Davidson-MacKinnon test	F(1.3212)=0.16 p value=0.69	F(1.3211)=0.31 p value=0.57		

Notes: Reference categories are basic education and metropolitan area. Standard errors adjusted for clustering on the mother's identification code because also twin pairs are included in the sample (3,186 clusters).
* significant at 10%; ** significant at 5%; *** significant at 1%

When I control for younger siblings—a factor that might reduce mothers' time with the child—having more siblings reduces the probability of being obese. Children who live in an urban area have a lower probability of being obese than children who live in a metropolitan area. A Danish statistical survey also shows differences in obesity rates between local districts (Ekholm et al. 2006).

To test for measurement error in the children's body weight measure, I have compared information on birth weight from the register with information from survey data. I construct a measure on misreport of birth weight defined as the deviance between these two measures. As this misreport measure is not significant when it is included in the model, it has been left out of the results in Table 2 and 3.[23]

Only approximately one out of five children defined as overweight in the probit model is correctly predicted in Table 2. In addition both the probit model and the LPM show that the explained part, measured by R^2 and pseudo R^2, is relatively small. However, low explanatory power is a problem that all the relevant studies listed in Table A1 face.

I have estimated several functional forms of maternal working hours in 1999. In particular, when I include mothers' working time squared, the first order variable becomes positive and significant at 10 percent, whereas the squared term becomes negative and significant at 1 percent. The maximum is reached at 26 hours, and 8 pct of the sample has working hours below 26. These results are available upon request.

All models in Table 2 and 3 are estimated both on the Danish and the international definition of child overweight. When I use the international classification of overweight status, the result on mothers' working hours in 1999 still has a reducing effect on children's overweight status, but the result is insignificant (see table A4).

To test the sensitivity of the cut-off point in child BMI, Table A5 shows quantile regression results on the association between mothers' average working hours in 1999 and the child's BMI at age 7½ (additional control variables are suppressed). The results show a negative association between mothers' working hours and the child's BMI at all quantiles. The negative association is

[23] The raw correlation between child's BMI at age 7½ and a measure of misreport on birth weight is 0.007.

insignificant at the lower quantiles but significant at the 0.90, 0.95, and 0.99 quantiles. These results validate the results found in Table 2.

To test the impact of fathers' employment, I have included fathers' working time in the estimation of equation (7). Fathers' working time is positively associated with child obesity but highly insignificant when included in the model, possibly because fathers' characteristics are highly correlated with mothers' characteristics. However, a specification check where only fathers' working time is included in the model also reveals a highly insignificant estimate on fathers' working time. This result is consistent with earlier results on the impact of fathers' working time on children's overweight status (Phipps et al., 2006; Courtemanche, 2007).

As suggested in the theoretical model a cumulative measure of the mother's working hours through their child's life is used for estimating equation (7). As discussed in section 5.3, this cumulative variable has several missing variables, primarily because small firms do not report the working hours of their employees. For that reason I have included a dummy for missing observations on the mother's working hours. None of these dummy variables are significant. The results in Table A6 corroborate the results found in Table 2. An increase in cumulative working hours (from 1997-2002) reduces the likelihood that the child is overweight.

As mentioned in section 5.1, 8 percent of the interviewed mothers did not respond to the question about the child's height and weight at age 7½. With a Heckman selection model with a binary outcome I test whether the results found in Table 2 hold when the group of children without information on child's height and weight are taken into account. This procedure is done in STATA with the STATA command HECKPROB. To identify the model, I use information on whether the child is the first born, as parents may be more inclined to record or recall height and weight of their first-born child. The results from the selection regression confirm that selection exist in the sample, but the result, that increased maternal working hours reduces child weight, is unchanged (these results are available upon request).

7.2 Does the quality of childcare matter?

In contrast to the relevant economic literature, the result for Denmark shows that a child is less likely to be overweight if his or her mother works more hours. In Anderson et al. (2003) maternal working hours increase the likelihood of a child's being overweight, a result mainly driven by mothers of higher social status. The authors argue that one reason for this result is that children of mothers in higher social classes in general are placed in a daycare facility in which the caregivers have lower skills than those of the mothers. In general, daycare quality in the U.S. varies substantially across locations and type of care. Childcare occurs in the context of a private market, and public subsidies were estimated in 2001 to be one third of all childcare expenditure. However, these subsidies have been increasingly targeted at low-income families in the U.S. (Blau, 2003).

The description of the childcare system in Denmark in Section 4 revealed some quality differences between family daycare and kindergarten. To test whether the effect of maternal working hours on children's overweight status at age 7½ differs depending on the quality of childcare, I compare the effect of maternal working hours among children in family daycare and kindergarten.

At the age of 4, most children in Denmark are enrolled in kindergarten. Due to a waiting list—each municipality controls its own waiting list—children in family daycare are assigned to kindergarten depending on age. Mainly in rural communities are children between 0 and 3 put in family daycare. For these reasons, the contrast between enrollment in family daycare and enrolment in kindergarten is considered random when one controls for region. A probit analysis on the probability of going to kindergarten compared to family daycare supports this argument (table A8). Besides 13 dummy variables indicating county, no other control variables can significantly explain differences in going to kindergarten compared to going to family daycare.

In Table 4, equation 7 is estimated by childcare type, as these results are more illustrative than those from a probit model with interactions effects (where the interaction effect is difficult to interpret). The results for children cared for at home by either relatives, friends, or parents are left out because too few observation were in this category. An increase in maternal working hours may have an indirect income effect. I therefore evaluate the marginal effect (with different reference categories) of mothers' working time on child obesity by type of civil status.[24] The results in Table 4 show that when the mother works full-time compared to part-time the likelihood of a child being overweight

[24] The overall results do not change if income is included in the regression or if maternal working time is measured as a continuous variable.

decreases among children in kindergarten, whereas no effect is found among children in family daycare.[25]

Table 4: Probit estimates of mothers' average hours worked on child overweightness for children in family daycare and kindergarten, marginal effects, robust standard errors in parentheses.

	Family daycare	**Kindergarten**
Estimate on working full-time with ref. cat. working part-time	0.013 (0.017)	-0.026*** (0.010)
Estimate on working over-time with ref. cat. working full-time	-0.028 (0.015)	0.018 (0.017)
No. of observation in subgroup	635	2,380

*** significant at 1 percent

Notes: Standard errors adjusted for clustering on the mother's identification code, because of twins and triplets. Three regressions are done with the same set of control variables but with different reference category. The same set of control variables as in Table 2 are included but not shown.

The significant effect of maternal employment on children's overweight status in kindergarten as opposed to family daycare is attributable to a number of factors: First, differences in the staff's educational level in kindergarten and family daycare are significant. More than 50 percent of all people employed in kindergarten (including assistants, managers, and cleaning and kitchen staff) have a medium further education, whereas only 8 percent of family daycare caregivers have a medium further education (Datta Gupta and Simonsen, 2007). Second, a number of descriptive reports on the quality of Danish kindergartens (Lissau et al., 2006; Galvind, 2007; Grønfelt, Nyboe, and Mikkelsen, 2007) show that even though only 50 percent of all kindergartens have a written food policy, 97 percent serve only milk and water (juice, soft drinks, etc. are banned), and 67 percent report that almost all children had at least one hour of physical activity every day. Furthermore, these reports show that 90 and 100 percent, respectively, of all educated personnel report that they are responsible for the children's dietary habits and physical training.

Unfortunately, comparable results on family daycare are not available. However, while both kindergarten and family daycare are legally supposed to supply care, education, and opportunities to play, kindergartens are clearly more regulated than family daycare. For example, in addition to regularly supervision, kindergartens must hand in a yearly report on the physical, mental and

[25] When I estimate equation 7 and include a dummy for child care and an interaction between mothers working time and childcare the results in Table 4 are confirmed in both the LPM and probit model. In these estimations I have left out the children cared for at home, as this is a very small and heterogeneous group. The main effect on mothers' working hours becomes insignificant when the interaction term is included. These results are available upon request.

aesthetic environment of the specific kindergarten, together with a plan how to solve any environmental problems should they occur.

A number of studies have examined the effect of maternal employment on cognitive child outcomes by type of childcare and confirm the result from above. Gregg et al. (2005) find that when the mother works more hours this leads to a poorer cognitive outcome when children are placed in care of a friend or relative. No significant effect is found when the children are placed in family daycare, and—for some outcome measures—maternal employment has a significant and positive effect on the children cognitive outcome when the children are placed in kindergarten.

If we believe that enrollment in kindergarten, as opposed to family daycare, represents differences in the quality of daycare two conclusions are possible from the result above: first, the effect of maternal employment on children's overweight status *does* differ depending on childcare quality. Second, high childcare quality can, up to a certain limit, reduce child weight problems.

8. Discussion

The general increase in the number of overweight and obese children has been subject to focus from researchers in many areas. In particular, medical research has looked for explanations for this phenomenon, pointing primarily to genetic and pre-natal factors as underlying explanations for obesity. As the results in this paper show, factors such as birth weight, smoking during pregnancy and parental weight status have a significant impact on children's weight. But the genetic component alone does not explain the recent significant increase in overweight and obesity.

The existing literature on maternal employment and children's overweight status generally hypothesizes that the mother's decision to work outside home leads to several changes in the household, any of which may affect the weight of a child. All previous studies conclude that when a mother's working hours increase, her child's likelihood of being overweight increases. However, different studies find that this result is significant for different socioeconomic groups.

Contrary to previous studies, this study finds that mothers' working hours reduce the probability of children's being overweight. Part of this contradiction may be attributable to the structural framework of the labor market and public daycare in Denmark, where the female labor market participation rate is relatively high and the quality of daycare is also relatively high, compared to other countries.

When the effect of maternal employment on children's overweight status is evaluated by type of daycare, the results show that the reducing effect of maternal employment on children's overweight status is only significant among children in kindergarten when the mother increases her working time from part-time to full-time. Among children in family daycare—a type of daycare considered of lower quality than kindergarten—an increase in mothers' working time from part-time to full-time does not affect the probability of her child being overweight.

According to the theoretical model developed in Section 4, the parameter on maternal work measures the effect of maternal time at work relative to maternal time with the child, plus a factor measuring changes in demand for health-related goods for the child when the mother works longer hours. In this paper I assume that the demand for health-related goods for the child is small and approximately zero. This model emphasizes that the environment in which children are placed during the time they are in non-parental care matters. Indeed, in this model, maternal working hours can have a reducing effect on child weight if the structural parameter on non-maternal childcare is larger than the structural parameter on maternal childcare. Increased maternal working hours might have a reducing effect on child obesity if the non-maternal childcare offers a more structured environment with, for example, more regulations on sugar, soft drinks, and physical activities than during maternal care. In this case the child's option set is reduced and includes less unhealthy behaviors. Literature on child development and childcare has pointed out that childcare may not simply be a question of "taking care" of the children but also of offering a social environment in which a healthy lifestyle pattern can be created. This observation appears especially true with regard to children's health, if the childcare offers good outdoor facilities and healthy food.

9. Conclusion

Previous literature consistently finds that more hours of work by mothers are associated with a higher probability for their children of being overweight. This paper finds the reverse result.

I test if difference in quality of childcare can explain my overall result of maternal work hours as a reducing factor on child overweight. I split the sample in two types of childcare depending on quality. Among children in informal daycare (family daycare) maternal employment has no significant impact on the probability that a child is overweight, whereas among children in formal daycare (kindergarten) maternal employment has a significant and negative impact on the probability that a child is overweight. Two conclusions can be made from these results. First, the effect of maternal employment on child obesity *does* differ depending on childcare quality. Second, high childcare quality can, within a certain limit, reduce child obesity.

Mothers (and fathers) time at work is not the perfect measure of time away from the child. In future research it would be interesting to look more into time spend in childcare and also study the effect of parents' occupation and working conditions, e.g. if they have flexible working time.

References

Anderson, P., K.F. Butcher and P.B. Levine. 2003. "Maternal employment and overweight children." Journal of Health Economics, 22: 477-504

Anderson, P. and K.F. Butcher. 2005. "Reading, Writing and Raisinets: Are School Finances Contributing to Children's obesity?" NBER Working Paper 11177

Anderson, P., K.F. Butcher and D. Whitmore Schanzenbach. 2007. "Childhood Disadvantage and Obesity: Is Nurture Trumping Nature?" NBER Working Paper 13479

Baum, C., M. Schaffer, and B. Stillman. 2003. "Instrumental variables and GMM: Estimation and testing." Stata Journal, 3(1), 1-31

Bernal, R. and M. Keane. 2006. "Child care Choices and Children's Cognitive Achievement: The Case of Single Mothers." working paper 06-09, North Western University

Blau, David M. 2003. "An Economic Perspective on Child Care Policy." Journal of Population and Social Security: Population Study 1, supplement June 2003: 423-442

Cawley, J. and F. Liu. 2007. "Maternal employment and Childhood Obesity: A Search for Mechanisms in Time Use Data." NBER Working Paper 13600

Chia, Yee Fei. 2006. "Maternal Labour Supply and Childhood Overweight and Obesity in Canada: Evidence from the NLSCY." Working Paper, University of Toronto

Chou, S., I. Rashad, and M. Grossman. 2005. "Fast food restaurants advertising on television and its influence on childhood obesity." NBER Working Paper 11879

Classen, T. and C. Hokayem. 2005. "Childhood influences on youth obesity." Economics and Human Biology, 3:165-87

Cole, T. et al. 2000. “Establishing a standard definition for child overweight and obesity worldwide: internation survey.” BMJ, 32

Comuzzie, A.G. and D.B. Allison. 1998. “The search for Human Obesity Genes.” Science, 280:1374-77

Courtemanche, C. 2007. “Working Yourself to Death? The Relationship Between Work Hours and Obesity.” Available at SSRN http://ssrn.com/abstract=975099

Datta Gupta, Nabanita and Marianne Simonsen. 2007. “Non-Cognitive Child Outcomes and Universal High Child Care.” IZA DP 3188

Datta Gupta, Nabanita. Nina Smith, and Mette Verner. 2008. “The Impact of Nordic countries’ family friendly policies on employment, wages, and children.” Review of Economics of the Household, vol 6,1: 65-89

Davis, George C. and Wen You. 2007. “Childhood Obesity: Does the Quality of Parental Time Matter?” Paper presented at International Association for Time Use Research, XXVIIII Conference, Washington DC., October, 2007

Deding, M. and M. Lausten. 2006. “Choosing between his time and her time? Paid and unpaid work of Danish couples.” International Journal of Time Use Research, 3,1: 28-48

Ebbelin, C.B., D.B. Rawlak and D.S. Ludwig. 2002 “Childhood obesity: public-health crisis, common sense cure.” The Lancet, 360: 473-482

Ekholm, O., M. Kjøller, M. Davidsen, U. Hesse, L. Eriksen, A.I. Christensen, and M. Grønbæk. 2006. “Sundhed og sygelighed i Danmark 2005 og udvikling siden 1987.” (The Danish Health and Morbidity Survey 2005) Statens Institut for Folkesundhed, København, December 2006

Fertig, A., G. Glomm, and R. Tchernis. 2006. “The connection between maternal employment and childhood obesity: inspecting the mechanism.” CAEPR Working Paper 2006-020

Flodmark, C-E., I. Lissau, L.A. Moreno, A. Pietrobelli, and K. Widhalm. 2004. "New insight into the field of children and adolescents' obesity: the European perspective." International Journal of Obesity, 28: 1189-1196

Galvind, N. 2007. Kost i dagtilbud (Food in childcare) Bureau2000. http://www.bureau2000.dk/fileadmin/users/bureau2000/Kost_i_dagtilbud.pdf

Garcia, E., J. Labeaga, and C. Ortega. 2006. "Maternal employment and childhood obesity in Spain." Working Paper FEDEA, Madrid.

Gortmaker, S.L., A. Must, A.M. Sobel, K. Peterson, G.A. Colditz, and W.H. Dietz. 1993. "Television viewing as a cause of increasing obesity among children in the United States, 1986-1990." Archives of Pediatrics & Adolescent Medicine, 150, 4: 356-362

Gregg, P., E. Washbrook, C. Propper, and S. Burgess. 2005. "The Effect of a Mother's Return to Work Decision in Child Development in the UK." The Economic Journal, 115: F48-F80

Grossman, M. 1972. "On the Concept of Health Capital and the Demand for Health." Journal of Political Economy, 80: 223-255

Grønfelt, V., M. Nyboe, and B.E. Mikkelsen. 2007. Hvor sunde er de danske børnehaver (How healthy are Danish kindergartens). Report from the National food institute, Danish Technical University

Kenkel, D. S. 1991. "Health Behaviors, Health Knowledge, and Schooling." Journal of Political Economy, 99, 2:287-305

Knudsen, K. and K. Wærness. 2008. "National Context and Spouses' Housework in 34 countries." European Sociological Review 24: 97-113

Lausten, Mette and Karen Sjørup. 2003. “Hvad kvinder og mænd bruger tiden til.” (What women and men spend time on), Danish National Institute of Social Research, report 03:08

Lissau, L., M. Overpeck, W.J. Ruan, P. Due, B.E. Holstein, M.L. Hediger, and the Health Behaviour School-age Children Obesity Working Group. “Body Mass Index and Overweight in Adolescents in 13 European Countries, Israel, and the United States.” American Medical Association 158: 27-33

Lissau, L., U. Hesse, M. Juhl, and M. Davidsen. 2006. Mad og fysisk aktivitet i børnehaver, skoler og fritidshjem/skolefritidsordninger. (Food and physical activity in kindergartens, schools, and youth centres) National Institute of Public Health, Copenhagen

Liu, Echu, Cheng Hsiao, and Shinyi Chou. 2005. “Maternal Full-Time Employment and Childhood Obesity: Parametric and Semiparametric Estimation.” Working paper, University of Southern California

Ministry of Social Affairs. 2000. Early Childhood Education and Care Policy in Denmark – Background Report. The Ministry of Social Affairs in consultation with the Ministry of Education.

Nysom, K., C. Mølgaard, B. Hutchings, and K.F. Michaelton. 2001. “Body mass index of 0-45-y-old Danes: reference values and comparison with published European reference values.” International Journal of Obesity, 25, 2: 117-184

OECD, 2001a. Early Childhood Education and Care Policies in Denmark. OECD country note

OECD, 2001b. Employment Outlook, June 2001. OECD, Paris

Phipps, Shelly A., Lynn Lethbridge, and Peter Burton. 2006. “Long-run consequences of parental paid work hours for child overweight status in Canada.” Social Science & Medicine, 62: 977-986

Ruhm, C. J. 2004. ”Maternal employment and adolescent development.” NBER Working Paper 10691

Ruhm, C. J. Forthcomning. ”Maternal employment and adolescent development.” Labour Economics

Sanz-de-Galdeano, A. 2005. “The Obesity Epidemic in Europe.” IZA DP 1814

Scholder, Stephanie von Hinke Kessler. 2007. “Maternal Employment and Overweight Children: Does Timing Matter?“ CMPO Working Paper Series no. 07/180

Staiger, D. and J.H. Stock. 1997. ”Tnstrumental variables regression with weak instruments.” Econometrica 65, 3: 557-586

Statistics Denmark. 2003a. “Arbejdstidsregnskabet 1995-2002.” (The working hour account 1995-2002) Statistiske efterretninger 2003:36

Statistics Denmark. 2003b. “Ældre mødre.” (Older mothers) Nyt fra Danmarks Statistik Nr. 251, 11. June 2003

Sørensen, T.V. 2004. “Myter i madpakke.” (Myths in lunch bags) Børn & Unge 31/2004

Sørensen, T.I.A., P. Due, B. Hansen, A. Lichtenberg, K.F. Michaelsen, P. Müller, and B. Richelsen. 2008. “Monitorering af forekomsten af fedme.“ (Monitoring the prevalence of obesity) Report, no 5 Motions-og Ernæringsrådet (The Danish Fitness and Nutrition Council)

Takahashi, Eiko, Katsumi Yoshida, Hiroki Sugimori, Michiko Miyakawa, Takashi Izuno, Takashi Yamagami, and Sadanobu Kagamimori. 1999. “Influenxe Factors on the Development of Obesity in 3-Year-Old Children Based on the Toyama Study.” Preventive Medicine, 28: 293-296

von Kries, R., A. M. Toschke, B. Koletzko, and W. Slikker. 2002. “Maternal smoking during pregnancy and childhood obesity.” American Journal of Epidemiology, 156: 954-61

Whitaker, Robert C., Margaret S. Pepe, Jeffrey A. Wright, Kristy D. Seidel, and William H. Dietz. 1998. "Early Adiposity Rebound and the Risk of Adult Obesity." Pediatrics, 101, 3

World Health Organization. 2000. Obesity: preventing and managing the global epidemic. Geneva: WHO

Zhu, A. 2007. "The Effect of Maternal Employment on the Likelihood of a Child Being Overweight." Discussion Paper 2007/17, School of Economics, University of New South Wales

Appendix

Figure A1: The Danish growth chart for boys.

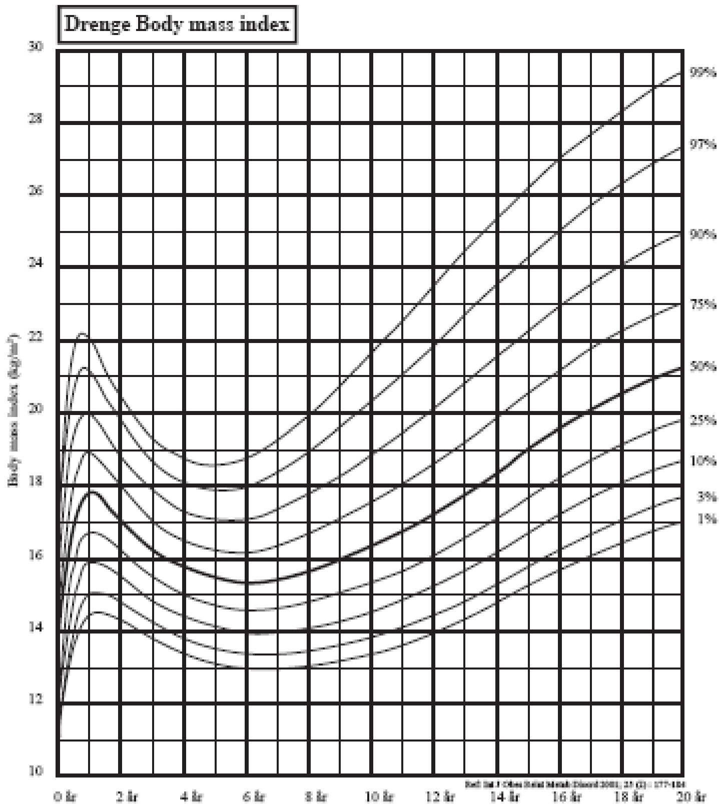

Figure A2: The Danish Growth chart for girls

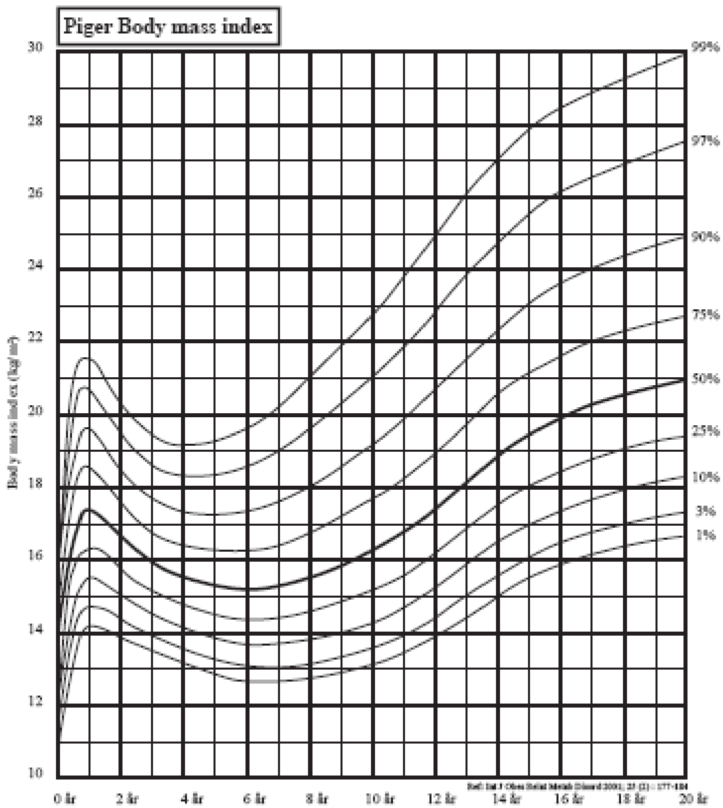

Figure A3: The density of BMI separately for boys and girls, aged 7½.

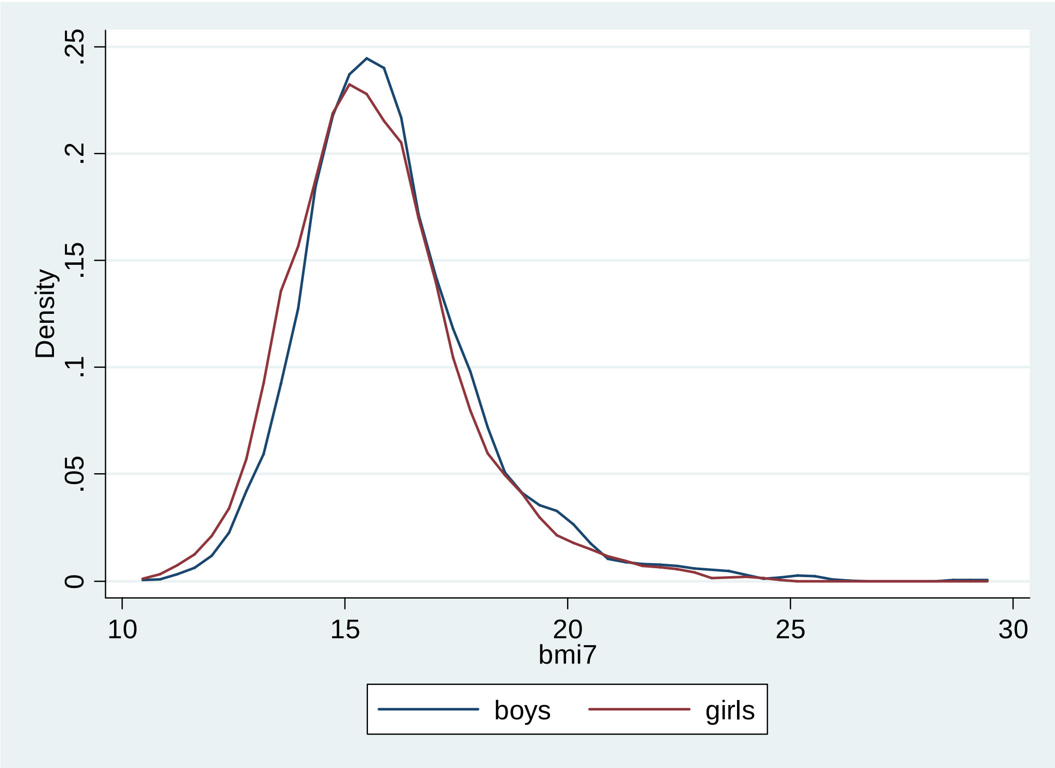

Table A1. Literature review on the relationship between maternal employment and children's overweight. Published papers in bold

Author, year	Sample (country, obs, age group)	Employment measure	Method	Effect on children's overweight
Anderson et al., 2003	USA, 16,650, 3-11 yr old	Av. hours per week since child's birth No. of weeks since child's birth	LPM (OLS), FE, sibling difference, IV[1]	Pos. eff. of hours of work. Only for higher socioeconomic status
Chia, 2006	Canada, 8,589, 2-17 yr old	Av. hours per week after the mother returned to work Age of child when mother returned to work	LPM (OLS) Sibling difference	Pos. effect of hours of work. Only sig. for mothers with some postsecondary education. Not significant for children born in the top income quartile
Classen and Hokayem. 2005.	USA, 15,086, 2-18 yr old	Works 35 h/week or more (at the time of the interview)	PROBIT	Pos. Effect of work 35 h/
Courtemanche, 2007	USA, 33,652(7,261), 3-17 yr old	Av. Work hours per week	RE, FE	Pos. effect of work hours
Davis and You, 2007	USA, 311, 9-11, 13-15 yr old	Engaged, non-engaged time for both mom and dad in current year	PROBIT	Non-engaged time has a reducing effect on child obesity
Fertig et al. 2006	USA, 3,400, 5-17 yr old	Hours per week since child's birth	Estimate the effect of children's activities and meal routines on BMI, estimating the effect of maternal employment on these activities and routines and then combining these two estimates	Hours of work affect child weight through supervision (watch TV) and nutrition (number of meals)
Garcia et al. 2006	Spain, 5099, 2-15 yr old	Mothers current employment situation	PROBIT, IVPROBIT[2]	If the mother works in 2003 the child is more likely to be obese and overweight in 2003
Liu et al., 2005	USA, 1,099, 3-11 yr old	Full time working mothers in 2000	PROBIT, ML, semi parametric estimation, ATE	Full time employment has a positive and significant effect
Phipps Lethbridge and Burton, 2006	Canada, 3400, 6-11 yr old	Hours pay work per week. Both current and since 1994. for both the father and the mother	LOGIT	Longer hours of work are associated with a higher probability of a child overweightness. Fathers' employment insignificant.

Author, year	Sample (country, obs, age group)	Employment measure	Method	Effect on children's overweight
Ruhm, forthcoming	USA, 3,500, 10-11 yr old	Av. hours per week since child's birth	OLS, PROBIT, mom's employment a period after assessment. FE, propensity score	Sig positive effect of hours work for advantaged adolescent.
Scholder, 2007	UK, Two data sources: 3,350, 1904, child binary overweight status at age 16	FT, PT at different ages of the child.	PROBIT, LPM, Mundlak-like specification and FE	Sig. positive correlation between maternal fulltime employment at ages 5-7 and children's overweightness at age 16. This is mainly driven by low SES groups
Takashi et al., 1999	Japan, 1281. 3 yr old	PT, FT	LOGIT	Sig positive effect of full time employment
Zhu, 2007	Australia, 4989, 4-5 yr old	Hour per week in 2004	LPM, IV[3] FIML	Sig positive effect of hours work

1 Local unemployment rate, child care regulations, wages of child care workers, welfare benefit levels, and the status of welfare reform in the state
2 Civil statuses, mothers' age, number of children and age of youngest child
3 If the mother is a native English speaker and if the mother did volunteer work

Table A2: Detailed description of variables from the Danish Longitudinal Survey of Children (DALSC), 1996, 1999, 2003 merged with administrative data 1996-2003

Dependent variable, child overweight (H_{it})
Child overweight (DK): 1 if child at age 7½ is above 97th percentile in Danish growth chart, gender specific
Child overweight (INT): 1 if child at age 7½ is above 85th percentile in Cole et al. (2001), gender specific

Mothers' employment (W_{it})
Hours 1999: Mother's self-reported average working hours in 1999, in units of 10
Cum. hours 1997-2002: Cumulated actual hours of work in all years 1997-2002, in units of 100, information from register data

Income (I_{it})
Income: log of average disposal family income 1997-2002, in units of 1000

Mothers' education (E_{it})
Basic schooling: 1 if mother's education is basic schooling
Vocational training: 1 if mother's education is vocational training or high school
Further schooling: 1 if mother's education is further schooling

Observed child endowment and environment (Z_{it})
Girl: 1 if child is a girl
Low birth weight: 1 if child's birth weight was <=2500 g
High birth weight: 1 if child's birth weight was >=4500 g
Breastfed: 1 if child was breastfed
Miss breastfeed: 1 if there is no information on breastfeeding
Mother smoked: 1 if mother smoked during pregnancy
Miss mother smoked: 1 if there is no information on smoking during pregnancy
Mother's age: Mothers age at child's birth
Siblings: Number of siblings in 1999
Young sibling: 1 if the child born in 1995 has a younger sibling
Lone mother: 1 if the mother lives alone with the child
Metropol: living in metropolitan area
Urban: Living in urban area
Rural: living in rural area
Mother obese: 1 if mother has BMI>30 in 2003
Mother overweight: 1 if mother has 25 <= BMI <=30 in 2003
Miss mother BMI: 1 if there is no information on mothers' height and weight in 2003
Father obese: 1 if father has BMI>30 in 2003
Father overweight: 1 if father has 25 <= BMI <=30 in 2003
Miss father BMI: 1 if there is no information on fathers' height and weight in 2003
Mothers mental health: 1 if mother is mentally unstable in 1999 in 2003
Home: 1 if childcare is at home at age 3½
Fam daycare: 1 if child is enrolled in family daycare at age 3½
Kindergarten: 1 if child is enrolled in kindergarten at age 3½

Instruments:
Av. hours in industry: Average hours of work among women in each industry (37 categories). Information from the Danish Labor force survey 2002
Local tax rate 1998 - 2002: Average tax rate in each of the 272 municipalities in 1998-2202. Information from www.noegletal.dk

Table A3: Descriptive statistics of healthy weight and overweight children (Danish definition). Mean and standard error, t-test of significant difference

	1. Healthy weight (DK) (N=3,360)		2. Overweight (DK) (N=285)		Diff. 1-2 Sign. at 5%
	Mean	Std. dev.	Mean	Std. dev.	
Hours 1999 (units of 10)	3.50	0.64	3.44	0.57	
Cum. hours 1997-2002 (units of 100)	44.78	31.55	43.05	31.56	
Girl	0.49	0.50	0.33	0.47	*
Low birth weight	0.04	0.20	0.02	0.14	
High birth weight	0.03	0.18	0.09	0.28	*
Breastfed	0.92	0.26	0.89	0.31	*
Miss Breastfeeding	0.04	0.20	0.07	0.25	*
Mother smoked	0.20	0.40	0.23	0.42	
Miss Mother smoked	0.14	0.35	0.19	0.39	*
Mother’s age	29.90	4.33	29.67	4.09	
Siblings	1.27	0.74	1.18	0.74	
Young sibling	0.60	0.49	0.59	0.49	
Lone mother	0.05	0.23	0.05	0.22	
Basic schooling	0.22	0.41	0.28	0.45	*
Vocational training	0.53	0.50	0.53	0.50	
Further education	0.25	0.43	0.19	0.39	*
Metropolitan	0.31	0.46	0.31	0.47	
Urban	0.35	0.48	0.27	0.44	*
Rural	0.35	0.48	0.42	0.49	*
Mother’s mental health	0.10	0.31	0.14	0.35	
Mother obese	0.06	0.23	0.10	0.30	*
Mother overweight 2003	0.18	0.38	0.24	0.43	*
Miss Mother’s BMI	0.17	0.38	0.25	0.43	*
Father obese 2003	0.06	0.23	0.15	0.35	*
Father overweight	0.34	0.47	0.36	0.48	
Miss Father’s BMI	0.24	0.42	0.28	0.45	
Income	5.09	0.23	5.03	0.22	*
Home	0.06	0.24	0.06	0.23	
Family daycare	0.20	0.40	0.18	0.38	
Kindergarten	0.73	0.44	0.76	0.43	

Table A4: The impact of mothers' working hours on child overweight status, *international definition*. Linear probability model, IV-GMM, and probit model. Coefficients, robust standard errors in parentheses. N=3,237

	1 LPM	2 IV-GMM	3 Probit
Hours 1999 (in units of 10)	-0.008(0.008)	-0.058 (0.101)	-0.049 (0.045)
Adjusted R^2	0.03		
Pseudo R^2			0.05

* significant at 10%; ** significant at 5%; *** significant at 1%
Notes: The same set of control variables as in Table 2 are included but not shown. Standard errors adjusted for clustering on the mother's identification code because also twin pairs are included in the sample (3,186 clusters).

Table A5: Quantile regression estimates on child's BMI at age 7½, bootstrapped standard errors (rep 100) in parentheses, N=3,237.[1]

	5th	25th	50th	75th	85th	90th	95th	99th
Hours 1999	-0.024 (0.106)	-0.008 (0.046)	-0.0729 (0.058)	-0.078 (0.085)	-0.149 (0.086) *	-0.220 (0.114) **	-0.3168 (0.161) **	-0.829 (0.364) **
Pseudo R^2	0.03	0.03	0.03	0.04	0.05	0.06	0.08	0.15

* significant at 10%; ** significant at 5%; *** significant at 1%
Notes: The same set of control variables as in Table 2 are included but not shown. Standard errors adjusted for clustering on the mother's identification code because also twin pairs are included in the sample (3,186 clusters).

Table A6: The impact of mothers' cumulated working hours 1997-2002 on whether the child is overweight (DK definition). In column 1 mean statistics (standard deviation in parentheses). In column 2, a probit model with only mothers cumulated hours included. In column 3, a probit model with all covariates excl. income. In column 3, a probit model with all covariates. Column 2-4 shows coefficients, and robust standard errors in parentheses, N=3,217.

	1	2	3	4
Child overweight	0.08 (0.27)			
Cum. Hours (in units of 100)	44.63 (31.54)	-0.004 (0.002)***	-0.003 (0.002)*	-0.003 (0.002)
Dum mis. 1 year	0.27 (0.44)	0.217 (0.168)	0.187 (0.180)	0.162 (0.191)
Dum mis. 2 year	0.24 (0.43)	0.07 (0.150)	-0.011 (0.159)	-0.032 (0.170)
Dum mis. 3 year	0.20 (0.40)	0.08 (0.143)	0.012 (0.152)	-0.003 (0.158)
Dum mis. 4 year	0.14 (0.34)	-0.198 (0.155)	-0.263 (0.162)	-0.272 (0.164)*
Dum mis. 5 year	0.08 (0.28)	0.093 (0.156)	0.051 (0.163)	0.046 (0.164)
Girl	0.49 (0.50)		-0.325 (0.068)***	-0.326 (0.068)***
Low birth weight	0.04 (0.20)		-0.235 (0.196)	-0.235 (0.196)
High birth weight	0.04 (0.19)		0.477 (0.145)***	0.477 (0.145)***
Breastfed	0.92 (0.27)		0.108 (0.183)	0.109 (0.184)
Mis. Breastfeeding	0.04 (0.20)		0.387 (0.231)*	0.385 (0.231)*
Mother smoked	0.20 (0.40)		0.225 (0.086)***	0.223 (0.086)***
Mis. mother smoked	0.15 (0.36)		-0.073 (0.174)	-0.074 (0.174)
Mother's age	29.88 (4.32)		0 (0.008)	0.001 (0.008)
Siblings	1.27 (0.74)		-0.067 (0.048)	-0.062 (0.049)
Younger siblings	0.61 (0.49)		-0.01 (0.076)	-0.009 (0.076)
Lone mothers	0.05 (0.23)		0.023 (0.143)	0.032 (0.145)
Vocational training	0.52 (0.50)		-0.129 (0.081)	-0.127 (0.081)
Further education	0.24 (0.43)		-0.205 (0.105)*	-0.201 (0.105)*
Urban	0.33 (0.47)		-0.101 (0.087)	-0.107 (0.087)
Rural	0.35 (0.48)		0.096 (0.084)	0.09 (0.084)
Mothers mental health	0.11 (0.32)		0.206 (0.099)**	0.208 (0.099)**
Mother obese	0.06 (0.24)		0.348 (0.132)***	0.348 (0.132)***
Mother overweight	0.18 (0.39)		0.282 (0.089)***	0.282 (0.089)***
Mis. Mothers' BMI	0.19 (0.39)		0.6 (0.196)***	0.601 (0.196)***
Father obese	0.06 (0.24)		0.703 (0.129)***	0.702 (0.129)***
Father overweight	0.33 (0.47)		0.281 (0.086)***	0.28 (0.086)***
Mis. Fathers' BMI	0.25 (0.43)		-0.005 (0.162)	-0.006 (0.162)
Income				-0.077 (0.167)
Constant			-1.531 (0.379)***	-1.174 (0.872)
Pseudo R^2			0.08	0.08
children being overweight correctly predicted			0.24	0.23

*significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Reference categories are basic education and metropolitan area. Standard errors adjusted for clustering on the mother's identification code because also twin pairs are included in the sample (3,168).

Table A7: First stage regression on endogenous variables: Mothers' self-reported average working hours in 1999 and log of average disposal family income 1997-2002, Robust t statistics in brackets. N=3,237

	1 Hours 1999	2 Income
Av. Hours in industry	0.028	
	[4.55]***	
Av. local tax-rate 1998-2002		-0.029
		[6.18]***
Girl	0.012	0.002
	[0.53]	[0.32]
Low birth weight	-0.069	-0.008
	[1.09]	[0.44]
High birth weight	0.095	-0.01
	[1.53]	[0.52]
Child was breastfed	-0.002	0.028
	[0.02]	[1.42]
Miss. breastfeeding	-0.021	-0.028
	[0.26]	[1.11]
Mother smoked during pregnancy	0.042	-0.05
	[1.46]	[5.30]***
Miss. smoking during pregnancy	-0.012	-0.016
	[0.17]	[0.73]
Mother's age, 1996	-0.007	0.013
	[2.40]**	[11.77]***
Siblings	-0.041	0.034
	[2.44]**	[6.36]***
Younger siblings	0.01	0.004
	[0.41]	[0.49]
Lone mother, 1999	0.075	0.043
	[1.82]*	[2.61]***
Vocational training	0.032	0.047
	[1.01]	[4.90]***
Further education	-0.072	0.052
	[2.02]**	[4.48]***
Urban area	0.017	-0.079
	[0.61]	[7.76]***
Rural area	-0.044	-0.108
	[1.55]	[10.41]***
Mental health	-0.009	0.005
	[0.24]	[0.37]
Mother obese 2003	0.084	-0.042
	[1.72]*	[3.00]***
Mother overweight 2003	0.029	-0.023
	[0.97]	[2.38]**
Mother's BMI missing	-0.007	-0.017
	[0.10]	[0.78]

Father obese 2003	0	-0.011
	[0.00]	[0.73]
Father overweight 2003	0.042	-0.003
	[1.55]	[0.35]
Father’s BMI missing	0.074	-0.025
	[1.72]*	[1.59]
Constant	2.815	5.633
	[12.21]***	[35.17]***
R-squared	0.03	0.18
Adjusted R2	0.02	0.18

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Reference categories are basic education and metropolitan area. Standard errors adjusted for clustering on the mother’s identification code because also twin pairs are included in the sample (3,186 clusters).

Table A8. The probability of being in kindergarten (p=1) compared to being in family daycare (p=0) in 1999. Probit model, estimates, robust standard errors in parentheses, N=3,031.

Variable	Estimates (robust std. errors)
Hours 1999	0 (0.044)
Girl	0.009 (0.055)
Low birth weight	0.285 (0.177)
High birth weight	0.146 (0.147)
Child was breastfed	0.029 (0.143)
Miss. breastfeeding	0.015 (0.201)
Mother smoked during pregnancy	-0.011 (0.071)
Miss. smoking during pregnancy	0.171 (0.165)
Mother's age, 1996	-0.002 (0.007)
Siblings	-0.018 (0.040)
Younger siblings	0.015 (0.061)
Lone mother, 1999	0.127 (0.131)
Vocational training	-0.063 (0.071)
Further education	0.048 (0.086)
Frederiksborg	-0.335 (0.156)**
Roskilde	-0.609 (0.164)***
Vestsjælland	-1.129 (0.150)***
Storstrøm	-0.688 (0.175)***
Bornholm	-1.185 (0.292)***
Fyn	- 1.426(0.132)***
Sønderjylland	- 0.722 (0.150)***
Ribe	-0.958 (0.152)***
Vejle	-1.454 (0.130)***
Ringkøbing	-1.316 (0.138)***
Århus	-0.915 (0.123)***
Viborg	-1.509 (0.148)***
Nordjylland	-1.18 (0.125)***
Mental health	0.058 (0.092)
Mother obese 2003	-0.087 (0.116)
Mother overweight 2003	-0.107 (0.073)
Mother's BMI missing	-0.145 (0.164)
Father obese 2003	-0.098 (0.116)
Father overweight 2003	0 (0.065)
Father's BMI missing	0.087 (0.114)
Income 1999 (in units of 1000)	0.183 (0.115)
Constant	0.867 (0.619)

Notes: Reference categories are basic education and Copenhagen county. Standard errors adjusted for clustering on the mother's identification code because also twin pairs are included in the sample (2,982 clusters).