The impact of parental job loss during the Great Recession on children's biomarkers: Findings from the Generation XXI Cohort

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Abstract

Emerging evidence suggests recessions have negative impacts on child health. In this study, we aim to detect underlying, biological pathways through which household economic shocks impact health in early life. Using data from the Generation XXI cohort (n=8647), we examine the impact of parental job loss during the Great Recession in Portugal on children's metabolic, cardiovascular, and stress-related inflammatory biomarkers and anthropometric measures. We find that parental job loss during the recession was associated with a number of metabolic, cardiovascular, and anthropometric outcomes in children, and effects were stronger among girls. These findings suggest that experiencing parental job loss during a period of economic decline may have primarily impacted children through nutrition related pathways. The results highlight the importance of protecting vulnerable families during economic downturns, as they may have lasting consequences for child health.

INTRODUCTION

While research on the effects of economic downturns on adult health has yielded mixed findings,(1) emerging research suggests that the Great Recession had negative impacts on the health of children. Studies have found that increased aggregate unemployment rates (2) as well as parents' perception of a severe recession impact on the household (3) were associated with increased risk of childhood overweight and obesity. Additionally, research has shown that specific impacts of the economic downturn on the household, such as social welfare reductions and difficulties paying bills and affording basics, such as food, were associated with increased risk of asthma, atopy, and parent-rated fair or poor child health status.(4)

Recent studies in adults have suggested that biomarkers, or biochemical, molecular, or cellular indicators of subclinical or clinical effects,(5) may offer additional insight into the effects of economic downturns on health. For example, research has found associations between work stress and higher white blood cell count and lower high-density lipoprotein [HDL] cholesterol,(6) as well as between unemployment and increased inflammatory biomarkers, particularly C-reactive protein [CRP].(7) Additionally, there is evidence that consistent and increased financial strain in the context of the Great Recession was linked to worsened metabolic and inflammatory biomarkers, such as HDL cholesterol, triglycerides, CRP, and glycated hemoglobin,(8) and that wealth shocks during the downturn were linked to increases in CRP and systolic blood pressure [SBP] in older adults.(9) Findings that behavioral pathways only explain 4.9% of the effect of financial strain on self-rated health suggest that it is important to explore underlying biological pathways between economic downturns and health in both adults and children.(10). To our knowledge, no studies have examined the impact of the Great Recession on children's biomarkers.

In this paper, we examine the impact of parental job loss during the Great Recession in Portugal on metabolic, cardiovascular, and stress-related, inflammatory biomarkers as well as on anthropometric outcomes in young children. Limited unemployment benefits and replacement income, increases in mean unemployment duration, as well as catastrophic job destruction due to firm closings and downsizing during the recession may have placed a severe financial strain on families in Portugal.(11) Additionally, there are several reasons to expect that parental job loss during the Great Recession would be associated with negative biomarker outcomes. It has been suggested that stress arising from economic downturns during childhood may 'reset' the immune system so that the inflammation process becomes dysregulated.(12) Given evidence of the negative effects of economic downturns and parental job loss on family dynamics and parent-child relationships,(13-15) we expect that increases in children's stress may be reflected in children's inflammatory biomarkers. Additionally, research on the high prevalence of food insecurity,(16) increased consumption of less-expensive, higher calorie foods,(17) and decreased consumption of fruits and vegetables (18) during the recession suggest that the impact of the recession may be reflected in children's metabolic and cardiovascular biomarkers as well as their anthropometric outcomes.

METHODS

Data

Data came from the Generation XXI child cohort study (n = 8647).(19) Women delivering live births were recruited at 5 public maternity hospitals in Porto Metropolitan Area, Portugal, which accounted for 95% of births in the region.(19) Children were assessed at birth (2005-2006), 4 years (2009 – 2011), and 7 years (2012-2014), and all children were invited to participate in biomarker collection at 7 years. Our sample for descriptive statistics included children who had at least one biomarker or anthropometric outcome measured at 7 years (n = 5842). The number of individuals included in each statistical model varies based on the number of missing cases for each outcome. Figure 1 details the timing of the Great Recession and data collection in Generation XXI.

Exposures

The main exposures were mother's job loss and father's job loss between baseline and 7 years, during which time the Great Recession began in Portugal. Both mother's and father's job loss were coded as binary variables equal to 1 if there was a change of parental employment status from employed to unemployed either between baseline and the 4-year follow-up, and/or between the 4-year and 7-year follow-up.

Biomarker and Anthropometric Outcomes

As only small sub-samples of children had biomarkers collected at birth and the 4-year follow-up, we used outcomes at 7-years when all children were invited to participate in biomarker collection. We analyzed inflammatory biomarkers (highly sensitive C-reactive protein [CRP] and leukocytes), metabolic biomarkers (high-density lipoprotein cholesterol [HDL], low-density lipoprotein cholesterol [LDL], total cholesterol, triglycerides, hemoglobin, glucose, insulin, and insulin resistance), cardiovascular biomarkers (systolic blood pressure [SBP], diastolic blood pressure [DBP], and heart rate), as well as anthropometric measures (height, weight, waist circumference, hip circumference, fat free mass, fat free mass percent, fat mass percent, body mass index [BMI], waist to height ratio, overweight, and obesity). Further details on the measurement units are provided in Table 1.

Prior to analysis, outcome values were screened, and extreme outliers were removed. Additionally, we excluded children with CRP > 10 as this is indicative of current infection rather than chronic inflammation.(20) SBP, DBP, and heart rate were calculated as the mean of three measurements. Body mass index was standardized according to World Health Organization [WHO] Body Mass Index [BMI]-for-age and sex standards, and overweight and obesity were determined using the WHO cut-offs.(21) Fat mass, fat mass percent, and fat free mass percent were measured with bioelectrical impedance and calculated with the Schaeffer equation.(22) Children were defined as pre-hypertensive if they have blood pressure > 95^{th} percentile for age and sex.(23) The cut-off for the binary waist to height ratio was 0.5.(24, 25) The cut-off used for a binary CRP variable was > 3, in line with previous research.(7)

Controls

We controlled for a range of baseline covariates, including child birthweight, maternal age at birth, child's sex, mother's marital status (married, consensual union, other: single/widow/separated/divorced), mother's education level (primary, secondary, tertiary), and household income bracket (< €500, €500 - 1000, €1001 - 1500, €1501 - 2000, €2001 - 2500, €2501 - 3000, > €3000). Depending on whether the exposure was mother's or father's job loss, we also controlled for mother's or father's baseline employment status (employed, unemployed, out of labor force) respectively. Additionally, we control for child's age in months at the 7-year follow-up, and for outcomes that do not include height in the measurement, we also controlled for child's height at the 7 years follow-up. In sensitivity analyses, we replace child height with child's body mass index [BMI] in all models that did not include height or weight in the measurement.

Statistical Analysis

We used ordinary least squares [OLS] for continuous and log-transformed outcomes, logistic regression for binary outcomes, and ordered logistic regression for ordinal outcomes to estimate the associations between parental job loss and the outcomes. Each outcome was individually regressed on the exposure variable and all covariates. The main models use the raw values of the continuous outcomes; however, in supplementary models, we log transformed all continuous outcomes to reduce skewness. We also transformed the raw variables into tertiles for use in ordered logistic regression and used binary outcomes at the top or lower tertile cut-offs as appropriate in logistic models. In sensitivity analyses, we also tested deciles and quartiles. To test for possible effect modification, we conducted subgroup analyses by child's sex, maternal education level at baseline, and period of job loss (baseline to 4 year follow up versus 4 year follow up to 7 year follow up).

Additionally, given the large number of outcomes being tested, we examined the false discovery rate using various methods to control the number of false positives, and further information is provided in the appendix. All analyses were conducted in Stata, version 15.(26)

RESULTS

Between baseline and wave 3, 16.84% of mothers and 8.88% of fathers experienced job loss (Table 2). Additionally, 39.27% of household experienced an income drop, as captured by changes in income bracket, and 16.76% of households experienced an increase in the neighborhood deprivation index (Table 2).

Among families where mothers experienced job loss, 53.15% also experienced a decrease in income bracket and 17.78% also experienced an increase in neighborhood deprivation. Among families where fathers experienced job loss, 56.26% also experienced an income bracket drop and 14.64% also experienced an increase in neighborhood deprivation level (Appendix Table 1). Parents who lost their jobs during the recession were more likely to have lower household income and lower educational levels at baseline (Appendix Tables 2 & 3). For both mothers and fathers, an additional year of education attained at baseline is associated with a -0.01 decrease in the probability of experiencing job loss.

Table 3 presents results from OLS models using raw value outcomes (column 1 for mother's job loss, column 3 for father's job loss) and log-transformed outcomes (column 2 for mother's job loss, column 4 for father's job loss). Mother's job loss was associated with higher SBP, DBP, heart rate, and fat mass percent, as well as with lower fat free mass percent. Father's job loss was associated with higher LDL cholesterol, weight, waist circumference, hip circumference, body mass index, and waist to height ratio. No associations were found between parental job loss and inflammatory biomarkers or metabolic biomarkers besides LDL.

Table 4 presents results from logistic models for binary outcomes. Father's job loss was associated with higher odds of the child being overweight and having a waist to hip ratio greater than 0.5 (column 2). There were no associations between mother's job loss and binary outcomes.

Table 5 presents results from models using ordered logistic and logistic regression on tertiles and highest tertile outcomes. No results using lowest tertile were significant. For the most part, results of ordered logistic models using tertiles of outcomes were consistent with the main models. Mother's job loss was associated with SBP, DBP, fat free mass percent, and fat mass percent (table 5, column 1). Father's job loss was associated with weight, waist circumference, hip circumference, body mass index, waist to height ratio, in addition to DBP, fat free mass percent, and fat mass percent (table 5, column 3). In logistic models which used binary outcomes indicating whether the child's outcome was in the highest tertile, mother's job loss was associated with triglycerides, SBP, fat free mass percent, and fat mass percent (table 5, column 2), and father's job loss was associated with haemoglobin, heart rate, weight, waist circumference, body mass index, waist to height ratio, and fat mass percent (table 5, column 4).

Sub-group analyses by child's sex are presented in tables 6 – 9. Among girls, mother's job loss is associated with higher SBP, DBP, heart rate, weight, waist circumference, hip circumference, body mass index, waist to height ratio, and fat mass percent, and lower fat free mass percent (table 6, columns 1 & 2), as well as greater odds of overweight and obesity (table 7, column 1). Also among girls, father's job loss was associated with higher CRP, SBP, weight, waist circumference, hip circumference, body mass index, and waist to height ratio, and lower fat free mass percent (table 6, columns 3 & 4), as well as with greater odds of a high waist to hip ratio (table 7, column 2).

By contrast, among boys, associations were less consistent. Mother's job loss was associated with less fat free mass (table 8, columns 1 & 2), and father's job loss was associated with less leukocytes, triglycerides, and glucose (table 8, columns 3 & 4), as well as with lower odds of having triglyceride levels greater than the 95th percentile (table 9, column 2). However, there were no clear associations for other outcomes for which an effect was observed among girls.

Sensitivity Analyses

Results of sensitivity and subgroup analyses are presented in the Appendix (appendix tables 4 - 12). Models which used quartiles (appendix table 4) and deciles (appendix table 5) in place of tertiles yielded mostly consistent results.

In sensitivity analyses which separated the periods of parental job loss, mother's job loss during the first period (baseline to wave 2), was associated with higher SBP, DBP, heart rate, and fat mass percent, as well as lower fat free mass percent (appendix table 6, columns 1 & 2). Father's job loss during the second period (wave 2 to wave 3) was associated with higher total and LDL cholesterol, weight, waist circumference, hip circumference, BMI, and waist to height ratio (appendix table 7, columns 3 & 4), as well as with higher odds of being overweight and having a high waist to height ratio (appendix table 8, column 2). However, no associations were detected between mother's job loss during period 2 or father's job loss during period 1 and child outcomes.

In subgroup analyses by maternal education level at baseline (appendix table 9), mother's job loss among children of mothers with primary education was associated with higher heart rate and fat mass percent, as well as lower fat free mass percent (columns 1 & 2). Mother's job loss among children whose mothers had secondary education was associated with higher diastolic blood pressure and lower fat free mass percent (appendix table 9, columns 3 & 4), as well as with higher odds of insulin resistance and high DBP (appendix table 10, column 2). Mother's job loss among children whose mothers had tertiary education was associated with lower glucose levels and greater height (appendix table 9, columns 5 & 6). Father's job loss among children of mothers with primary education at baseline was associated with higher CRP, weight, waist circumference, hip circumference, body mass index, and waist to height ratio in log-transformed models (appendix table 11, columns 1 & 2) as well as higher odds of overweight and waist to height ratio > 0.5 (appendix table 12, column 1). Father's job loss was associated with higher odds of obesity among children whose mothers had secondary education at baseline (appendix table 12, columns 2). Among children of mothers with tertiary education, father's job loss was associated with lower levels of leukocytes and haemoglobin (appendix table 11, columns 5 & 6).

DISCUSSION

To our knowledge, this is the first paper to examine potential biological pathways through which economic shocks impact health in childhood. This study contributes to the literature by examining the association between parental job loss and children's biomarkers during a period of significant economic decline in Portugal. Our results suggest that exposure to parental job loss during the Great Recession in Portugal was associated with a number of metabolic, cardiovascular, and anthropometric outcomes in children at age 7, including LDL cholesterol, total cholesterol, triglycerides, blood pressure, heart rate, fat mass, BMI, overweight, and waist to height ratio. These findings suggest that exposure to parental job loss during recessions in childhood may have lasting consequences for health.

Several mechanisms may explain the associations between parental job loss and poor metabolic, cardiovascular, and anthropometric outcomes in children. Psychosocial stress is a plausible pathway through which parental job loss during economic recessions may impact child health and biology.(12-15) However, the lack of consistent associations between parental job loss and inflammatory biomarkers suggests that stress might not be the primary pathway. Instead, the associations between parental job loss and higher lipid levels, blood pressure, body mass index and body fat levels point to nutrition related pathways. International evidence suggests that high quality diets are more expensive than low quality diets, and food may be considered a flexible part of a household's budget and scaled back in times of scarcity, particularly among those on low incomes who are more sensitive to the cost of food.(27) For example, in households experiencing food insecurity, food variety tends to decrease and the consumption of energy-dense foods tends to increase.(16) Evidence suggests that the Great Recession was detrimental for food security and nutritional intake among families in particular.(16, 28) For example, in the UK, families with young children exhibited greater declines in the nutritional quality

of foods purchased and larger reductions in real expenditure per calorie compared to other households during the Great Recession.(16) In the US, a one-percentage point increase in the local unemployment rate during the recession was associated with a 1.6-4.1 kcal per capita increase in total calories purchased.(28) Authors speculate that families may shift towards cheaper store-brand food alternatives during economic recessions, which are on average more calorically dense.(28)

Subgroup analyses suggest that there were important differences by child's sex, and that girls were more vulnerable to negative biomarker effects of parental job loss than boys. Prior research has offered a mixed picture on the differential effect of changes in family circumstances arising from economic downturns by gender, and the mechanisms that may explain this difference are not well understood. Some studies have reported that recessions have stronger effects on the emotional wellbeing of boys than girls, [15, 31] with a recent study on the Great Recession suggesting that parental job loss increased the risk of behavioural problems among boys but not girls.[32] The differential impact of parental job loss between boys and girls may emerge because of differences in their response to changes in parent's behaviour, or as a result of differences in parents' reaction to parental job loss depending on the gender of their child.[32] Yet, most of the literature has focused on emotional and psychological responses to the recession, while our findings suggest that diet-related biomarkers seem to be more sensitive than biomarkers of stress to economic shocks. The nature of differences by gender also points to a potential difference in metabolic response: girls appeared to be more likely to gain weight and develop overweight, obesity and a higher waist to hip ratio as a result of parental job loss; while boys exposed to parental job loss experienced higher triglycerides levels. While both effects might result from changes in diet, the difference may reflect metabolic differences in the reaction of body systems to sudden changes in dietary habits, which may end up harming girls more than boys.

This study had several limitations. First, we did not have longitudinal data on biomarkers for the entire sample, so we were not able to examine changes in biomarkers over time in relation to recession impacts. Additionally, our exposure variables may be prone to measurement error, as we may not capture job loss that occurred between waves where the parent returned to employment before the next wave of the study. This would potentially lead to underestimating the effects of parent job loss on parental health, as some parents who lost their jobs would be treated as employed. Additionally, our results may be biased due to using individual measures of parental unemployment, which may be connected to child health through unmeasured confounding. As we do not have a consistent measure of perceived economic hardship or other measures of household economic changes, we were not able to study the impacts of the macro-economic downturn on children whose parents remained employed, which may also influence children's health (33).

In conclusion, this study provides new evidence of an association between parental job loss and subclinical disease processes captured by a detailed biomarker assessment. We find that parental job loss during the recession may have negatively impacted children primarily in terms of metabolic and cardiovascular biomarkers and anthropometric outcomes. We find little evidence that these effects occurred through biomarkers of stress, and instead, findings suggest that children may have been affected through diet and nutrition related pathways. Our findings also highlight potential gender differences in biological responses to parental job loss, with girls more likely to develop overweight and obesity, and boys at higher risk of increased triglycerides, placing them both at increased risk of metabolic syndrome and non-communicable disease. These findings score the importance of policies that protect families and children from the severe impacts of economic hardship on diet and nutrition. Social protection programmes that enable families to purchase healthy foods may prevent long-lasting effects of economic downturns on child health and development.

FIGURES

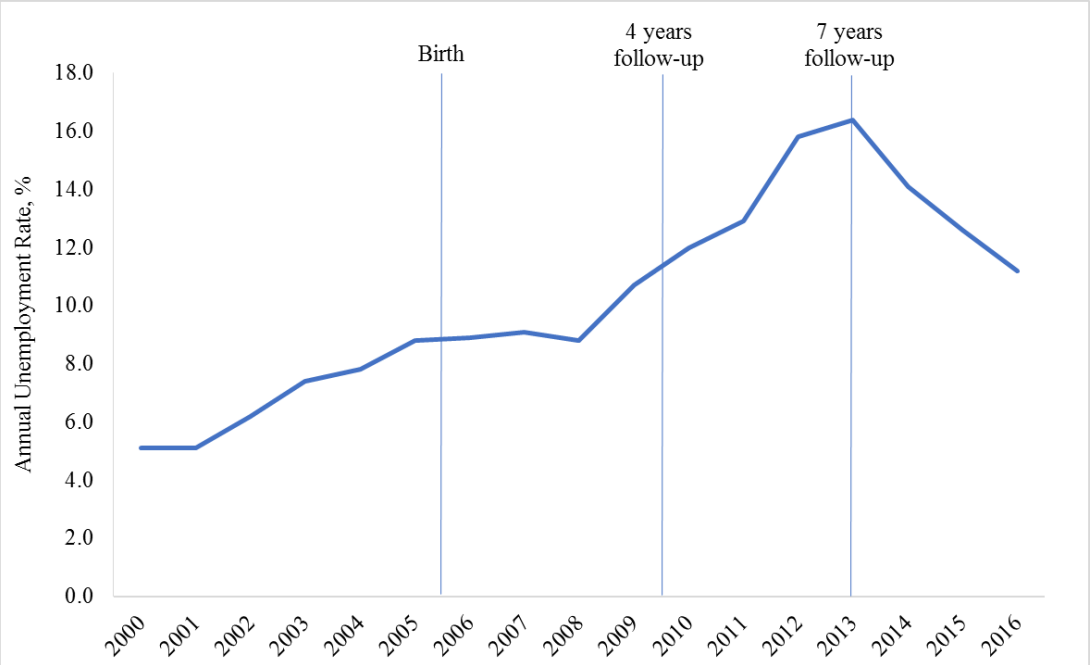

Figure 1: Portuguese Recession and Timing of Generation XXI Data Collection. Unemployment rate data from Eurostat. Unemployment rate is the annual rate among the active population. Generation XXI data was collected at birth (2005-2006), 4 years (2009-2011), and 7 years (2012-2014).

TABLES

Table 1: Biomarkers & Anthropometric Health Outcomes

Biomarkers	**Units**
Inflammatory	
Highly Sensitive C-Reactive Protein	mg/L
Leukocytes/White Blood Cells	$*10^9$/L
Metabolic	
Lipids	
HDL cholesterol	mg/dL
LDL cholesterol	mg/dL
Total cholesterol	mg/dL
Triglycerides	mg/dL
Other	
Hemoglobin	g/dL
Glucose	mg/dL
Insulin	microunit/mL
Insulin resistance	--
Cardiovascular	
Systolic Blood Pressure	mmHg

Diastolic Blood Pressure	mmHg
Heart Rate	bpm
Anthropometric	
Height	cm
Weight	kg
Waist Circumference	cm
Hip Circumference	cm
Fat free mass (Schaefer)	kg
Fat free mass percent (Schaefer)	%
Fat mass percent (Schaefer)	%
Body Mass Index	kg/m^2
Waist to height ratio	--
Waist to height ratio> 0.5	--
Overweight	--
Obese	--

Table 2: Families' transitions during the recession (between baseline and wave 3), n = 5842

Transition	n (%)
Mother's Job Loss	
Yes	984 (16.84)
No	4639 (79.41)
Missing	219 (3.75)
Father's Job Loss	
Yes	519 (8.88)
No	4619 (79.07)
Missing	704 (12.05)
Household Income Drop	
Yes	2294 (39.27)
No	3257 (55.75)
Missing	291 (4.98)
Neighborhood Deprivation Increase	
Yes	979 (16.76)
No	4855 (83.11)
Missing	8 (0.14)

Table 3: Ordinary Least Squares: Association between parental job loss during the recession and children's biomarkers and anthropometric measures

	Mother's Job Loss		**Father's Job Loss**	
	(1) OLS: Raw β (95% CI)	(2) OLS: Log β (95% CI)	(3) OLS: Raw β (95% CI)	(4) OLS: Log β (95% CI)
Inflammatory				
C-Reactive Protein[a]	0.053 (-0.064,0.170)	0.038 (-0.064,0.140)	0.101 (-0.083,0.285)	0.146 (-0.019,0.310)+
Leukocytes[a]	0.040 (-0.149,0.228)	0.008 (-0.016,0.032)	-0.216 (-0.526,0.093)	-0.034 (-0.073,0.006)+
Metabolic				
Total Cholesterol	0.111 (-2.283,2.505)	0.001 (-0.013,0.015)	2.682 (-1.078,6.442)	0.015 (-0.007,0.038)
HDL[a]	-0.254 (-1.163,0.656)	-0.006 (-0.023,0.010)	0.141 (-1.313,1.594)	0.001 (-0.025,0.027)
LDL[a]	0.148 (-1.885,2.180)	0.003 (-0.018,0.023)	**3.432 (0.223,6.642)***	**0.036 (0.003,0.069)***
Triglycerides[a]	0.365 (-2.470,3.199)	0.014 (-0.020,0.048)	-4.007 (-8.677,0.663)+	-0.045 (-0.100,0.010)
Glucose[a]	-0.268 (-0.924,0.388)	-0.003 (-0.010,0.005)	-0.934 (-2.038,0.169)+	-0.010 (-0.023,0.002)+
Insulin[a]	0.105 (-0.276,0.487)	0.018 (-0.039,0.075)	0.002 (-0.619,0.623)	0.046 (-0.046,0.137)
Hemoglobin[a]	-0.038 (-0.102,0.026)	-0.003 (-0.008,0.002)	0.070 (-0.035,0.175)	0.005 (-0.003,0.013)
Cardiovascular				
Systolic Blood Pressure[a]	**0.795 (0.162,1.428)***	**0.007 (0.002,0.013)***	0.656 (-0.378,1.690)	0.006 (-0.003,0.016)
Diastolic Blood Pressure[a]	**0.573 (0.021,1.124)***	**0.008 (0.000,0.016)***	0.816 (-0.085,1.717)+	0.012 (-0.001,0.025)+
Heart Rate[a]	**1.070 (0.170,1.970)***	**0.012 (0.002,0.022)***	1.107 (-0.291,2.505)	0.011 (-0.005,0.027)
Anthropometric				
Height[b]	-0.110 (-0.484,0.265)	-0.001 (-0.004,0.002)	-0.204 (-0.822,0.414)	-0.002 (-0.007,0.003)
Weight[a]	0.158 (-0.119,0.435)	0.007 (-0.003,0.016)	**0.483 (0.038,0.928)***	**0.021 (0.005,0.036)****
Waist Circumference[a]	0.267 (-0.175,0.710)	0.005 (-0.003,0.012)	**0.937 (0.222,1.652)***	**0.016 (0.004,0.027)****
Hip Circumference[a]	0.199 (-0.178,0.576)	0.003 (-0.002,0.009)	**0.725 (0.111,1.339)***	**0.011 (0.002,0.020)***
Body Mass Index[b]	0.093 (-0.092,0.279)	0.005 (-0.005,0.016)	**0.325 (0.031,0.620)***	**0.019 (0.002,0.035)***
Waist to Height Ratio[b]	0.002 (-0.002,0.006)	0.004 (-0.003,0.011)	**0.008 (0.002,0.013)***	**0.015 (0.004,0.027)***
Fat Free Mass[a]	-0.109 (-0.248,0.030)	-0.005 (-0.011,0.002)	0.010 (-0.221,0.241)	0.001 (-0.009,0.012)
Fat Free Mass Percent[a]	**-1.047 (-1.709,-0.384)****	**-0.013 (-0.021,-0.004)****	-1.030 (-2.104,0.045)+	-0.013 (-0.027,0.001)+
Fat Mass Percent[a]	**1.047 (0.384,1.709)****	**0.099 (0.042,0.156)*****	1.030 (-0.045,2.104)+	0.048 (-0.042,0.138)

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

[a] Models control for child birthweight, mother's age at baseline, child's gender, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up, & child's height at 7-year follow-up

[b] Models control for child birthweight, mother's age at baseline, child's gender, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up

Models 1 & 2 control for mother's employment at baseline

Models 3 & 4 control for father's employment at baseline

Models 1 & 3 use the raw outcomes

Models 2 & 4 use log-transformed outcomes

Table 4: Logistic Models: Association between parental job loss during the recession and binary outcomes

	(1) Mom became unemployed, baseline to 7-years follow-up	(2) Dad became unemployed, baseline to 7-years follow-up
	Logistic Binary Variables	Logistic Binary Variables
	OR (95% CI)	OR (95% CI)
High C-Reactive Protein, > 3	1.07 (0.76,1.49)	0.93 (0.53,1.63)
Low HDL, < 5th Percentile for age and sex	1.06 (0.71,1.58)	1.39 (0.72,2.66)
High Triglycerides, > 95th Percentile for age and sex	0.85 (0.56,1.29)	0.55 (0.26,1.16)
Insulin Resistance, HOMA > 2	1.12 (0.84,1.50)	1.01 (0.64,1.60)
High SBP, > 95th Percentile for age and sex	1.10 (0.85,1.42)	1.07 (0.70,1.64)
High DBP, > 95th Percentile for age and sex	1.20 (0.93,1.53)	0.81 (0.51,1.28)
Overweight, by BMI Z-score for age and sex	1.04 (0.89,1.21)	**1.40 (1.09,1.80)****
Obese, by BMI Z-score for age and sex	1.04 (0.84,1.27)	1.35 (0.98,1.85)+
Waist to Height Ratio > 0.5	1.01 (0.85,1.20)	**1.45 (1.10,1.90)****

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

All models control for child birthweight, mother's age at baseline, child's gender, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up

Model 1 controls for mother's employment at baseline

Model 2 controls for father's employment at baseline

Table 5: The impact of parental job loss on tertiles of biomarker outcomes: Ordered Logistic & Logistic Models

	(1) Mother's Job Loss		**(2) Father's Job Loss**	
	(a) Tertiles: Ordered Logistic	(b) Top Tertile: Logistic	(a) Tertiles: Ordered Logistic	(b) Top Tertile: Logistic
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Inflammatory				
C-Reactive Protein[a]	1.06 (0.90,1.24)	0.99 (0.82,1.20)	1.27 (0.98,1.65)+	1.32 (0.98,1.78)+
Leukocytes[a]	1.05 (0.90,1.24)	1.08 (0.90,1.29)	0.85 (0.65,1.11)	0.95 (0.70,1.28)
Metabolic				
Total Cholesterol	0.99 (0.84,1.16)	1.00 (0.84,1.20)	1.15 (0.89,1.48)	1.18 (0.88,1.57)
HDL[a]	0.95 (0.82,1.12)	1.05 (0.87,1.26)	0.99 (0.77,1.28)	0.95 (0.71,1.28)
LDL[a]	1.04 (0.89,1.22)	1.00 (0.83,1.20)	1.24 (0.97,1.60)+	1.17 (0.87,1.56)
Triglycerides[a]	1.12 (0.95,1.31)	**1.20 (1.00,1.44)***	0.89 (0.69,1.15)	0.90 (0.67,1.22)
Glucose[a]	0.90 (0.77,1.06)	0.87 (0.72,1.06)	0.86 (0.66,1.11)	0.87 (0.63,1.19)
Insulin[a]	1.03 (0.86,1.22)	1.07 (0.88,1.31)	1.14 (0.87,1.50)	1.18 (0.86,1.61)
Hemoglobin[a]	0.93 (0.80,1.09)	0.92 (0.76,1.11)	1.22 (0.93,1.59)	**1.42 (1.06,1.91)***
Cardiovascular				
Systolic Blood Pressure[a]	**1.21 (1.05,1.39)****	**1.18 (1.01,1.39)***	1.08 (0.86,1.36)	1.05 (0.80,1.38)
Diastolic Blood Pressure[a]	**1.15 (1.00,1.33)***	1.14 (0.97,1.34)	**1.27 (1.01,1.60)***	1.21 (0.93,1.57)
Heart Rate[a]	**1.16 (1.01,1.34)***	1.14 (0.97,1.34)	1.20 (0.95,1.52)	**1.34 (1.02,1.75)***
Anthropometric				
Height[b]	0.96 (0.84,1.11)	0.94 (0.79,1.11)	0.94 (0.74,1.18)	0.90 (0.68,1.18)
Weight[a]	1.10 (0.94,1.28)	1.07 (0.88,1.30)	**1.57 (1.21,2.04)*****	**1.51 (1.11,2.06)****
Waist Circumference[a]	1.09 (0.94,1.27)	1.10 (0.93,1.32)	**1.35 (1.06,1.73)***	**1.52 (1.15,2.01)****
Hip Circumference[a]	1.11 (0.95,1.29)	1.13 (0.94,1.36)	**1.35 (1.05,1.72)***	**1.31 (0.98,1.75)+**
Body Mass Index[b]	1.06 (0.92,1.22)	1.02 (0.87,1.20)	**1.30 (1.03,1.64)***	**1.37 (1.06,1.78)***
Waist to Height Ratio[b]	1.09 (0.94,1.25)	1.06 (0.90,1.24)	**1.38 (1.09,1.74)****	**1.52 (1.17,1.95)****
Fat Free Mass[a]	0.94 (0.80,1.10)	0.92 (0.75,1.11)	1.15 (0.90,1.49)	1.01 (0.73,1.39)
Fat Free Mass Percent[a]	**0.77 (0.66,0.89)*****	**0.70 (0.58,0.84)*****	**0.73 (0.57,0.93)***	0.78 (0.58,1.04)+
Fat Mass Percent[a]	**1.30 (1.12,1.51)*****	**1.23 (1.03,1.47)***	**1.37 (1.07,1.75)***	**1.41 (1.06,1.86)***

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

[a] Models control for child birthweight, mother's age at baseline, child's gender, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up, & child's height at 7-year follow-up
[b] Models control for child birthweight, mother's age at baseline, child's gender, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up
Model 1 controls for mother's employment at baseline
Model 2 controls for father's employment at baseline

Table 6: Sub-Group Analyses: Girls: Ordinary Least Squares: Association between parental job loss during the recession and children's biomarkers and anthropometric measures

	Mother's Job Loss		**Father's Job Loss**	
	(1) OLS: Raw β (95% CI)	(2) OLS: Log β (95% CI)	(3) OLS: Raw β (95% CI)	(4) OLS: Log β (95% CI)
Inflammatory				
C-Reactive Protein[a]	0.102 (-0.078,0.281)	0.100 (-0.048,0.247)	0.148 (-0.140,0.437)	**0.292 (0.047,0.537)***
Leukocytes[a]	-0.017 (-0.293,0.259)	-0.001 (-0.035,0.034)	0.137 (-0.339,0.614)	0.010 (-0.050,0.071)
Metabolic				
Total Cholesterol	-0.510 (-3.992,2.973)	-0.002 (-0.022,0.019)	3.161 (-2.561,8.884)	0.016 (-0.017,0.049)
HDL[a]	-0.507 (-1.764,0.751)	-0.012 (-0.035,0.011)	-0.949 (-3.095,1.198)	-0.021 (-0.060,0.018)
LDL[a]	0.041 (-2.971,3.053)	0.003 (-0.026,0.032)	4.407 (-0.553,9.367)+	0.047 (-0.003,0.096)+
Triglycerides[a]	0.353 (-3.773,4.479)	0.007 (-0.041,0.054)	1.067 (-6.189,8.323)	0.021 (-0.058,0.101)
Glucose[a]	0.256 (-0.638,1.150)	0.003 (-0.008,0.014)	-0.118 (-1.713,1.478)	-0.001 (-0.019,0.018)
Insulin[a]	0.433 (-0.131,0.996)	0.078 (-0.001,0.157)+	0.703 (-0.243,1.649)	0.107 (-0.025,0.239)
Hemoglobin[a]	-0.024 (-0.115,0.067)	-0.002 (-0.009,0.005)	0.148 (-0.009,0.306)+	0.011 (-0.001,0.023)+
Cardiovascular				
Systolic Blood Pressure[a]	**1.562 (0.645,2.478)*****	**0.015 (0.006,0.023)*****	**2.245 (0.674,3.817)****	**0.022 (0.007,0.036)****
Diastolic Blood Pressure[a]	**1.250 (0.454,2.045)****	**0.018 (0.007,0.029)****	1.246 (-0.110,2.602)+	0.018 (-0.001,0.037)+
Heart Rate[a]	**1.453 (0.104,2.802)***	**0.016 (0.002,0.030)***	1.961 (-0.159,4.081)+	0.022 (-0.001,0.046)+
Anthropometric				
Height[b]	0.104 (-0.425,0.632)	0.001 (-0.003,0.005)	-0.599 (-1.499,0.301)	-0.005 (-0.012,0.003)
Weight[a]	**0.566 (0.157,0.976)****	**0.020 (0.006,0.035)****	**0.780 (0.090,1.470)***	**0.033 (0.008,0.057)****
Waist Circumference[a]	**0.880 (0.223,1.538)****	**0.014 (0.004,0.025)****	**1.367 (0.249,2.485)***	**0.023 (0.005,0.041)***
Hip Circumference[a]	**0.700 (0.146,1.254)***	**0.010 (0.002,0.018)***	0.903 (-0.048,1.854)+	**0.014 (0.000,0.028)***
Body Mass Index[b]	**0.387 (0.110,0.663)****	**0.021 (0.006,0.036)****	**0.462 (0.003,0.922)***	**0.027 (0.001,0.052)***
Waist to Height Ratio[b]	**0.007 (0.002,0.013)****	**0.014 (0.004,0.025)****	**0.011 (0.002,0.020)***	**0.022 (0.004,0.040)***
Fat Free Mass[a]	0.043 (-0.158,0.243)	0.002 (-0.007,0.012)	0.141 (-0.206,0.489)	0.008 (-0.009,0.024)
Fat Free Mass Percent[a]	**-1.668 (-2.628,-0.709)*****	**-0.021 (-0.034,-0.009)*****	**-1.684 (-3.327,-0.041)***	**-0.021 (-0.042,-0.000)***

Fat Mass Percent[a]	**1.668 (0.709,2.628)*** **	**0.127 (0.051,0.203)** **	**1.684 (0.041,3.327)***	0.080 (-0.048,0.209)

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

[a] Models control for child birthweight, mother's age at baseline, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up, & child's height at 7-year follow-up

[b] Models control for child birthweight, mother's age at baseline, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up

Models 1 & 2 control for mother's employment at baseline

Models 3 & 4 control for father's employment at baseline

Models 1 & 3 use the raw outcomes

Models 2 & 4 use log-transformed outcomes

Table 7: Sub-Group Analyses: Girls**:** Logistic Models: Association between parental job loss during the recession and binary outcomes

	(1) Mom became unemployed, baseline to 7-years follow-up	(2) Dad became unemployed, baseline to 7-years follow-up
	Logistic Binary Variables	Logistic Binary Variables
	OR (95% CI)	OR (95% CI)
High C-Reactive Protein, > 3	1.04 (0.66,1.64)	0.97 (0.44,2.14)
Low HDL, < 5th Percentile for age and sex	0.92 (0.49,1.73)	1.84 (0.66,5.10)
High Triglycerides, > 95th Percentile for age and sex	0.90 (0.51,1.59)	1.21 (0.52,2.81)
Insulin Resistance, HOMA > 2	1.21 (0.83,1.76)	1.75 (0.96,3.18)+
High SBP, > 95th Percentile for age and sex	1.27 (0.89,1.81)	1.42 (0.76,2.64)
High DBP, > 95th Percentile for age and sex	1.34 (0.95,1.89)+	0.95 (0.49,1.85)
Overweight, by BMI Z-score for age and sex	**1.26 (1.01,1.58)***	1.37 (0.94,2.01)
Obese, by BMI Z-score for age and sex	**1.36 (1.03,1.80)***	1.58 (0.98,2.52)+
Waist to Height Ratio > 0.5	1.23 (0.98,1.55)+	**1.74 (1.18,2.56)****

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

All models control for child birthweight, mother's age at baseline, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up

Model 1 controls for mother's employment at baseline

Model 2 controls for father's employment at baseline

Table 8: Sub-Group Analyses: Boys: Ordinary Least Squares: Association between parental job loss during the recession and children's biomarkers and anthropometric measures

	Mother's Job Loss		**Father's Job Loss**	
	(1) OLS: Raw β (95% CI)	(2) OLS: Log β (95% CI)	(3) OLS: Raw β (95% CI)	(4) OLS: Log β (95% CI)
Inflammatory				
C-Reactive Protein[a]	0.015 (-0.137,0.168)	-0.013 (-0.155,0.129)	0.043 (-0.195,0.282)	0.003 (-0.221,0.228)
Leukocytes[a]	0.100 (-0.158,0.358)	0.017 (-0.017,0.050)	**-0.521 (-0.930,-0.112)***	**-0.072 (-0.125,-0.020)****
Metabolic				
Total Cholesterol	0.821 (-2.497,4.140)	0.005 (-0.015,0.025)	2.093 (-2.920,7.107)	0.014 (-0.017,0.044)
HDL[a]	0.077 (-1.244,1.398)	0.001 (-0.023,0.024)	1.092 (-0.901,3.085)	0.020 (-0.015,0.056)
LDL[a]	0.327 (-2.434,3.089)	0.002 (-0.026,0.031)	2.396 (-1.826,6.618)	0.025 (-0.020,0.070)
Triglycerides[a]	0.131 (-3.792,4.053)	0.018 (-0.031,0.067)	**-8.447 (-14.531,-2.362)****	**-0.103 (-0.179,-0.026)****
Glucose[a]	-0.832 (-1.794,0.130)+	-0.009 (-0.020,0.002)+	**-1.571 (-3.117,-0.026)***	**-0.018 (-0.035,-0.002)***
Insulin[a]	-0.236 (-0.753,0.281)	-0.042 (-0.125,0.041)	-0.488 (-1.316,0.340)	-0.000 (-0.129,0.128)
Hemoglobin[a]	-0.055 (-0.145,0.036)	-0.004 (-0.011,0.003)	-0.003 (-0.145,0.139)	-0.000 (-0.011,0.011)
Cardiovascular				
Systolic Blood Pressure[a]	0.027 (-0.849,0.903)	0.000 (-0.008,0.009)	-0.745 (-2.115,0.625)	-0.007 (-0.020,0.005)
Diastolic Blood Pressure[a]	-0.080 (-0.847,0.687)	-0.001 (-0.012,0.010)	0.405 (-0.807,1.616)	0.006 (-0.011,0.024)
Heart Rate[a]	0.706 (-0.496,1.909)	0.008 (-0.006,0.022)	0.340 (-1.527,2.206)	0.001 (-0.020,0.023)
Anthropometric				
Height[b]	-0.306 (-0.837,0.226)	-0.002 (-0.007,0.002)	0.091 (-0.764,0.947)	0.001 (-0.006,0.008)
Weight[a]	-0.232 (-0.608,0.144)	-0.006 (-0.019,0.006)	0.237 (-0.341,0.815)	0.011 (-0.009,0.031)
Waist Circumference[a]	-0.332 (-0.928,0.265)	-0.005 (-0.014,0.004)	0.608 (-0.313,1.530)	0.010 (-0.005,0.025)
Hip Circumference[a]	-0.283 (-0.797,0.230)	-0.004 (-0.011,0.004)	0.566 (-0.233,1.365)	0.009 (-0.003,0.021)
Body Mass Index[b]	-0.182 (-0.431,0.066)	-0.009 (-0.023,0.004)	0.202 (-0.177,0.582)	0.012 (-0.010,0.033)
Waist to Height Ratio[b]	-0.003 (-0.008,0.002)	-0.006 (-0.015,0.004)	0.005 (-0.002,0.013)	0.010 (-0.005,0.025)
Fat Free Mass[a]	**-0.253 (-0.447,-0.060)***	**-0.011 (-0.020,-0.002)***	-0.099 (-0.410,0.212)	-0.004 (-0.018,0.010)
Fat Free Mass Percent[a]	-0.457 (-1.373,0.459)	-0.005 (-0.016,0.007)	-0.512 (-1.930,0.906)	-0.007 (-0.024,0.011)

Fat Mass Percent[a]	0.457 (-0.459,1.373)	0.073 (-0.011,0.157)+	0.512 (-0.906,1.930)	0.019 (-0.108,0.147)

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

[a] Models control for child birthweight, mother's age at baseline, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up, & child's height at 7-year follow-up

[b] Models control for child birthweight, mother's age at baseline, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up

Models 1 & 2 control for mother's employment at baseline

Models 3 & 4 control for father's employment at baseline

Models 1 & 3 use the raw outcomes

Models 2 & 4 use log-transformed outcomes

Table 9: Sub-Group Analyses: Boys**:** Logistic Models: Association between parental job loss during the recession and binary outcomes

	(1) Mom became unemployed, baseline to 7-years follow-up	(2) Dad became unemployed, baseline to 7-years follow-up
	Logistic Binary Variables	Logistic Binary Variables
	OR (95% CI)	OR (95% CI)
High C-Reactive Protein, > 3	1.08 (0.66,1.78)	0.87 (0.39,1.92)
Low HDL, < 5th Percentile for age and sex	1.10 (0.65,1.86)	1.24 (0.53,2.92)
High Triglycerides, > 95th Percentile for age and sex	0.73 (0.39,1.36)	**0.11 (0.02,0.83)***
Insulin Resistance, HOMA > 2	1.01 (0.64,1.61)	0.55 (0.25,1.19)
High SBP, > 95th Percentile for age and sex	0.93 (0.63,1.35)	0.84 (0.47,1.53)
High DBP, > 95th Percentile for age and sex	1.08 (0.75,1.56)	0.72 (0.38,1.36)
Overweight, by BMI Z-score for age and sex	0.85 (0.68,1.07)	1.40 (1.00,1.96)+
Obese, by BMI Z-score for age and sex	0.79 (0.58,1.07)	1.17 (0.76,1.82)
Waist to Height Ratio > 0.5	0.79 (0.61,1.04)+	1.21 (0.82,1.78)

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

All models control for child birthweight, mother's age at baseline, mother's marital status at baseline, household income bracket at baseline, mother's education level at baseline, child's age in months at 7-year follow-up

Model 1 controls for mother's employment at baseline

Model 2 controls for father's employment at baseline

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