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# The impact of maternal employment on children's weight: Evidence from the UK

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# Contents



# Abstract

Previous research shows that maternal employment is associated with higher children's body mass index (BMI). Using a very rich UK longitudinal birth cohort study following 19,519 children from birth through age 14, we examine the effect of maternal employment during childhood on children's weight. We address the endogeneity of maternal employment by including household fixed effects. We find that maternal employment has a positive effect on children's BMI and therefore on excess weight, and this is particularly the case for single mothers. We investigate potential pathways, including children's sedentary behaviour and nutrition, and find evidence of more sedentary behaviour and poorer nutrition amongst children whose mothers are in employment. This is consistent with higher BMI levels amongst these children.

**Keywords:** BMI; maternal employment; partnership status; fixed effects; sedentary behaviour; nutrition.

## Declarations of interest

Emla Fitzsimons is Principal Investigator of the Millennium Cohort Study, but declares no conflict of interest in relation to this work.


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# Introduction

Estimated spending by the National Health Service (NHS) in England on overweight and obesity-related ill-health was at £5.1 billion in 2014/15 (HM Government 2016). Childhood obesity is the most common chronic disease of childhood, and one that is likely to persist into adulthood (Reilly and Kelly 2011), with far-reaching effects. Physical health risks, including high blood pressure and cholesterol, type 2 diabetes, and sleep apnea, present themselves in both the short- and long-term (Bhave et al. 2004; Biro and Wien 2010; Craigie et al. 2011; Ng et al. 2014). Psychological effects including low self-esteem and depression also manifest themselves throughout life (Schwimmer, Burwinkle and Varni 2003). Economic outcomes such as wages are also affected adversely (Cawley 2004). With disadvantaged children increasingly more likely to display increased levels of excess weight (Shrewsbury and Wardle 2008), understanding the factors contributing to excess weight in childhood is important both in its own right, and as a means of reducing the intergenerational transmission of inequality.

This paper's motivation stems from three stylised facts. First, the prevalence of childhood overweight and obesity has soared in recent decades. The number of obese children and teenagers across the world has increased tenfold over the past four decades: from 1975 to 2016, the number of obese girls (boys), aged 5 to 19, rose from 5m to 50m (6m to 74m) (NCD Risk Factor Collaboration (NCD-RisC) 2017). Second, maternal employment has increased dramatically over the same period. For instance, among mothers with children under 18 in the US, 47% were in the labour force in 1975, rising to more than 70% in the late 1990s, where it has remained over the last 15 years (Galinsky, Aumann and Bond 2013; Pilkauskas, Waldfogel and Brooks-Gunn 2016). The UK has also witnessed a steady rise in the percentage of women aged 16 to 64 in employment over the past 40 years, from around 53% in 1971 to 67% in 2013 (ONS 2013). The rate of increase in employment has been fastest for

mothers, particularly those with pre-school children – rising from 31% in 1980 to 58% in 2008, amongst mothers with a child aged under five (Fagan and Norman 2012; OECD 2011). A third stylised fact is the stark rise in the number of single-parent households in the UK over the past few decades. For instance, amongst children born in 2000/01, 23.8% of them lived with a single mother at the age of 11, compared to around 7% for those born in 1958.[1]

In this paper, we investigate whether changes in maternal employment have contributed to increased childhood weight – and the extent to which family structure plays a role. The majority of existing evidence on this topic is based on US data, and moreover it is mostly concerned with associations rather than causal effects. The specific contribution of our study is threefold. First, it is the first paper providing causal evidence on the effect of maternal employment on children's weight in a UK context, for a large contemporaneous cohort of children through childhood and early adolescence, one that has grown up in the midst of the childhood 'obesity epidemic'. Second, to the best of our knowledge, it is one of the first papers on this topic to distinguish between mothers who are single and partnered – a key distinction given the growing incidence of single parent families, with just under one quarter of our sample of children raised in a one-parent family. Third, it uses robust econometric methods to provide empirical evidence on the mechanisms underlying the effects, adding to the very limited body of knowledge on this topic.

Excess weight is due to a changing energy balance, i.e. consuming more calories than expended (Hill, Wyatt and Peters 2012), and there are several ways in which parental - and maternal in particular - working may affect this in children. First, an increase in

[1] Author's calculations based on Millennium Cohort Study and National Child Development Study. We refer to age 11 because both studies interviewed participants when they were aged 11.

employment means that parents (mothers) spend less time at home, with less time allocated to housework, including meal preparation (Monsivais, Aggarwal and Drewnowski 2014). Gershuny and Fisher (2000) provide evidence that the time British women spend cooking has always been less for employed compared to non-employed mothers. Second, the child will spend more time in the care of other family members and in childcare. This reduction in parental (maternal) child supervision may have adverse implications for the choices children make in relation to food intake (Klesges et al. 1991) and physical activity (Cawley and Liu 2012). Conversely, an increase in employment in a household corresponds to an increase in family income, making healthier, more nutritious foods - typically more expensive than highly processed energy-dense foods - more affordable. These mechanisms are likely to operate differently depending on whether the mother has a partner or not: married parents have higher average family incomes than single parents (Duncan and Hoffman 1985; Fronstin, Greenberg and Robins 2001; Ribar 2004); partnered parents have more time, jointly, to spend with their children than single parents (Fronstin, Greenberg and Robins 2001; Lopoo and DeLeire 2014). Previous work found a strong relationship between single-parent status and excess weight in children in the US (Huffman, Kanikireddy and Patel 2010).

Applying household fixed effects on detailed longitudinal data from the UK Millennium Cohort Study, we find that maternal employment increases children's BMI, and that the magnitude of the relationship is understated in ordinary least squares (OLS) models, with fixed effects estimates significantly larger. We investigate the mechanisms underlying the observed effects, and in particular whether an imbalance between energy expenditure (sedentary behaviour) and energy intake (nutrition) contributes to the estimated effects. Consistent with their higher levels of excess weight, we find that children of working mothers are more likely to be sedentary and less likely to eat breakfast regularly. This is consistent with an overall positive effect on children's BMI.

The paper proceed as follows. Section 2 discusses the related literature and background; in section 3 we describe the data, followed by the empirical methodology in section 4. Section 5 presents the main findings and potential mechanisms, and section 6 concludes.

## Background

Over the past couple of decades, a growing body of literature has explored whether maternal employment raises the risk of childhood obesity. The vast majority of this literature, reviewed in Anderson (2011), estimates associations between maternal employment and children's weight. Far fewer studies attempt a credible identification strategy to estimate the causal effect of maternal employment on children's weight. The study of Anderson, Butcher and Levine (2003) was the first to attempt to estimate a causal relationship, finding in a US context that mothers' full-time work over her child's life increased the higher probability that her child was overweight. Subsequent studies with a credible identification strategy, including instrumental variables and/or fixed effects, have mostly focused on the US (Anderson, Butcher and Levine 2003; Courtemanche 2009; Courtemanche, Tchernis and Zhou 2017; Fertig, Glomm and Tchernis 2009; Morrissey, Dunifon and Kalil 2011; Ruhm 2008), with a more limited number of non-US studies (Bishop 2011; Dunifon et al. 2013; Greve 2011; Scholder 2008). With the exception of Bishop (2011) and Greve (2011), all of this evidence finds that maternal employment increases children's BMI.

Compared to the US, there is a dearth of research looking at this issue in a UK context. Existing studies include Hawkins, Cole and Law (2008), who estimate associations bwteen maternal employment and early childhood overweight when study members of the Millennium Cohort Study were aged three. Scholder (2008) estimates the effect of maternal employment on children's weight using the National Child Development

Study, so a cohort of children born in 1958, facing a very different childhood environment to today and not part of the 'obesity epidemic'.

Several papers discuss the theoretical mechanisms through which increased employment may affect children's weight, but very few assess them empirically (see Anderson (2012) for a review). The main channels associated with higher weight include less time allocated to housework (including meal preparation), a reduction in maternal supervision affecting children's food intake and/or physical activity; on the other hand, increased family income can facilitate the adoption of healthier life styles and thereby healthier weights (Wake et al. 2009; Wang, Patterson and Hills 2002).

Regarding empirical evidence on the importance of these mechanisms, most studies are confined to the US, and evidence is non-conclusive. For instance, Fertig, Glomm and Tchernis (2009) explore the mechanisms by which maternal employment affects obesity using children's time diaries in the PSID, but without obtaining any strong findings. Morrissey, Dunifon and Kalil (2011), using the National Institute of Child Health and Human Development (NICHD)'s Study of Early Child Care and Youth Development, also look at how maternal employment is associated with children's time use, finding no significant effects in relation to TV watching and physical activity. Crepinsek, Burstein and Associates (2004) find no impact of maternal employment on children's physical activity children get, though Cawley and Liu (2007) find that employed mothers spend less time playing with their children. Anderson (2012) find that maternal work hours are negatively associated with routines such as eating meals as a family or at regular times, or having family rules about hours of television watched. The study of Gwozdz et al. (2013), based on eight European countries, finds little evidence of associations between maternal employment and the mechanisms at play. In the UK, to our knowledge, Hawkins, Cole and Law (2009) is the only study exploring mechanisms. Looking at five year-olds in the MCS, they find that children with working mothers are more likely to consume sweetened drinks, use the TV or computer at least

2 hours per day, and to be driven to school, and eat less fruit and vegetables. Overall, the evidence points to inferior food choices amongst working mothers as the more dominant mechanism at play, though evidence is scant and at that, mainly confined to the US.

## Data

This paper examines the effect of maternal employment on children's weight using data from the UK Millennium Cohort Study (MCS), an ongoing longitudinal study following a cohort of over 19,000 children in the UK (Joshi and Fitzsimons 2016). It is a representative sample of those born between 2000 and 2002 in England, Wales, Scotland and Northern Ireland. A total of 19,244 families were recruited, representing an overall response rate of 71%. Families were first assessed when children were 9 months old, and subsequently followed up at ages 3, 5, 7, 11 and 14. 61% of the initial respondents were in the study at the sixth wave, though attrition is not absorbing, and re-entry occurs. Due to differential patterns of response, weights are used in the analysis to adjust for inter-wave attrition and survey design (Mostafa and Wiggins 2015).

In each sweep, an interview is carried out with the main parent (normally the mother), resident partners, and, increasingly as the child grows older, with the cohort member. Each sweep contains detailed information on the family, including: parental education; employment and income; housing; family structure; ethnicity; parenting activities such as reading to child; developmental indicators such as bedwetting; parental relationship status; and parental mental health. Items specific to a certain stage of life are collected – for instance at age 9 months, child birth weight and gestational age; as well as early life conditions including breastfeeding and infant development. Weight and height have been measured at each sweep since age 3 by trained interviewers.

## Sample selection

The sample selected for analysis was derived from the second sweep of MCS (corresponding to respondent age of 3), which is the first time anthropometric measures of participants were collected in the study. Of the 15,382 singletons interviewed at age 3, 14,109 (91.7%) had valid measures of BMI. We exclude twins and triplets to avoid the problem of non-independence of observations, and because of the very modest number of twins/triples in the sample (1.33%). Given the longitudinal nature of the study, we further selected participants including only those with valid measures of BMI at each sweep, ending up with 7,894 observations. We use inverse probability weights to account for non-random attrition from the sample (Mostafa and Wiggins 2015; Wooldridge 2007).

## Measures

### Child BMI

Both height and weight were measured by trained interviewers in the home, at ages 3, 5, 7, 11 and 14. BMI is calculated by dividing weight in kilograms by squared height in metres. We standardized BMI by age and sex according to the 1990 UK Growth Reference, which is based on population reference curves derived from around 30,000 BMI measurements from 11 different sources in England, Scotland and Wales collected between 1978 and 1990 (Cole, Freeman and Preece 1995).

## Maternal Employment

Maternal employment was defined combining answers to a number of questions asked of the mothers of participants, either if they were the main or partner respondents to the survey. A mother was considered to be employed if she reported having been in work in the last week, or if she has a job and did not work in the past week for reasons other than parental leave.[2] Mothers who were not classified as employed were defined "not working"; for those employed, we defined those working between 1 and 34 hours as "working part time", and those working 35 hours or more as "working full time". The strength of these measures was that they were asked prospectively at each sweep in a consistent way, thereby increasing their accuracy and comparability over time.

## Single status

A mother was defined as single if she was the only parent living in the household. An alternative was to use marital status, but this is less indicative of who else is living in the household, whilst single status captures one-parent households. However, we control for marital status in the analysis.[3] In the remainder of the text, for simplicity, we refer to mothers who are the only parent in the household as "single", and "partnered" to identify those who are not the only parent in household.

## Mechanisms

As discussed in section 2, excess weight reflects an imbalance between energy expenditure and energy intake. To explore mechanisms, we use measures that are consistently collected from childhood through age 14, and therefore comparable over time. Energy expenditure is proxied using data on sedentary behaviour, measured

[2] Those on parental leave were categorised as not working for the purpose of analysis.
[3] Amongst those who are 'single' (i.e. the only parent living in the household), 5.9% report being married/cohabiting at sweep 2. Proportions fluctuate from 6% to 8.4% across sweeps.

since age 3 by TV watching exceeding three hours per term-time weekday. Nutrition is proxied using information collected since age 5 on whether or not the child has a regular breakfast every weekday. Each of these variables is parent-reported at ages prior to 14; and child-reported at 14. Our choice of dietary variable is due to inconsistency in and/or lack of availability of other measures, such as sweet drinks, fruit, and readymade meals, across all sweeps.

## Covariates

We distinguish between time-invariant variables, included explicitly only in OLS models, and time-varying variables included in both OLS and fixed effect models. Time invariant confounders include child's ethnicity and maternal education, and time of survey. Time varying confounders include: father's employment, measured in the same way as maternal employment. As the vast majority of fathers work full-time, we control for hours worked as a continuous variable (where 0 corresponded to fathers not in employment, or on parental leave). Household income was measured using a survey-derived variable on predicted weekly net family income. Note that by controlling for income, the estimated effect of employment is capturing the labour supply time use effect, net of income. We also show a specification in which we do not control for income, and results are very similar. We also control for whether any grandparent lived in the household, and the number of siblings of the cohort member.

To mitigate the issue of time-varying unobserved factors affecting both maternal employment and children's weight, discussed below in section 4, we control for the following characteristics at each sweep: maternal physical health, captured by a dichotomous measure of self-rated health (good health=excellent, good and very good; and poor health=fair and poor), and self-reported longstanding illness/disability (yes/no); maternal mental health, measured using a continuous score of depression

from the Kessler scale, and ranging from 0 to 24; marital status; child's general health on a binary scale (good and poor health).[4]

## Methodology

The equation we estimate is

$$y_{ijt} = \beta_0 + \beta_1 E_{jt} + X'_{ijt}\beta_2 + f_j + \delta_t + u_{ijt} \qquad (1)$$

where i denotes the cohort member; j denotes the household; t denotes time (t = 1 denotes age 3/survey 2…t=5 denotes age 14/survey 6); $y_{ijt}$ is a measure of weight (BMI); and $E_{jt}$ denotes maternal employment at time t. $X_{ijt}$ is a vector of observed time-varying child and household characteristics, including all variables described in the previous paragraph. $f_j$ is a household fixed effect capturing unobserved time-invariant household characteristics[5]; $\delta_t$ is a survey-round dummy; and $u_{ijt}$ is an error term assumed to be independent and identically distributed.

The empirical challenge is that unobserved characteristics of the household (such as genetic or environmental influences), represented by $f_j$ in equation (1), may be associated both with maternal employment, and with children's weight. Mothers in employment are likely to be different from those not in employment. Such differences, rather than employment, could be influencing child outcomes. We use household fixed effects to deal with this, so to deal with time invariant unobserved confounding factors. The model is identified under the assumption that there are no time-varying unobserved variables affecting both changes in maternal work status over time and changes in child's BMI. This assumption would be violated if, for instance, serious

[4] At ages 3, 5 and 7, child's health is rated by the parent, and ages 11 and 14 general health is self-reported.
[5] As there is one child and mother per household, the household fixed effects absorb time-invariant child and maternal characteristics.

illness of the mother affected her ability to work and also her ability to engage in household production, which may affect children's weight. To mitigate this issue, we control for some key time-varying measures including maternal and child health/illness, and maternal depression, as described above, thereby strengthening our assumption of conditional exogeneity of maternal employment.

# Results

## Descriptives

Table 1 displays the pattern of maternal employment at each sweep of data collection, along with the proportions of single mothers over time. Around 50% of mothers worked when their child was 3 years old, rising to 73% by the time the child was 14. Among mothers in employment, the percentage working full time (≥ 35 hours) increases as the child ages, while proportions in part-time employment remain quite stable. This pattern of increasing maternal employment over childhood is commonly observed. For instance in the US in 2008, 59.6% of U.S. mothers of children aged 0-3 were employed, 63.6% of mothers with children under age 6, and 77.5% of those whose youngest child is aged 6-17 years old (Bureau of Labor Statistics 2009). The proportion of single mothers increases over childhood, from 16.5% when the child was 3 to 24.5% ten years later.

**Table 1.** Descriptive statistics of maternal working profile and partnership status

| | **3 years** | **5 years** | **7 years** | **11 years** | **14 years** |
|---|---|---|---|---|---|
| % Mothers not working | 50.7 | 44.9 | 38.9 | 33 | 26.6 |
| (95% CI) | (49.5; 51.8) | (43.8; 46) | (37.9; 40) | (32; 34.1) | (25.6; 27.6) |
| % Mothers working PT | 39.3 | 43.5 | 46.9 | 49.1 | 48.3 |
| (95% CI) | (38.2; 40.3) | (42.4; 44.6) | (45.8; 48.1) | (48; 50.2) | (47.2; 49.4) |
| % Mothers working FT | 10.1 | 11.6 | 14.1 | 17.9 | 25.1 |
| (95% CI) | (9.4; 10.8) | (10.9; 12.3) | (13.3; 14.9) | (17; 18.8) | (24.2; 26.1) |
| % Single mothers | 16.5 | 19 | 20.3 | 23.8 | 24.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (95% CI) | (15.7; 17.3) | (18.1; 19.8) | (19.4; 21.2) | (22.8; 24.7) | (23.5; 25.5) |

Table 2 shows average BMI values, alongside the prevalence of overweight/obesity, by age, both for the whole sample, and separately by gender. We see that BMI increases with age, among both females and males. The proportion of overweight and obesity fluctuates between 20% and 24% from age 3 to 7, and rises starkly to 35% at age 11, where it remains stable to age 14 (see Pongiglione and Fitzsimons (2017)). There are no stark gender differences in trends.

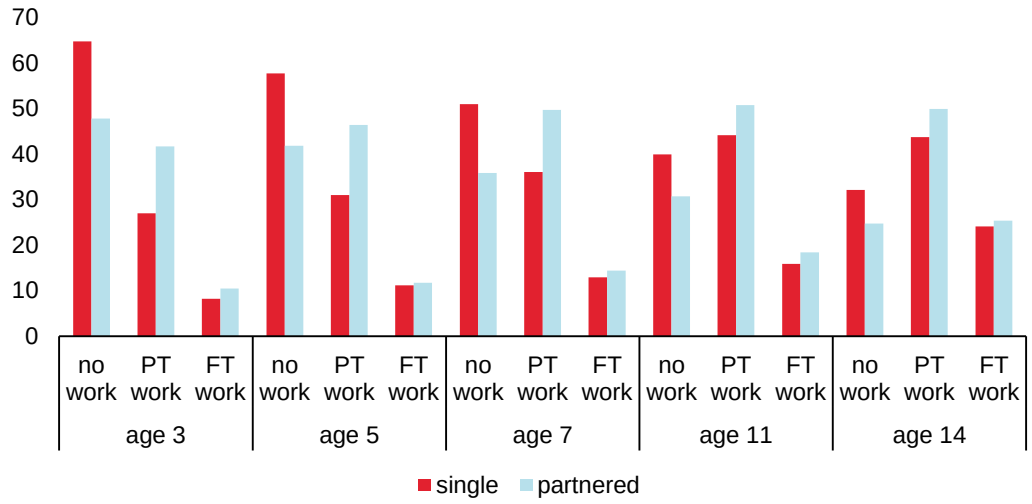
**Table 2.** BMI and prevalence of overweight/obesity based on UK90 cut-offs, by age for the whole sample and separately by gender

| | | **3 years** | **5 years** | **7 years** | **11 years** | **14 years** |
|---|---|---|---|---|---|---|
| **Full sample** | N | 7,894 | 7,894 | 7,894 | 7,894 | 7,894 |
| | BMI Mean (SD) | 16.3 (1.57) | 16.2 (1.55) | 16.5 (2.18) | 19.1 (3.45) | 21.4 (4.09) |
| | % Overweight/obese (95% CI) | 20.2 (19.3; 21.1) | 24.0 (23; 24.9) | 22.2 (21.3; 23.2) | 34.0 (33; 35.1) | 34.2 (33.2; 35.3) |
| **Females** | N | 3,964 | 3,964 | 3,964 | 3,964 | 3,964 |
| | BMI Mean (SD) | 16.2 (1.59) | 16.2 (1.66) | 16.5 (2.22) | 19.3 (3.54) | 22.0 (4.16) |
| | % Overweight/obese (95% CI) | 18.2 (17.0; 19.4) | 21.2 (19.9; 22.5) | 20.6 (19.4; 21.9) | 32.0 (30.5; 33.4) | 35.7 (34.2; 37.2) |
| **Males** | N | 3,930 | 3,930 | 3,930 | 3,930 | 3,930 |
| | BMI Mean (SD) | 16.5 (1.55) | 16.3 (1.64) | 16.5 (2.13) | 18.9 (3.52) | 20.9 (3.94) |
| | % Overweight/obese (95% CI) | 22.2 (20.9; 23.5) | 26.6 (25.2; 28) | 23.8 (22.4; 25.1) | 36.0 (34.5; 37.5) | 32.9 (31.4; 34.3) |

Figure 1 shows how maternal employment varies by sweep, according to whether the mother is single or in a partnership, and distinguishing full- and part-time employment. We see that trends for single mothers (blue bars) and partnered mothers (red bars) are similar in showing declining proportions of mothers not in employment, and increasing proportions of mothers working full-time across childhood. Whilst the

proportions in full-time employment are similar across both, the proportions not in employment are higher among single mothers, with a greater proportion of partnered mothers in part-time employment.

**Figure 1.** Proportions of maternal employment by single/partnered status and sweep



In Table 3, we compare socio-demographic characteristics at baseline (i.e. sweep 2/age 3) of single and partnered mothers, separately by employment status. Across each type of employment status, the largest differences between single and partnered mothers are in education level and household income, with single mothers having lower levels of both. Another striking difference is that single mothers in employment are more likely to live with their parents, and figures are very similar for part- and full-time (13% and 14% respectively); corresponding figures for partnered mothers are 1.7% and 4.8%.

**Table 3**. Basic characteristics of mothers at baseline (sweep 2), by partnership and working status

| | Not working | | Working PT | | Working FT | |
|---|---|---|---|---|---|---|
| | Single ($N^a$=600) | Couple ($N^a$=3119) | Single ($N^a$=258) | Couple ($N^a$=2872) | Single ($N^a$=102) | Couple ($N^a$=861) |
| Age at sweep 2 | 27.8 (6.3) | 31.5 (5.68) | 29.9 (6.44) | 33.1 (5.18) | 30.5 (6.15) | 33.6 (5.32) |
| % A level or higher qualification | 6.7 (24.97) | 23.3 (42.29) | 13.9 (34.62) | 38.6 (48.69) | 28.4 (45.33) | 49.2 (50.02) |
| % Married | 4.4 (20.61) | 74.4 (43.63) | 5.5 (22.86) | 79.3 (40.53) | 9.4 (29.35) | 77.7 (41.66) |
| Depression (Kessler scale 0-24) | 5 (4.89) | 3.5 (3.94) | 3.7 (3.63) | 2.7 (3.04) | 3.8 (3.85) | 2.6 (2.79) |
| % with long-lasting physical illness | 29.1 (45.47) | 24.5 (43) | 24.3 (42.96) | 19.1 (39.33) | 21.9 (41.58) | 19.3 (39.52) |
| % poor self-rated health | 27.9 (44.9) | 17.5 (38.02) | 19 (39.32) | 10.2 (30.28) | 18.2 (38.81) | 11.5 (31.89) |
| % Grandparent(s) living in HH | 5.9 (23.67) | 3.5 (18.27) | 13.3 (34.01) | 1.7 (12.76) | 14.3 (35.2) | 4.8 (21.3) |
| Number of siblings of CM in HH | 1.2 (1.21) | 1.5 (1.1) | 0.8 (0.98) | 1 (0.87) | 0.6 (0.99) | 0.8 (0.82) |
| Weekly net family income | 127.1 (63.08) | 457.4 (311.06) | 211.5 (104.32) | 587.7 (300.58) | 319 (142.04) | 722.8 (361.55) |

HH=household; CM= core-member (i.e. child)

Descriptive statistics weighted, sample sizes N not weighted.

s.d. in brackets ()

[a] Descriptive statistics in the table may refer to smaller sample size in case of unit non-response

## Main Findings

Table 4 presents the main findings, showing OLS alongside fixed effects estimates. The effect of part-time employment on children's BMI is 0.08 of a standard deviation (sd), while in the OLS model the coefficient is not significant. The corresponding coefficient for full-time employment is 0.12sd (compared to OLS estimate of 0.095sd). This downward bias in the OLS estimates likely reflects the fact that mothers in work, who typically have higher levels of education than those not in employment, have unobserved time-invariant preferences which also tend to decrease children's BMI. If we omit these, the resulting OLS estimate is downward biased.

Amongst other regressors in the model, having resident grandparents is noteworthy. Its association with children's BMI is positive and statistically significant (0.104), compared to a negative effect on BMI of 0.11 in the fixed effects model. We come back to this in section 6. We also highlight the inclusion of extensive health-related variables at each sweep - maternal physical health, maternal mental health, and child physical health at all observed ages in the study – to mitigate concerns around unobserved time varying shocks affecting both maternal employment and children's weight. Child physical health is the most strongly associated, with children with poor health having higher BMI. Finally, we note that, in Table A1 in the Appendix, we show a specification in which we do not control for income, and the employment effects are very similar, albeit slightly larger. This suggests that the income effect of employment is not a mechanism at play in the observed findings.

**Table 4.** OLS and FE linear probability models, dependent variable BMI

| VARIABLES | | OLS | | FE | |
|---|---|---|---|---|---|
| | | β | S.E. | β | S.E. |
| Mother Part Time (1-34 hrs) | | 0.015 | (0.0138) | 0.084*** | (0.0177) |
| Mother Full Time (35+ hrs) | | 0.099*** | (0.0187) | 0.127*** | (0.0250) |
| Single mother | | 0.063*** | (0.0227) | 0.108*** | (0.0296) |
| Father works | | -0.055** | (0.0242) | 0.028 | (0.0307) |
| HH income (in thousands) | | -0.001 | (0.0026) | -0.002 | (0.0026) |
| Grandparents in HH | | 0.101*** | (0.0299) | -0.111*** | (0.0426) |
| # siblings | | -0.016*** | (0.0061) | 0.008 | (0.0129) |
| Mother long lasting illness | | 0.004 | (0.0144) | 0.015 | (0.0178) |
| Mother poor heath | | 0.087*** | (0.0180) | 0.022 | (0.0222) |
| Mother Depression | | -0.003 | (0.0016) | -0.002 | (0.0211) |
| Marital status (married/cohabiting) | | -0.029* | (0.0161) | -5.8E-05 | (0.0227) |
| CM poor health | | 0.112*** | (0.0164) | 0.054*** | (0.0021) |
| Ethnicity | Mixed | -0.313*** | (0.0587) | | |
| | Indian | -0.316*** | (0.0411) | | |
| | Pakistani and Bangladeshi | -0.175*** | (0.0318) | | |
| | Black or Black British | 0.441*** | (0.0353) | | |
| | Other | -0.168*** | (0.0481) | | |
| Mother's Education | GCSE D-G w/ voc>=L3 | 0.031 | (0.0246) | | |
| | Voc>=3 + GCSE D-C or less | 0.182*** | (0.0292) | | |
| | GCSE A-C & A lev w/ voc>=L3 | 0.041** | (0.0178) | | |
| | A lev + voc>= L3 & diploma HE | -0.016 | (0.0235) | | |
| | Degree | -0.112*** | (0.0236) | | |
| | Higher degree | -0.030 | (0.0371) | | |
| Age 5 | | 0.215*** | (0.0181) | | |
| Age 7 | | 0.120*** | (0.0183) | | |
| Age 11 | | 0.321*** | (0.0186) | | |
| Age 14 | | 0.363*** | (0.0187) | | |
| Observations | | 39470 | | 39470 | |
| Number of unique observations | | | | 7894 | |

PT=part time; FT=full time; HH=household; Voc=vocational classification; HE= higher education.
Standard errors in parentheses.
*, ** and *** denote statistical significance at 1%, 5% and 10% levels respectively.

We next assess whether the effects of maternal employment vary depending on whether the mother is single or in a partnership. We include an interaction between mother's partnership status and her employment status (part-/full-time). When we do this, some striking differences emerge, shown in Table 5. Looking at the fixed effects estimates, the adverse effect of maternal employment on children's BMI is particularly pronounced for single mothers working full-time (0.23sd), with significant but lower

effects for part-time employment of single mothers (0.08sd). Turning to mothers in partnerships, the effects of employment on children's BMI are significantly lower than for single mothers, at 0.05sd (part-time) and 0.09sd (full-time). The table reaffirms the large downward bias in the OLS estimates (first two columns).

**Table 5.** OLS and FE linear probability models, interaction between maternal employment and single status. Dependent variable BMI.

| VARIABLES | | OLS | | FE | |
|---|---|---|---|---|---|
| | | β | S.E. | β | S.E. |
| Single mother not working | | 0.131*** | (0.038) | 0.257*** | (0.0488) |
| Single mother works PT | | 0.053* | (0.0272) | 0.046566 | (0.0376) |
| Single mother works FT | | 0.092*** | (0.0292) | 0.213*** | (0.0374) |
| Couple mother works PT | | 0.007 | (0.0153) | 0.0593*** | (0.0186) |
| Couple mother works FT | | 0.099*** | (0.0207) | 0.0940*** | (0.0249) |
| Father works | | -0.053** | (0.0243) | 0.0356 | (0.0311) |
| HH income (in thousands) | | -0.001 | (0.0026) | -0.00209 | (0.0026) |
| Grandparents in HH | | 0.101*** | (0.0299) | -0.113*** | (0.0426) |
| # siblings | | -0.012*** | (0.0061) | 0.00765 | (0.0129) |
| Mother long lasting illness | | 0.004 | (0.0144) | 0.0158 | (0.0178) |
| Mother poor heath | | 0.087*** | (0.0180) | 0.0229 | (0.0211) |
| Mother Depression | | -0.002 | (0.0016) | -0.00196 | (0.0017) |
| Marital status (married/cohabiting) | | -0.028* | (0.0161) | 0.00277 | (0.0228) |
| CM poor health | | 0.112*** | (0.0164) | 0.0539*** | (0.0176) |
| Ethnicity | Mixed | -0.312*** | (0.0587) | | |
| | Indian | -0.317*** | (0.0411) | | |
| | Pakistani and Bangladeshi | -0.176*** | (0.0319) | | |
| | Black or Black British | 0.440*** | (0.0354) | | |
| | Other | -0.169*** | (0.0481) | | |
| Mother's Education | GCSE D-G w/ voc>=L3 | 0.031 | (0.0246) | | |
| | voc>=3 + GCSE D-C or less | 0.182*** | (0.0292) | | |
| | GCSE A-C & A lev w/ voc>=L3 | 0.041** | (0.0178) | | |
| | A lev + voc>= L3 & diplomas in HE | -0.016 | (0.0235) | | |
| | Degree | -0.112*** | (0.0236) | | |
| | Higher degree | -0.030 | (0.0371) | | |
| Age 5 | | 0.216*** | (0.0181) | | |
| Age 7 | | 0.121*** | (0.0183) | | |
| Age 11 | | 0.321*** | (0.0186) | | |
| Age 14 | | 0.363*** | (0.0187) | | |
| Observations | | 39704 | | 39704 | |
| Number of unique observations | | | | 7953 | |

PT=part time; FT=full time; HH=household; Voc=vocational classification; HE= higher education.
Standard errors in parentheses.
*, ** and *** denote statistical significance at 1%, 5% and 10% levels respectively.

## Mechanisms

In this section we explore the potential mechanisms, outlined in previous sections, underlying the strong adverse effects of maternal employment on children's BMI, particularly for single mothers. As noted already, we control for income in our main specification, thereby ruling out the income effect of labour supply. The two mechanisms we explore here relate to energy intake and energy expenditure.

Table 6 shows results from FE models (OLS models are presented in Table A2 of the appendix). We see that compared to children whose mothers are not in employment, those whose mothers work part-time are around 5 percentage points more likely to watch TV for more than three hours per day, whilst the figure is around 14 percentage points for those whose mothers are in full-time employment. Looking at nutrition, we see that children whose mothers are in part- or full-time employment are respectively 11 percentage points (ppt) and 20 ppt less likely to have a regular breakfast compared to children whose mothers are not in employment. These findings of adverse effects of maternal employment on energy expenditure and nutrition, particularly for full-time employment, are consistent with BMI increasing in maternal employment.

When we estimate the effects separately by partnership status, shown in column (2) of Table 6, we find that the effects on nutrition (likelihood of regular breakfast) are most adverse for mothers in full-time employment, regardless of partnership status. This is consistent with the estimated effects of employment on BMI, shown in Table 5. For single mothers in part-time employment, we observe no adverse effects on either proxy of sedentary behaviour or nutritional intake. Amongst those who work part-time, it is the children of mothers in a partnership who are least likely to have a regular breakfast. Regarding sedentary behaviour, children of mothers in a partnership working full-time are most sedentary, followed by those with single mothers working full-time/partnered

mothers working part-time. Whilst these findings are broadly consistent with the adverse effects of employment on BMI, it is children of partnered mothers in full-time employment who appear slightly most disadvantaged on these outcomes, though differences compared to single mothers in full-time employment are very small. Overall we find strong evidence that maternal employment has an adverse effect on indicators of activity and nutrition.

Another noteworthy finding, which helps shed some light on the mechanisms underlying the association between maternal employment and children's BMI, is the effect of living with grandparents. In Table 4, we observed that having resident grandparents in the household reduces children's BMI (fixed effect estimate). In Table 6, we see children with grandparents living in the household are less likely than those without grandparents present to be sedentary, and more likely to have breakfast every day. This is consistent with children's BMI being lower in these households, and indicates potential substitution of maternal time and inputs by grandparents.

**Table 6.** FE linear probability models, dependent variables inactivity (watch TV), nutrition (regular breakfast)

| | Calories expenditure | | Calories intake | |
|---|---|---|---|---|
| VARIABLES | **Inactivity** (watch TV 3+ hrs per weekday) | | **Breakfast** (having breakfast every day) | |
| | (1) | (2) | (1) | (2) |
| Mother works PT | 0.047*** | | -0.105*** | |
| | (0.0085) | | (0.0112) | |
| Mother works FT | 0.130*** | | -0.199*** | |
| | | | (0.0148) | |
| Single mother | 0.002 | 0.152*** | -0.039** | -0.263*** |
| | (0.0152) | (0.0258) | (0.0167) | (0.0289) |
| Single mother works PT | | -0.011 | | 0.010 |
| | | (0.0196) | | (0.0218) |
| Single mother works FT | | 0.047*** | | -0.152*** |
| | | (0.0193) | | (0.0225) |
| Couple mother works PT | | 0.043*** | | -0.086*** |
| | | (0.0087) | | (0.0116) |
| Couple mother works FT | | 0.118*** | | -0.170*** |
| | | (0.0126) | | (0.0151) |
| Father works | 0.017 | 0.018 | -0.048** | -0.054*** |
| | (0.0165) | (0.0168) | (0.0195) | (0.0196) |
| HH income (in thousands) | -0.013*** | -0.013*** | 0.019*** | 0.019*** |
| | (0.0012) | (0.0012) | (0.0013) | (0.0013) |
| Grandparents in HH | -0.054*** | -0.054*** | 0.102*** | 0.103*** |
| | (0.0191) | (0.0192) | (0.0225) | (0.0223) |
| # siblings | 0.016** | 0.016** | -0.038*** | -0.037*** |
| | (0.0064) | (0.0064) | (0.0087) | (0.0087) |
| Mother's marital status (married) | -0.013 | -0.012 | -0.034** | -0.036** |
| | (0.0125) | (0.0125) | (0.0143) | (0.0143) |
| Mother's long lasting illness | 0.018* | 0.018* | -0.024** | -0.024** |
| | (0.0096) | (0.0096) | (0.0103) | (0.0103) |
| Mother's poor heath | 0.024** | 0.025** | -0.034*** | -0.035*** |
| | (0.0119) | (0.0119) | (0.0125) | (0.0125) |
| Mother's depression | 0.004*** | 0.004*** | -0.003** | -0.003*** |
| | (0.001) | (0.001) | (0.0011) | (0.0011) |
| Child's poor health | 0.017* | 0.017* | -0.057*** | -0.057*** |
| | (0.0101) | (0.0101) | (0.0114) | (0.0114) |
| Observations | 39000 | | 31356 | |
| Number of ID | 7894 | | 7894 | |

PT=part time; FT=full time; HH=household; Voc=vocational classification; HE= higher education.
Standard errors in parentheses.
*, ** and *** denote statistical significance at 1%, 5% and 10% levels respectively.

# Conclusion

The findings in this paper, based on fixed effects estimates from rich longitudinal data collected on a large scale from infanthood, show that maternal employment during childhood increases children's body mass index. The effects are particularly pronounced for single mothers in employment, whether part- or full-time. The increased BMI is consistent with higher sedentary behaviour and poorer nutritional intake amongst children whose mothers work.

We note some caveats to the findings. First, the endogeneity of maternal employment is dealt with using household fixed effects. If there are residual time-varying unobservables correlated with maternal employment and children's BMI, our estimates will be biased. Whilst we mitigate this concern by controlling for several time-varying child and maternal health indicators, it cannot be completely ruled out. Second, we consider part- and full-time maternal employment, and do not look at in-depth work patterns such as non-standard shifts or at the timing of labour supply over childhood. However, our results are consistent with previous work suggesting that maternal employment is associated with worse health outcomes including BMI.

There are several policy implications of this research. One is that programmes to tackle the high rates of childhood excess weight, such as access to healthier foods and physical exercise, could be better tailored to meet the demands of working parents. A second is that preschool childcare settings, which are used by a growing number of families for extended periods each day, may be an increasingly important target for promoting early healthy behaviours.

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