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Kabir Dasgupta, Keshar M. Ghimire, and Gail Pacheco

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Kabir Dasgupta[a], Keshar M. Ghimire[b], and Gail Pacheco[a]
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Abstract
We study the effect of mothers' smoking during pregnancy on children's body weight outcomes during pre-school ages using a nationally representative sample of children surveyed in NLSY79 Children and Young Adults. Exploiting 'within mother and across pregnancies' variation in smoking behavior, we find that maternal smoking during pregnancy has a negative effect on weight outcomes at birth but the children of mothers who smoked during pregnancy catch up with the children of non-smokers, usually within their first-year post birth. We also find evidence to suggest that children of smokers in later pre-school ages (3 to 5 years old) are likely to have higher weight outcomes relative to children of non-smokers when their mother reported higher intensity levels of smoking (greater than one pack per day).

Keywords: Maternal smoking; children's health outcomes; child weight; child BMI

JEL codes: I10, I12, I18

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Compliance with ethical standards:
We hereby declare that this project was not funded by any public or private entity. We also declare that this study does not involve any conflict of interest.

[a] NZ Work Research Institute, Faculty of Business, Economics & Law, Auckland University of Technology, New Zealand.
[b] Business and Economics Department, University of Cincinnati – Blue Ash, United States.

Corresponding author: kabir.dasgupta@aut.ac.nz

1. Introduction

The effects of maternal smoking during pregnancy on child outcomes have been explored across numerous academic disciplines, ranging from epidemiology, economics, and medicine, to sociology and psychology. Existing studies have linked maternal smoking during pregnancy with a wide array of both short-term and long-term child outcomes. However, most of the relevant literature in this space is descriptive in nature, providing correlations rather than causal interpretations. This study contributes to the literature by utilizing a robust empirical strategy, with a nationally representative dataset, to investigate the causal impacts of maternal smoking during pregnancy on childhood weight indicators during the preschool years (i.e. from birth through age five).

Examples of short-term consequences associated with maternal smoking during pregnancy include premature childbirth, fetal growth restriction, lower birthweight and infant mortality (Comstock et al., 1971; Meyer & Tonascia, 1977; Cnattingius, 2004). The longer-term consequences for children include higher blood pressure levels, respiratory and pulmonary disorders (Stick et al., 1996; Blake et al., 2000; Li et al., 2016; Hanrahan et al., 1992); psychological and behavioral problems - such as attention deficit hyperactivity disorder, neurological problems, and poor cognitive functioning (Milberger et al., 1996; Weitzman, Gortmaker, & Sobol, 1992; Huizink & Mulder, 2006; Thapar et al., 2003; Gilman, Gardener, & Buka, 2008; Wakschlag et al., 1997; Key et al., 2007); and increased risks of childhood obesity (Vik et al.,1996; Von Kries et al., 2002; Fried, Watkinson, & Gray, 1999; Oken, Levitan, & Gillman, 2008).

Our study focusses on child weight outcomes in particular and examines both short and longer-term impacts of maternal smoking during pregnancy. Specifically, we investigate the impact on weight outcomes from birth through age five[1]. Interestingly, existing research indicates that children whose mothers smoke during pregnancy are born with lower birth weight than non-smokers' children but that the risk of obesity during childhood, mainly during the pre-school ages one to five, is much higher amongst the former group.[2] A closer examination of the child-weight dynamics in prior literature suggests that while prenatal exposure to maternal smoking results in fetal growth retardation (Miller, Hassanein, & Hensleigh, 1976; Ward, Lewis, & Coleman, 2007; Cnattingius, 2004), the same is associated with stunted growth (in terms of height), higher risk of adiposity, and obesogenic growth during later childhood (Conter et. al 1995; Oken et al., 2008; Ino, 2010; Howe et al., 2012; Li et al., 2016). The evolving effects likely prompt smokers' children to 'catch up' with non-smokers' children in terms of weight and Body Mass Index (BMI). We further contribute to the literature by exploring this 'catch up' hypothesis.

For our analysis, we link mothers' data from the National Longitudinal Survey of Youth 1979

[1] We do not study effects after five as there would be many confounders such as peer effects that we would not be able to control for using our data (Gaviria & Raphael, 2001).

[2] See Ino (2010) for a meta-analysis of studies exploring the association between maternal smoking and child obesity.

(NLSY 79) with their biological children's information from the National Longitudinal Survey of Children and Young Adults (NLS-CYA). We capture children's bodyweight outcomes using information on their weight and BMI.[3] We model children's weight outcomes as a function of their own characteristics, mother's characteristics, and family information. Importantly, we exploit the 'within-mother and across pregnancies' variation in smoking habit to identify the causal effects of maternal smoking on children's weight outcomes. Our estimates are therefore, based on differences in weight outcomes of siblings whose mother smoked during certain pregnancies and did not smoke during others.

The 2000 Centre for Disease Control (CDC) Growth Charts (Kuczmarski et al., 2002) indicate that BMI thresholds for healthy and extreme bodyweight for children vary by age and sex. As such, we analyze separate samples of male and female children. However, we also present results from the combined sample for the interested reader. The sex-specific samples allow us to explore sex-related heterogeneities in the effects of maternal smoking during pregnancy, thereby providing new evidence to address some of the ambiguities present in existing literature. More specifically, while Suzuki et al. (2011; Japanese sample) find that maternal smoking during pregnancy puts boys at a higher risk of childhood obesity relative to girls, studies by Durmus et al. (2014; Dutch sample) and Li et al. (2016; Portuguese sample) show that girls are more likely to have excess weight during later childhood. We provide new evidence that speaks to these contradictions in existing literature.

In line with the findings in previous literature, our estimates suggest a significant reduction in children's birth weight and birth BMI because of maternal smoking during pregnancy. However, to this general result, we find that the negative impact is statistically significant for birth weight (rather than for BMI) when we classify the samples by children's sex. Interestingly, we also find that for both boys and girls, by age one, there appears to be no significant impact on either child weight or BMI, when we estimate the impact of the indicator of whether the mothers smoked during pregnancy. This is indicative of the catch-up scenario hypothesized in the past literature. There is also a little evidence that by age three to five, children whose mothers smoked during pregnancy have a higher weight and BMI relative to children of non-smoking mothers.

The paper is organized as follows: Section 2 describes the data and variables used in the analysis; Section 3 explains the identification strategy utilized to estimate the effects of maternal smoking during pregnancy; Section 4 discusses the key findings of the study; and Section 5 presents concluding remarks.

2. Data

For our empirical analysis, we link mothers' information from the original cohort of the NLSY

[3] We do not breakdown BMI information into disaggregate categories (such as excess weight and obesity indicators) due to lack of variation in binary indicators for these categories. As such, we cannot investigate the relationship between maternal smoking during pregnancy and likelihood of childhood obesity.

79 with information for their biological children from the NLS-CYA. The NLSY-79 is an extensively utilized dataset for social and policy-relevant research, which incorporates a wide range of socio-economic and demographic information on a nationally representative sample of 12,686 individuals, who were born between 1957 and 1964. Commencing in 1979, the surveys were administered annually until 1994, and biennially thereafter.

The NLS-CYA, on the other hand, began in 1986 and are conducted biennially. These surveys collect children's health, schooling, behavioral, as well as family-specific information related to their mothers in the original NLSY79 cohort. The biennial format of the NLS-CYA restricts us from following a child for all successive years over the preschool period from birth through the age of five. Rather, the children are surveyed either during their odd-number ages (i.e. 1, 3, 5, and so on) only or even number ages (i.e. 2, 4, 6, and so on) only. As such, our analysis combines these two cohorts to evaluate the impact on a yearly basis. Noticeably, the same general trends are evident in our results regardless of whether we view the cohorts separately or together – i.e. the same trends in impact are found when viewing the birth, 1, 3, 5 cohort versus the birth, 2, 4 cohort.

It is important to note that the transition of the NLSY79 into a biennial format posits a minor data-related concern for the birth outcome analysis for children born in odd-numbered years after the 1994 survey.[4] In particular, the biennial nature of the NLSY79 data limits the availability of year-specific NLSY79-sourced covariates (such as marital and employment status for example) for children who were born during non-survey years. As a plausible alternative, for these children, we utilize NLSY79 information from the survey year preceding their birth year. As an example, for a child who was born in 1997, the birth outcome regression incorporates 1996 survey information on mothers and their family characteristics. This includes information on mothers' schooling (highest grade completed), weight (in pounds), employment status (determined based on number of jobs being at least one), marital status, household size, and poverty status. Table 1 presents descriptives for these control variables for the birth sample, as well as the sample at each age of the child (i.e. 1, 2, 3, 4, 5 years). The descriptives are presented separately based on the gender of the child.

< Insert Table 1 about here >

Table 1 also illustrates mother's smoking information during pregnancy. There is a binary indicator of whether they smoked during pregnancy, as well as disaggregated information regarding intensity of smoking – whether less than one pack per day or at a minimum one pack per day. As shown in Table 1, approximately 29 percent of the sample report smoking during pregnancy. Most of this group indicate it was less than one pack per day (72%). Another prenatal characteristic that we account for in our analysis is substance use before pregnancy, which is a composite binary indicator for drinking, using marijuana and cocaine in 12 months

[4] Children who were born during odd-numbered years after 1994 comprise only 6.2 percent of the overall child-sample. Restricting our birth outcome regression sample to children who were born only during the biennial survey years does not affect our key findings.

prior to childbirth. This measure provides a general signal regarding mothers'risky behavior. We find that, in our birth outcome regression sample, at least 45% of mothers reported using some form of substance before childbirth.

With respect to the outcomes of interest, Table 2 illustrates mean information for both child weight and BMI conditional on the age and gender of the child in our regression samples. This information is compared for the sample where mothers smoked during pregnancy versus those that did not smoke. For both girls and boys, while we observe that children of smokers have significantly lower birthweight than children of non-smokers, the majority of the differences post birth are statistically insignificant. This descriptive profile suggests that children of mothers who smoke during pregnancy are likely to catch up with children of non-smokers in terms of our two bodyweight measures.

<< Insert Table 2 about here >>

A final data-related point to raise is exclusions from our sample. Since our empirical analysis, (which is explained in the following section) relies on mothers' fixed effects regressions, which requires information on variations in mothers' smoking behavior during pregnancy across multiple childbirths – our sample excludes one-child families or observations with twin births.

3. Identification strategy

Much of the existing literature tests the hypothesized relationship between maternal smoking and childhood obesity by estimating the association between the two variables rather than attempting to assess a causal link (Von Kries et al. 2002; Widerøe et al. 2003; Whitaker 2004; Al Mamun et al. 2006; Oken et al. 2008).[5] In particular, most analyses in this research space do not account for the potential confounding influences of unobserved heterogeneities. As such, exclusion of key variables that are likely to be correlated with mothers' smoking behavior (such as unobserved ability and personality traits) and also affect children's body weight may yield biased estimates (Blackburn & Neumark 1993; Nizalova & Murtazashvili 2016).

To address these empirical concerns, we adopt Rosenzweig and Wolpin's (1991) strategy by controlling for mother-specific unobserved time-invariant effects. It is important to note that in the context of our study, controlling for mother fixed effects allows us to control for sibling and family fixed effects as well. In addition, our regressions incorporate a wide range of important time-variant socio-economic as well as demographic indicators to minimize omitted variable biases that may restrict the scope of causal interpretation of the coefficients of interest.

To estimate the effect of maternal smoking on body weight outcomes of pre-school children, we consider samples of children at each age from zero through five and estimate:

$$Y_{cm} = \alpha_1 + \delta . Mother\ Smoking_{cm} + \alpha_2 . X_{cm} + \mu_m + \epsilon_{cm} \qquad (1)$$

where Y_{cm} is one of two possible bodyweight outcome measures (weight or BMI) of child c born to mother m. $Mother\ Smoking_{cm}$ indicates whether (and quantity) a mother smoked. The binary indicator for smoking (and the quantity smoked) is based on mothers' smoking behavior during pregnancy. X_{cm} is a vector of time-varying child- and family-specific characteristics. μ_m represents mother-specific time-invariant effects that are likely to be correlated with their smoking behavior and may affect child health outcomes. Finally, ϵ_m is the error term.

When standard assumptions of the fixed effects regression are met, the parameter of interest δ in equation (1) measures the impact of maternal smoking on children's bodyweight measures. Because we control for mother fixed effects, our identification is based on within-mother and across pregnancies variation in smoking behavior.

We estimate the models by least squares and adjust standard errors for clustering around mothers (Bertrand, Duo, & Mullainathan, 2004; Cameron & Miller, 2015). We report the results from unweighted regressions but results from weighted regressions are comparable (Solon, Haider, & Wooldridge, 2015).

[5] The findings from previous analyses are generally based either on descriptive analyses (comparing sample means of bodyweight measures across groups classified by mothers' smoking behavior) or simple regressions that exclude a number of potential observed and unobserved confounders.

Finally, some research indicate that bodyweight measures (such as the BMI) are likely to exhibit state-dependence (Cohen-Cole & Fletcher 2008; Norton & Han 2008; Fitzgibbons 2010; Deb et al. 2011). As such, regression analyses that consider bodyweight outcomes (especially BMI measures) as dependent variables often control for baseline (or prior measures of) BMI estimates to isolate the effects of interventions studied (Fitzgibbons 2010; Fletcher et al. 2010; Deb et al. 2011). Following from these studies, we test the robustness of our key findings by incorporating children's bodyweight measures from the immediately previous survey in equation (2).

$$Y_{cm} = \beta_1 + \rho.Mother\ Smoking_{cm} + \omega.LagY_{cm} + \beta_2.X_{cm} + \mu_m + \upsilon_{cm} \qquad (2)$$

In equation (2), $LagY_{cm}$ represents the bodyweight measures reported in the previous survey in NLS-CYA and ρ is the parameter that estimates the relationship between maternal smoking and children's bodyweight outcomes under the new specification.

4. Results

Table 3 reports results from the fixed effects regressions aimed at investigating the impact of maternal smoking while pregnant on child bodyweight outcomes. All models are estimated with the full set of controls presented in Table 1 along with mother fixed effects.

The first panel of Table 3 present estimates generated in the combined sample consisting of boys and girls. The second and third panels of Table 3 present results for the gender-specific samples, which are motivated by the fact that different gendered children have different developmental, physiological trajectories (Suzuki et al., 2011; Li et al., 2016; Durmuş et al., 2014).

If we first focus on the main variable of interest – the binary smoking indicator - in line with findings in previous literature, estimates in Table 3 suggest a significant reduction in children's birth weight and birth BMI because of maternal smoking during pregnancy. Specifically, full sample estimates show that mothers who report having smoked during pregnancy have children with birthweight lower by approximately 0.29 pounds and BMI lower by approximately 0.58 units compared to mothers who report otherwise. In terms of gender differences, we find birthweight drops by 0.25 and 0.37 pounds for girls and boys respectively when their mothers smoked during pregnancy, relative to those that did not.

After birth, we present the results from age one through five years. Interestingly, while continuing to focus on the binary indicator of smoking, we find that by age one, the estimated impact is statistically insignificant. At age two, the majority of the weight outcomes are also statistically insignificant – apart from the negative outcome for bodyweight for boys, which is marginally significant at the 10% level. This is evidence in favour of the 'catch up' effect hypothesized earlier. By age three and four, the impact has reversed and there is now evidence of positive effects of maternal smoking during pregnancy on bodyweight and BMI -

particularly for boys.

When we shift our focus to the impact dependent on quantity smoked, the results follow a similar pattern. We find negative impacts at birth, which are larger in magnitude the greater the quantity smoked. There is also evidence that these negative effects may linger at age two when the level of smoking is high (greater than a pack a day). From age three to five, these effects are either positive or statistically insignificant. The findings for smoking more than a pack a day should however be viewed with the caveat in mind that it is based on a small sample of women, and therefore may lack the same level of robustness that accompanies the results for the binary indicator of smoking.

It is also important to point out that Table 3 illustrates remarkable differences in the impact of maternal smoking on weight outcomes across samples of boys and girls. This gender disparity is consistent with broader scientific evidence on gender differences in fetal and infant development from medical literature (Halpern, 2013; Tontisirin et al., 2007; Brody, 1985; Collaer & Hines, 1995). In particular, our findings are in line with those by Suzuki et al. (2011) that finds smoking by pregnant women increases the likelihood of childhood weight gain for boys. Apart from minimal evidence when smoking intensity is high (at age five), there is close to no support for an increase in childhood weight gain for girls. This is in contrast to findings by Durmus et al. (2014) and Li et al. (2016), based on Dutch and Portuguese samples respectively.

While not provided in Table 3[6], for brevity sake, we find expected results for other controls included in our specifications. For instance, in the birth outcome model for body weight for all children, birth weight was higher the greater the birth order, and the higher the mother's weight, and lower when family size was greater, as well as if the baby was female.

Table 4 provides results for our robustness check of including lagged values of body weight measures in our specification. This is done for our core variable of interest – the binary indicator of smoking. In general, our key findings from Table 3 remain. There is evidence of lingering negative impacts on bodyweight for boys if their mother smoked during pregnancy, relative to those that did not. There is also continued evidence of positive impacts on bodyweight and BMI for boys at age three and four.

A further robustness check that we perform is related to the potential bias in our data due to misreporting of child height and weight information. To address this concern, we utilize additional information from the NLS-CYA to restrict our analysis to purely objective measurements of children's height and weight. While not reported here for the sake of brevity[6], this additional data restriction provides qualitatively similar findings to the results provided in Table 3. Although it should be noted that this robustness test has its own disadvantage of a

[6] NLS-CYA incorporates information on whether children's height and weight information are measured by scales. The additional analysis is available upon request to author.

substantially reduced sample size, which limits the reliability of the regression estimates obtained.

5. Conclusion

This study provides policy-relevant evidence on the potential child health impacts of a large preventable health risk. We examine the impact of mothers' smoking during pregnancy on children's body weight outcomes. Our contribution to the literature in this space is a focus on the causal link via exploiting the 'within-mother and across pregnancies' variation in smoking habits. Our estimates are therefore, based on differences in weight outcomes of siblings whose mother smoked during certain pregnancies and did not smoke during others.

Overall, our results indicate that children born to mothers who smoke during pregnancy are likely to have a lower birthweight and BMI, relative to children born to mothers who don't smoke during pregnancy. Further, there is evidence that boys in particular are at a greater risk of excess weight gain during later childhood years (ages 3 and 4).

As such, our study provides enhanced motivation for implementation of policies to effectively address smoking behavior among pregnant mothers, which is associated with large health concerns among mothers as well as their children.

Table 1: Descriptive statistics, NLSY CYA regression samples – Mean (Standard Deviation)

	Birth		1 year		2 years	
Mother information	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**
Smoked before childbirth	0.294 (0.456)	0.296 (0.456)				
Quantity smoked: < 1 pack	0.211 (0.408)	0.207 (0.406)				
≥ 1 pack	0.082(0.275)	0.090 (0.287)				
Substance use before childbirth	0.452 (0.497)	0.468 (0.499)				
Highest grade completed	12.270 (2.304)	12.271 (2.304)	13.025 (2.333)	13.042 (2.398)	12.964 (2.388)	12.904 (2.449)
Married	0.667 (0.471)	0.672 (0.469)	0.749 (0.434)	0.753 (0.432)	0.704 (0.457)	0.732 (0.443)
Employed	0.919 (0.272)	0.922 (0.267)	0.971 (0.168)	0.971 (0.167)	0.968 (0.175)	0.976 (0.153)
Age (years)	25.150 (4.787)	25.174 (4.741)	30.331 (4.889)	30.095 (4.691)	30.712 (4.981)	30.805 (5.053)
Weight (pounds)	166.085 (31.572)	166.843 (30.600)	148.150 (35.211)	146.730 (35.127)	147.786 (33.276)	147.871 (33.202)
Family information						
Family size	3.581 (1.797)	3.549 (1.758)	4.146 (1.358)	4.133 (1.331)	4.151 (1.358)	4.135 (1.337)
Poverty status	0.248 (0.432)	0.245 (0.433)	0.243 (0.429)	0.219 (0.413)	0.241 (0.428)	0.244 (0.430)
Sample Size	2995	3151	1066	1144	1200	1172

	3 years		4 years		5 years	
Mother information	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**
Highest grade completed	12.805 (2.349)	12.886 (2.456)	12.849 (2.354)	12.823 (2.378)	12.725 (2.287)	12.766 (2.502)
Married	0.693 (0.461)	0.713 (0.453)	0.685 (0.465)	0.686 (0.464)	0.648 (0.478)	0.667 (0.472)
Employed	0.968 (0.177)	0.969 (0.174)	0.967 (0.180)	0.968 (0.177)	0.969 (0.173)	0.971 (0.169)
Age	31.123 (5.252)	31.096 (5.027)	31.604 (5.414)	31.739 (5.473)	32.187 (5.591)	32.231 (5.459)
Weight (pounds)	148.214 (34.876)	148.830 (33.137)	150.198 (35.423)	147.957 (33.492)	151.137 (37.028)	150.230 (34.631)
Family information						
Family size	4.224 (1.414)	4.252 (1.342)	4.316 (1.401)	4.236 (1.338)	4.339 (1.390)	4.293 (1.407)
Poverty status	0.259 (0.438)	0.244 (0.430)	0.238 (0.426)	0.255 (0.436)	0.278 (0.448)	0.247 (0.431)
Sample Size	1325	1375	1410	1425	1488	1569

Notes: Due to the biennial nature of the NLSY data, the regression sample used for birth outcome regressions are classified into two cohorts of children (ages 1, 3 and 5 and ages 2 and 4). Binary indicators 'Married' and 'Employed' are constructed from NLSY information on mothers' marital status and number of jobs. 'Smoked before childbirth' and 'Substance use before childbirth' are based on the one year preceding childbirth. 'Quantity smoked' is based on the nine months during pregnancy.

Table 2: Weight and BMI, by smoking behaviour of mothers during pregnancy

	Age	Weight in pounds- children of non-smokers	Weight in pounds- children of smokers	Difference (1) – (2)	BMI - children of non-smokers	BMI- children of smokers	Difference (4) – (5)
		(1)	(2)	(3)	(4)	(5)	(6)
Girls	Birth	7.351	6.827	0.524***	13.148	12.418	0.730***
	1 year	21.038	21.142	-0.104	19.104	19.348	-0.244
	2 years	26.882	26.759	0.123	18.566	18.814	-0.247
	3 years	31.284	31.708	-0.013	16.737	17.598	-0.859*
	4 years	36.134	36.196	-0.061	16.174	16.904	-0.730*
	5 years	41.371	41.656	-0.283	16.063	16.111	-0.048
Boys	Birth	7.592	7.095	0.497***	13.090	12.740	0.349***
	1 year	22.901	22.970	0.068	20.057	20.083	0.026
	2 years	28.563	28.341	0.222	18.731	18.960	-0.229
	3 years	32.701	32.674	0.026	17.481	17.693	-0.211
	4 years	37.736	36.598	1.137**	16.486	16.580	-0.094
	5 years	42.328	42.339	-0.011	16.178	15.976	0.201

Notes: The body mass index (BMI) estimates are reported by age and sex for greater comparability in weight outcomes, as indicated by the CDC 2000 growth charts. The above estimates are based on regression samples used for corresponding age- and sex-specific regressions. The BMI-for-age charts are presented in https://www.cdc.gov/growthcharts/html_charts/bmiagerev.htm; Accessed on September 17, 2017.

***, **, * denotes difference between the means is significantly different from zero at the 10%, 5%, and 1% level respectively.

Table 3: Effects of maternal smoking during pregnancy on weight and BMI

ALL												
Age-	**Birth**		**1 year old**		**2 years old**		**3 years old**		**4 years old**		**5 years old**	
	Weight	**BMI**	**Weight**	**BMI**	**Weight**	**BMI**	**Weight**	**BMI**	**Weight**	**BMI**	**Weight**	**BMI**
Smoked	-0.287***	-0.577**	0.257	0.486	-0.940	-1.878	1.672**	0.931	1.278	1.551*	0.791	0.485
	(0.091)	(0.254)	(0.711)	(0.945)	(0.983)	(2.272)	(0.738)	(0.753)	(1.108)	(0.910)	(0.964)	(0.506)
Smoked < 1 pack	-0.272***	-0.514**	0.507	0.504	-0.627	-1.375	1.541**	0.572	1.279	1.799*	0.698	0.475
	(0.093)	(0.253)	(0.805)	(1.056)	(1.015)	(2.386)	(0.744)	(0.737)	(1.137)	(0.973)	(1.019)	(0.539)
Smoked ≥ 1 pack	-0.372***	-0.926**	-0.078	0.425	-2.650*	-4.665*	2.188*	2.348*	1.273	-0.082	1.221	0.529
	(0.131)	(0.423)	(1.353)	(2.192)	(1.559)	(2.402)	(1.245)	(1.252)	(1.513)	(1.901)	(1.462)	(0.601)
No. of mothers	3714		1749		1858		2048		2137		2243	
Sample size	6146		2210		2372		2700		2835		3057	
GIRLS												
Smoked	-0.254*	-0.511	0.946	-2.178	-1.348	-3.071	0.314	-0.402	0.061	-0.089	2.379	0.885
	(0.151)	(0.387)	(1.501)	(2.302)	(1.877)	(1.995)	(1.316)	(1.246)	(1.852)	(1.311)	(2.011)	(0.768)
Smoked < 1 pack	-0.191	-0.434	1.295	-1.423	-1.470	-3.189	0.320	-0.844	0.128	-0.195	1.741	0.569
	(0.150)	(0.392)	(1.723)	(2.432)	(1.868)	(2.058)	(1.337)	(1.292)	(1.874)	(1.327)	(2.070)	(0.761)
Smoked ≥ 1 pack	-0.623***	-0.968*	0.373	-3.428	-10.320**	-12.450***	0.292	1.212	-0.713	1.130	5.302*	2.336**
	(0.220)	(0.514)	(1.788)	(3.737)	(4.427)	(3.771)	(2.044)	(1.462)	(2.160)	(1.223)	(3.074)	(1.091)
No. of mothers	2361		945		1057		1152		1220		1270	
Sample size	2995		1066		1200		1325		1410		1488	
BOYS												
Smoked	-0.368**	-0.720	-0.937	1.265	-2.344*	-2.080	3.185*	1.596	3.820*	2.896	1.821	0.379
	(0.176)	(0.526)	(1.300)	(2.018)	(1.305)	(1.981)	(1.685)	(1.664)	(2.272)	(1.986)	(2.416)	(1.012)
Smoked < 1 pack	-0.349*	-0.562	-1.492	0.137	-1.945	-1.116	2.654	0.811	4.425*	3.447	1.536	0.250
	(0.183)	(0.531)	(1.403)	(2.111)	(1.329)	(2.132)	(1.649)	(1.356)	(2.369)	(2.234)	(2.438)	(1.029)
Smoked ≥ 1 pack	-0.457**	-1.464	2.217	7.625**	-4.661*	-7.888*	6.043***	5.970	1.485	0.767	3.597	1.184
	(0.229)	(0.947)	(1.745)	(3.165)	(2.546)	(4.125)	(2.049)	(3.732)	(2.585)	(1.310)	(3.354)	(1.440)
No. of mothers	2411		1014		1041		1208		1246		1337	
Sample size	3151		1144		1172		1375		1425		1569	

Notes: Fixed effects regressions control for mother's schooling, marital status, employment status, age, weight, family size and poverty status, birth order (and sex for the full sample regressions). The regressions for children's weight (as dependent variable) additionally controls for children's height (in feet). Robust standard errors in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels respectively.

Table 4: Effects of maternal smoking during pregnancy on weight and BMI by controlling for lagged values of body weight measures

ALL										
Age-	**1 year old**		**2 years old**		**3 years old**		**4 years old**		**5 years old**	
Variables	**Weight**	**BMI**	**Weight**	**BMI**	**Weight**	**BMI**	**Weight**	**BMI**	**Weight**	**BMI**
Smoked	0.188	0.498	-2.536**	-0.768	1.420	1.639*	1.302	1.605	0.399	1.463**
	(0.908)	(1.264)	(0.990)	(2.187)	(0.934)	(0.841)	(1.145)	(0.993)	(1.116)	(0.615)
No. of mothers	1590	1536	1687	1610	1608	1511	1741	1655	1841	1888
Sample size	1937	1855	2063	1951	2057	1897	2221	2087	2397	2489
GIRLS										
Smoked	1.026	-3.472	-2.769	-2.492	0.160	0.140	-0.037	-3.377	1.172	0.584
	(1.908)	(3.132)	(1.768)	(2.907)	(1.453)	(1.041)	(2.286)	(2.897)	(2.082)	(0.884)
No. of mothers	848	818	942	890	884	823	983	929	1054	1025
Sample size	932	899	1044	980	1000	928	1111	1046	1215	1174
BOYS										
Smoked	0.203	0.992	-3.723***	-5.105	2.245	2.664**	3.287	2.237**	2.088	1.721
	(1.542)	(3.057)	(1.280)	(4.423)	(1.890)	(1.227)	(2.106)	(1.028)	(2.826)	(1.191)
No. of mothers	907	870	922	884	944	944	995	937	1110	1075
Sample size	1005	956	1019	971	1057	969	1110	1041	1274	1223

Notes: Fixed effects regressions control for lagged outcome variable, mother's schooling, marital status, employment, age, weight, family size and poverty status, birth order (and sex for the full sample regressions). Robust standard errors in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels respectively.

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