It's Just a Game

The Super Bowl and Low Birth Weight

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ABSTRACT

Previous studies have explored the effect of earthquakes and terrorist attacks on birth outcomes. These events are unexpected and obvious sources of distress, but could affect fetal health through multiple channels. Using data from the National Vital Statistics System for the period 1969–2004, we estimate the relationship between prenatal exposure to the Super Bowl and low birth weight. Although sporting events can elicit intense emotions, they do not pollute the environment or threaten viewers with direct physical harm. We find that Super Bowl exposure is associated with a small, but precisely estimated, increase in the probability of low birth weight.

I. Introduction

Prenatal shocks can have long-lasting economic consequences (Almond and Currie 2011) and take a variety of forms. For instance, researchers have examined the effects of poor nutrition (Lumey and Stein1997; Almond and Mazumder 2011), pollution (Currie, Greenstone, and Moretti 2011; Currie and Walker 2011), and infection (Kelly 2011; Currie and Schwandt 2013; Schwandt 2014) on birth outcomes.

There is also evidence that prenatal shocks can be psychological in nature (Aizer, Stroud, and Buka 2016). In-utero exposure to earthquakes (Torche 2011), terrorist attacks (Eskenazi et al. 2007), and the loss of a close relative (Persson and Rossin-Slater 2016; Black, Devereux, and Salvanes 2016) are all associated with reductions

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in birth weight. However, as noted by Black, Devereux, and Salvanes (2016), the literature has struggled to clearly distinguish the psychological impact of an event from its direct physical and financial consequences. For instance, natural disasters can pollute the environment or damage infrastructure (Liu, Liu, and Tseng 2015; Currie and Schwandt 2016), while the death of a parent can affect the resources available to a family.

In this study, we estimate the reduced-form effect of prenatal exposure to an event that takes place every year, the Super Bowl. The Super Bowl is the championship game of the National Football League (NFL). It is typically played in late January or early February, draws tens of millions of television viewers, and generates billions of dollars in revenue.[1] The Super Bowl is an ideal natural experiment because, unlike earthquakes and terrorist attacks, it takes place at a neutral location and does not expose pregnant women to pollution or prevent them from seeking prenatal care, nor does it threaten its viewers with direct physical harm or loss of livelihood.[2] To our knowledge, no previous study has examined the effect of intra-uterine exposure to a sporting event, although major sporting events clearly elicit intense emotional reactions (White, Katz, and Scarborough 1992; Kloner et al. 2009; Rees and Schnepel 2009; Card and Dahl 2011).

Drawing on publicly available data from the National Vital Statistics System (NVSS) for the period 1969–2004, we examine children who were born after, but conceived before, the Super Bowl by mothers who lived no further than one county away from an NFL stadium. Our identification strategy is based on the assumption that, because of league polices designed to promote parity and the sudden-death structure of NFL playoffs, the year in which a particular team advanced to the Super Bowl can be thought of as, in effect, randomly assigned. In other words, we assume that Super Bowl exposure is orthogonal to unobservable factors influencing birth weight.

We begin our analysis by showing that observables such as mother's age, educational attainment, marital status, and race are uncorrelated with Super Bowl exposure, a result that is consistent with random assignment to treatment. Next, we conduct a simple event study, the results of which suggest that first-trimester exposure to the Super Bowl leads, on average, to a 2 percent increase in the incidence of low birth weight, and then confirm this result using a standard difference-in-differences regression approach. Interestingly, first-trimester exposure to a Super Bowl win is associated with an almost 4 percent increase in the probability of having a low-birth-weight child, while the estimated effect of being exposed to a Super Bowl loss is much smaller and statistically insignificant. Upset wins (which could not have been anticipated) are associated with larger increases in the probability of having a low-birth-weight child than are predicted wins. We find no evidence that second- or third-trimester exposure to the Super Bowl increases the

1. The 2015 Super Bowl drew a record 114 million viewers, 47 percent of whom were women (Woodyard 2016). In comparison, the 2015 Academy Awards drew 36.6 million viewers (Kissell 2015). Recent Super Bowls have generated well over 100 million dollars in merchandise sales and over 300 million dollars in advertising revenue (Muret 2014; Johnson 2016).

2. In a similar spirt, Carlson (2014) estimated the impact of a Base Realignment and Closure (BRAC) announcement on gestational age and birth weight. This announcement, which occurred in May of 2005, "was met with much anxiety and distress" and led to temporary reductions in gestational age and birth weight (Carlson 2014, p. 31).

probability of having a low-birth-weight child.[3] Lastly, we consider potential behavioral responses to the Super Bowl. We find that winning the Super Bowl is associated with increased alcohol and tobacco use by pregnant mothers and note that Super Bowl exposure could lead to intimate partner violence. We conclude that psychological stress could contribute to the reduced-form relationship between prenatal Super Bowl exposure and low birth weight, but this relationship also could reflect one (or some combination) of these behavioral responses.

II. Background

A. Sporting Events as Triggers

The Super Bowl does not pollute the environment, threaten its viewers with direct physical harm, or limit access to prenatal care. There is, however, evidence from a variety of sources that major sporting events can produce intense emotional reactions.

For instance, Rees and Schnepel (2009) examined the relationship between Division I-A college football games and reported crime. These authors documented sharp increases in assaults and vandalism on game days. Although college football games often attract a temporary influx of people from outside the host community, Rees and Schnepel (2009) found that both upset wins and losses led to more assaults and vandalism than nonupsets, suggesting that fans were reacting to the outcome of the game.

Card and Dahl (2011) examined the relationship between domestic violence and the outcomes of regular-season NFL games. They argued that, conditional on the Las Vegas point spread, these outcomes can be thought of as exogenously generated emotional cues.[4] Card and Dahl found that upset losses were associated with a 10 percent increase in the number of police reports of male-on-female intimate partner violence (IPV), while the estimated relationship between upset wins and male-on-female IPV was much smaller and statistically insignificant at conventional levels.

Kloner et al. (2009) analyzed Los Angeles County death records from January and February for the period 1980–88. These authors found a spike in heart attacks immediately after the 1980 Super Bowl, when the Pittsburgh Steelers staged a fourth-quarter comeback to beat the Los Angeles Rams. Four years later when the Los Angeles Raiders cruised to an easy victory over the Washington Redskins (the final score was 38 to 9), there was no detectible increase in heart attacks in the Los Angeles area, and the overall death rate actually fell slightly.[5] Kloner et al. (2009) argued that "overindulgence" was not a good explanation for this pattern of results "given that the only Super Bowl associated with an increase in cardiac events was the losing 1980

3. We do not focus on regular-season games because fertility decisions could be a function of team performance, which is predictable. Moreover, the Super Bowl arguably affects a larger share of the population as compared to regular-season games.

4. In order to ensure that the betting market clears, Las Vegas bookmakers produce "point-spreads" before each regular-season and post-season NFL game. Research by Gandar et al. (1988) and Card and Dahl (2011) provides evidence that the closing point spread is a strong, unbiased predictor of game outcome.

5. A related study examined cardiovascular events among residents of the greater Munich area during the 2006 Federation Internationale de Football Association World Cup (Wilbert-Lampen et al. 2008). The authors found that when the German team played, cardiac emergencies increased sharply among both men and women.

game" (p. 1650), and concluded that, "The emotional stress of loss by a local sports team in a highly publicized rivalry such as the Super Bowl can serve as a trigger of cardiovascular deaths" (p. 1649).

B. Natural Disasters, Terrorist Attacks, and Birth Weight

A number of previous studies have examined the effects of dramatic, but wholly unexpected, events on birth outcomes. For instance, using vital statistics records from New York, Eskenazi et al. (2007) found an increased risk of very low birth weight (that is, less than 1,500 grams) among children born 33 through 36 weeks after the 2001 attack on the World Trade Center. Glyn et al. (2001) found that first-trimester exposure to an earthquake that struck Northridge, California, in 1994 was associated with a reduction in gestation duration of approximately 10 days. Torche (2011) found that first-trimester exposure to an earthquake that struck northern Chile in 2005 was associated with fewer weeks of gestation and an increased risk of low birth weight.[6]

These findings are consistent with the hypothesis that fetal health is negatively impacted by psychological stress experienced during pregnancy. However, earthquakes and terrorist attacks could, at least in theory, affect fetal health through other channels. An ideal natural experiment would elicit an emotional or psychological response, but would not, for instance, pollute the environment, limit access to prenatal care, reduce the availability of nutrient-rich food, or cause loss of livelihood. Sporting events can elicit strong reactions, their outcomes are often unpredictable, and they are materially inconsequential—there is no bigger sporting event in the United States than the Super Bowl.

III. The Data

The registration of births, deaths, and other vital events is done at the state level, but the National Center for Health Statistics (NCHS) is responsible for collecting and disseminating vital statistics data, which are made available through the National Vital Statistics System (NVSS). Our empirical analysis draws on NVSS data for the period 1969–2004, the final year in which geographic identifiers were publicly available. The full sample is composed of 29,595,333 singletons, all of whom were conceived one to nine months before the Super Bowl to mothers living in what we label an NFL "fan base area."

NFL fan base area is assigned using the mother's county of residence. In 1969 there were ten AFL (American Football League) and 16 NFL football teams. By 2004, the two

6. Specifically, Eskenazi et al. (2007) found that exposure to the September 11, 2001 attack on the World Trade Center increased the odds of very low birth weight by approximately 30 percent, while Torche (2011) found that first-trimester exposure to an earthquake led to an almost 40 percent increase in the incidence of low birth weight. Additional studies based on plausibly exogenous prenatal shocks include: Smits et al. (2006), Camacho (2008), Khashan et al. (2008), Mansour and Rees (2012), Persson and Rossin-Slater (2016), Brown (2014), Carslon (2014), Brown (2015), and Black, Devereux, and Salvanes (2016). Researchers also have explored the effects of maternal stress in the laboratory. For instance, Schneider et al. (1999) subjected pregnant rhesus monkeys to daily short bursts of noise. They found that early-pregnancy exposure to noise bursts led to significantly lower birth weight but did not shorten gestation duration. See Mulder et al. (2002) and Beydoun and Saftlas (2008) for reviews of the experimental literature.

Table 1
Descriptive Statistics

		At Risk of Exposure in:		
	Full Sample	First Trimester	Second Trimester	Third Trimester
Birth outcomes				
Birth weight (in grams)	3,353	3,330	3,342	3,384
	(0.103)	(0.207)	(0.171)	(0.165)
Low-birth weight (<2,500 g)	0.057	0.064	0.062	0.045
Gestation length in weeks	39.2	39.0	39.1	39.4
	(0.0004)	(.0009)	(0.0007)	(0.0006)
Preterm birth (<35 weeks gestation)	0.077	0.090	0.088	0.054
First born child	0.415	0.417	0.412	0.417
Born in hospital	0.987	0.987	0.987	0.987
Father indicated on birth certificate	0.889	0.886	0.888	0.891
Mother's characteristics				
Age	26.6	26.5	26.6	26.6
	(0.001)	(0.002)	(0.002)	(0.002)
Married	0.644	0.638	0.644	0.648
Unknown marital status	0.088	0.088	0.087	0.088

White	0.757	0.752	0.757	0.762
Black	0.190	0.196	0.190	0.185
Asian	0.045	0.045	0.045	0.046
Other race	0.007	0.007	0.007	0.007
Hispanic	0.189	0.196	0.188	0.186
Unknown Hispanic origin	0.256	0.257	0.256	0.256
Less than four high school	0.204	0.209	0.204	0.202
Four years of high school or some college	0.455	0.455	0.455	0.455
Four or more years of college	0.175	0.169	0.177	0.178
Education not reported	0.165	0.167	0.164	0.165
Sample size	29,595,333	7,953,443	11,364,724	10,277,166

Source: National Center for Health Statistics, Vital Statistics Data, 1969–2004.

Notes: Standard errors for continuous variables are shown in parentheses. The full sample includes singleton children who were conceived in May through December by mothers living in an NFL fan base area. Month of conception was assigned using gestation duration in weeks and month of birth. The first trimester sample is limited to children conceived in November and December; the second trimester sample is limited to children conceived in August through October; the third trimester sample is limited to children conceived in May through July. NFL fan base area was assigned using the mother's county of residence. If an NFL stadium was located in a county at any time during the period 1969–2004, then that county and its neighboring counties constitute an NFL fan base area. Hispanic origin questions first appear in the Vital Statistics Data in 1978.

leagues had merged, and the NFL included 32 teams, some of which had changed stadiums during the previous 35 years. If an NFL stadium was located in a county at any time during the period 1969–2004, then that county and its neighboring counties constitute one of 32 unique NFL fan base areas in the analyses below.[7]

For children born between 1969 and 1988, month of conception was determined by subtracting gestation duration (in weeks) from exact date of birth. However, exact date of birth is not available in the public-use NVSS data after 1988. For children born after 1988, month of conception was determined by subtracting gestation duration from the 15th of the birth month.[8]

Descriptive statistics for the full sample are given in the first column of Table 1. Mean birth weight is 3,353 grams; 5.7 percent of the children in the full sample weighed less than 2,500 grams at birth, the standard cutoff for low birth weight (LBW). In comparison, mean birth weight among all U.S. singletons in 1990 was 3,365 grams, and 5.9 percent were LBW (Martin et al. 2005).

In the second column of Table 1, the sample is restricted to children whose likely month of conception was either November or December. These children were at risk of Super Bowl exposure during their first trimester.[9] Descriptive statistics for children at risk of second-trimester exposure are reported in the third column of Table 1, and descriptive statistics for children at risk of third-trimester exposure are reported in the fourth column of Table 1.[10]

IV. Prenatal Exposure to Super Bowl and Low Birth Weight

A. Identification Strategy

Appendix Table 1 provides information on the 36 Super Bowls played during the period 1969–2004. During this period, 23 fan base areas were exposed to a Super Bowl at least once, and several were exposed more than once. Obviously, NFL teams are not randomly assigned to communities, but our analyses rely on within-community variation over time, in effect using each fan base area as its own control.

The NFL has adopted a number of policies designed to promote competitive balance, including ordering the draft (the team with the worst regular-season record picks first),

7. Several of the 32 NFL fan base areas did not have football teams every year during the period under study. However, all children born between 1969 and 2004 to mothers living in these fan base areas were included in the analysis.

8. We experimented with assigning date of birth to the first, and to the last, day of the birth month. The results reported below were not sensitive to these alternative methods of assignment.

9. The Super Bowl took place in January until 2002, when it was played on February 3; in 2003, it was played on January 26, and in 2004 it was played on February 1. We exclude children whose likely month of conception was January from the analysis because their mothers were potentially exposed to the Super Bowl before conceiving.

10. Children at risk of second-trimester exposure were conceived in August, September, or October, while children at risk of third-trimester exposure were conceived in May, June, or July. Because children born before February are excluded from the analysis, gestation duration is slightly longer (and the incidence of LBW is slightly lower) among children at risk of third-trimester exposure.

free agency, and the salary cap (Young 2014; Bien 2015).[11] These policies, combined with the sudden-death structure of the NFL playoffs, make it exceedingly difficult to predict which two teams will advance to the Super Bowl in any given year. The validity of our identification strategy rests on the premise that, for any given fan base area, the year in which their team advances to the Super Bowl is as good as randomly assigned. In this context, as-good-as-random assignment means that the year in which a team advances to the Super Bowl is independent of unobservable factors influencing birth weight. Although this assumption is fundamentally untestable, we provide strong empirical evidence supporting its validity.

Several previous studies in this literature have attempted to address complications due to geographical sorting and selective fertility.[12] Because the Super Bowl does not disrupt city services or damage infrastructure, geographical sorting is unlikely. Fertility decisions could, however, be influenced by a team's regular season record and playoff performance, potentially changing the composition of pregnant women exposed to the Super Bowl. In an effort to address this concern, we begin by examining the relationship between Super Bowl exposure and observable features of the mother and birth such as age, educational attainment, marital status, and race. Specifically, we consider the following linear probability model:

$$(1) \quad Y_{iat} = \alpha + \delta SuperBowl_{at} + \nu_a + w_t + \theta_a t + \varepsilon_{iat},$$

where Y_{iat} is an indicator for a particular feature of the mother or birth, and $SuperBowl_{at}$ is equal to one if fan base area a was exposed to the Super Bowl in year t (and is equal to zero otherwise). Year fixed effects are represented by w_t, area fixed effects are represented by ν_a, and area-specific linear time trends are represented by $\theta_a t$. The results of this exercise, which are reported in Table 2, suggest that Super Bowl years can be thought of as, in effect, randomly assigned. We report estimates of δ from 20 separate regressions in Table 2, and only one of these estimates is statistically significant at conventional levels.[13]

It is difficult to imagine why Super Bowl exposure would be essentially uncorrelated with observables such as mother's age and race, but correlated with the unobserved determinants of birth weight. Nevertheless, we provide two corroborating pieces of evidence for exogeneity below. First, we test whether the probability of having a LBW child was higher in the year prior to Super Bowl exposure. The estimated coefficient of the Super Bowl lead is small and statistically insignificant, suggesting that our results are not being driven by difficult-to-observe trends in the determinants of birth weight.

11. The NFL's commitment to league parity is embodied in its motto "Any given Sunday," which alludes to the fact that even the worst team in the league has a chance of beating the best team.

12. For example, an earthquake or hurricane might cause some pregnant women to move out of the affected area, creating the potential for endogenous sorting. Currie and Rossin-Slater (2013, p. 494) accounted for geographical sorting by using "the hypothetical exposure the mother would have experienced during each trimester of pregnancy as if she had never moved" to instrument for exposure. Black, Devereux, and Salvanes (2016) accounted for selective fertility and reverse causality by comparing mothers who experienced a death of a parent during pregnancy to mothers who experienced the death of a parent immediately before or after pregnancy.

13. We also estimated the relationship between Super Bowl exposure and conceptions, but found no evidence that exposure to the Super Bowl was related to the total number of conceptions occurring in an NFL fan base area. Likewise, there was no evidence that Super Bowl exposure impacted conceptions among women with less than a high school education or among black and Hispanic women. Estimates of these regressions for women whose likely month of conception was January or February are reported in Appendix Table 2. Estimates for women who conceived in other months are available upon request.

Table 2
The Relationship between Super Bowl Exposure and Mother/Birth Characteristics

	Mother's Race				Mother's Education					
	White	Black	Asian	Hispanic	No HS	HS	College	Married	Girl	First Birth
SB Year	–0.0034	0.0011	0.0008	0.0047	0.0019	0.0145	0.0082	0.0120	0.0002	0.0020
	(0.0028)	(0.0013)	(0.0013)	(0.0065)	(0.0104)	(0.0174)	(0.0055)	(0.0214)	(0.0005)	(0.0026)
Mean of *y*	0.757	0.190	0.0454	0.189	0.204	0.455	0.175	0.644	0.488	0.415
	Mother's Age									
	14–16	17–19	20–24	25–29	30–34	35–39	40–44	45–50	Father on Cert.	Hospital Birth
SB Year	0.0001	0.0004	0.0001	–0.0014	–0.0007	0.0014**	0.00004	0.00001	0.0043	0.0018
	(0.0002)	(0.0006)	(0.0017)	(0.0010)	(0.0014)	(0.0007)	(0.0002)	(0.00002)	(0.0040)	(0.0021)
Mean of *y*	0.0246	0.101	0.266	0.295	0.212	0.0850	0.0156	0.0007	0.889	0.987

Notes: Statistically significant at ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. The reported regressions are individual linear probability models with the indicated dependent variable. Each regression includes year fixed effects, NFL area fixed effects, and area-specific linear trends. The sample size is 29,595,333. Mean of *y* is the mean of the indicated dependent variable.

Second, we use the pregame Las Vegas point spread to identify upset wins and losses, which are inherently difficult to predict (Gandar et al. 1988; Card and Dahl 2011). We find that exposure to an upset win is associated with a substantial increase in the probability of LBW, while exposure to a predicted win is associated with a significantly smaller increase in this probability; exposure to other Super Bowl outcomes (for example, a predicted loss) is essentially unrelated to birth weight.

B. Event Study of Super Bowl Runs

If the year in which an NFL team advances to the playoffs is as good as randomly assigned, then identifying the treatment effect of prenatal exposure to the Super Bowl on birth outcomes can proceed much as it would in a randomized control trial. We begin by conducting a simple event study that compares birth outcomes in Super Bowl years with birth outcomes in the years immediately before and after a Super Bowl appearance. We follow existing literature by focusing on LBW.

Our event study is complicated by the fact that teams can make back-to-back Super Bowl appearances. To account for this, we consider Super Bowl "runs," defined as the year in which a team advanced to the Super Bowl or all of the years in series of back-to-back Super Bowl appearances with no more than a one-year gap. Using this definition, there were 44 distinct Super Bowl runs during the period under study.[14]

Figure 1 shows the percentage of children whose birth weight was below the 2,500 gram cutoff in a fan base area the year before, the year (or years) during, and the year following each of these 44 Super Bowl runs. An example of a simple one-year Super Bowl run is provided by the Baltimore Ravens, who played in the 2001 Super Bowl. Baltimore's previous Super Bowl appearance was in 1971, and the team did not return to the Super Bowl until 2013. The Figure 1 panel labeled BAL (Run 1) shows that 8.57 percent of children born in the Baltimore fan base area during the 2001 Super Bowl year were below the 2,500 gram cutoff, as compared to 8.40 percent the previous year and 9.09 percent the following year.

An example of a more complicated multiple-year Super Bowl run is provided by the Denver Broncos, who played in the 1987, 1988, and 1990 Super Bowls. The Figure 1 panel labeled DEN (Run 2) shows that 7.78 percent of children born in the Denver fan base area in the years 1987, 1988, and 1990 were below the 2,500 gram cutoff. This is higher than the 7.60 percent observed in 1986, the year before the Super Bowl run, and also higher than the 7.66 percent observed in 1991, the year after. Babies born in the "gap year" are not included in the analysis because 1989 was both the year before, and the year after, a Super Bowl appearance.[15]

In Figure 2A, we report averages across the 44 Super Bowl runs for the full sample and also for a subsample of children conceived in either November or December. No

14. Super Bowl runs that began before 1969 (the Baltimore Colts and the New York Jets) or concluded after 2004 (Carolina Panthers and New England Patriots) are excluded from this event study because the NVSS data for the year before or after the Super Bowl run are not available.

15. We explored several alternative definitions of a Super Bowl run, including defining the Super Bowl year as simply the first year of back-to-back appearances, limiting the sample to a team's first Super Bowl appearance, and limiting the sample to include only the one-year Super Bowl runs. All of these methods yielded similar results to those presented here.

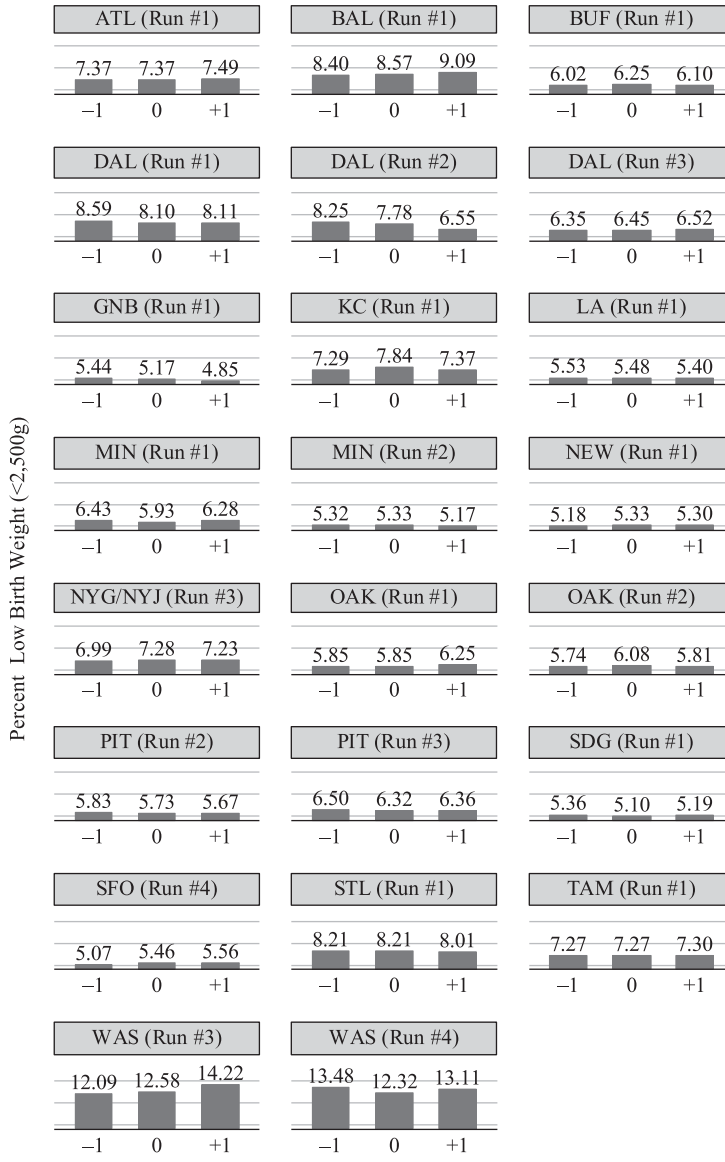

Figure 1

Percent Low Birth Weight (<2,500 g) Babies in the Years of and Surrounding Super Bowl Runs

Source: National Center for Health Statistics, Vital Statistics Data, 1969–2004.

Notes: The sample includes children who were conceived by mothers living in an NFL fan base area in May through December. A Super Bowl year (year zero) is all of the years the NFL team played in the Super Bowl during a Super

(*continued*)

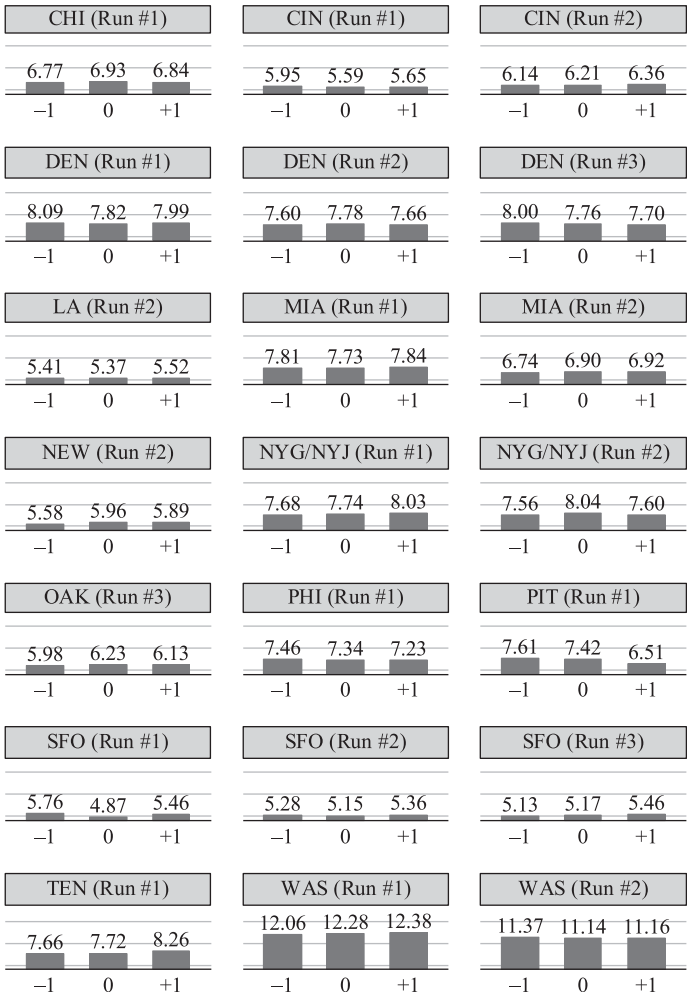

Figure 1

(Continued)

Bowl run. If a team played in two Super Bowls with a one-year gap in between, then the gap year is excluded from the sample. Year "–1" is the year before a Super Bowl appearance, or the year before the first in a series of back-to-back Super Bowl appearances with no more than a one-year gap. Year "+1" is the year after a Super Bowl appearance, or the year after the last in a series of back-to-back Super Bowl appearances with no more than a one-year gap.

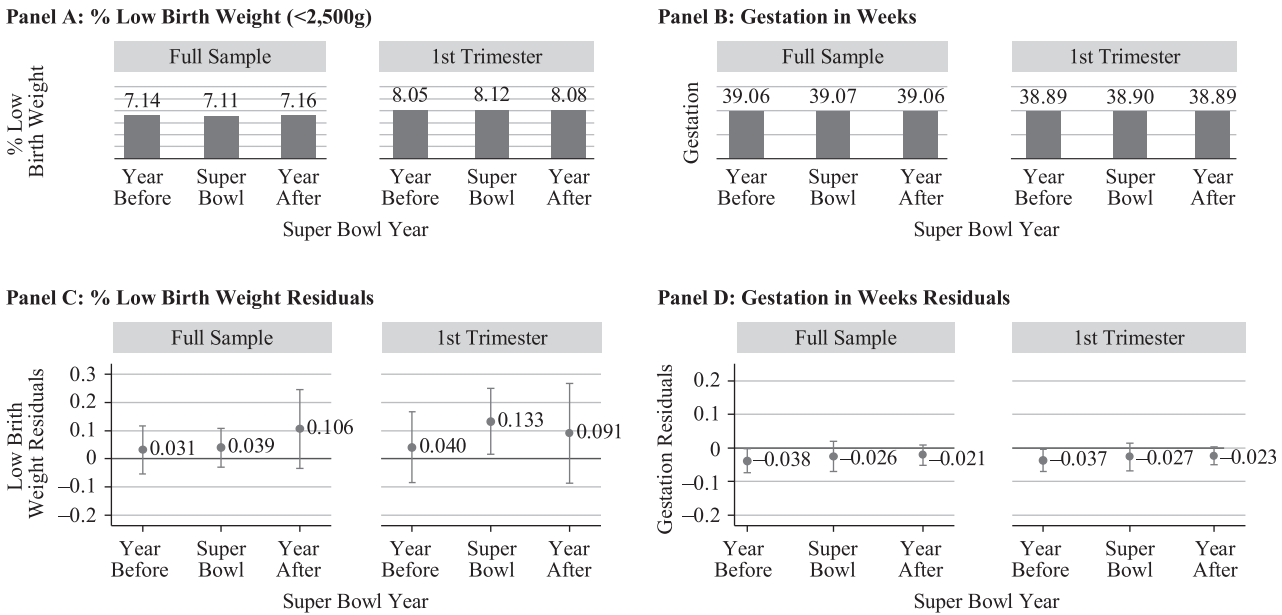

Figure 2

Average Percent Low Birth Weight (<2,500 g) Babies and Gestation in Weeks in the Years of and Surrounding Super Bowl Runs

Source: National Center for Health Statistics, Vital Statistics Data, 1969–2004.

Notes: The full sample includes singleton children who were conceived in May through December by mothers living in an NFL fan base area. The first trimester sample is limited to children conceived in November and December. Confidence intervals are at the ninety percent confidence level calculated from standard errors clustered at the NFL fan base level. The average residuals are calculated from regressions that includes area fixed effects, year fixed effects, and area-specific linear time trends. A Super Bowl year is the year the NFL team played in the Super Bowl or all years the NFL team played in the Super Bowl during a run of back-to-back Super Bowl appearances. If a team played in two Super Bowls with a -one-year gap in between, then the gap year is excluded from the sample and the Super Bowl run continues. Defined in this way, there are 44 Super Bowl runs during the sample period. Year before is the year before a Super Bowl run. Year after is the year after a Super Bowl run. The averages displayed give equal weight to each of the 44 Super Bowl runs shown individually in Figure 1. Averages that give equal weight to each birth produce a similar pattern.

clear pattern emerges in the full sample. However, when we restrict our attention to the subsample of children conceived in November or December, the results are consistent with the notion that first-trimester Super Bowl exposure can lead to LBW. Specifically, during Super Bowl runs, the mean of LBW was 8.12 percent. In comparison, it was 8.05 the year before and 8.08 percent the year after Super Bowl runs.

Figure 2B presents averages of gestational age measured in weeks across Super Bowl runs. Regardless of whether we examine the full sample or restrict our attention to children conceived in November or December, Figure 2B provides little evidence that the Super Bowl affects gestation duration.[16]

An analogous set of estimates using residuals from a simple low-birth-weight regression is presented in Figure 2C. These residuals are calculated by estimating:

$$(2) \quad LBW_{iat} = \alpha + \nu_a + w_t + \theta_a t + \varepsilon_{iat},$$

where LBW_{iat} is an indicator of low birth weight for child i born in NFL fan base area a and year t. Thus, the residuals from Equation 2 are the deviations in low birth weight that are not explained by location, year, and area-specific linear trends, and provide a direct estimate of the Super Bowl effect.

Figure 2C shows the estimated residuals from Equation 2 averaged across the 44 Super Bowl runs (giving equal weight to each run). There is little evidence of an association between Super Bowl exposure and LBW in the full sample. Similarly, Super Bowl exposure is essentially unrelated to gestation duration (Figure 2D).

However, when the sample is restricted to children who were at risk in their first trimester, Super Bowl exposure is associated with a 0.13 percentage-point increase in the probability of LBW. This estimate corresponds to a 2 percent increase relative to the mean of LBW ($0.13/6.4 = 0.02$) and is consistent with evidence that first-trimester exposure to an earthquake or extreme violence can increase the risk of LBW (Glyn et al. 2001; Eskenazi et al. 2007; Torche 2011; Mansour and Rees 2012; Brown 2015). The year before a Super Bowl run is associated with a relatively small (0.04 percentage-point) increase in the probability of LBW among children conceived in November or December, a result consistent with random assignment of Super Bowl exposure.[17]

C. Baseline Difference-in-Differences Estimates

To further explore the effect of prenatal exposure to the Super Bowl on birth weight, we estimate the following equation:

$$(3) \quad LBW_{iat} = \pi_0 + \pi_1 SuperBowl_{at} + \pi_2 SuperBowl_{at+1} + \pi_3 SuperBowl_{at-1} + \pi_4 LostDivision_{at} + \pi_5 LostConference_{at} + \mathbf{X}_{iat}\boldsymbol{\beta} + \nu_a + w_t + \theta_a t + \varepsilon_{iat},$$

where, as before, LBW_{iat}, is an indicator variable of low birth weight. The variable $SuperBowl_{at}$ is equal to one if children living in fan base area a were exposed to the

16. It is important to note that these averages give equal weight to each Super Bowl run, in effect imagining each Super Bowl run as a single treatment. However, averages that give equal weight to each birth produce identical patterns. These results can be provided from the authors upon request.

17. Although Figure 2 displays 90 percent confidence intervals, we formally address statistical significance when we turn to the regression analysis.

Super Bowl in year t, and is equal to zero otherwise. Including a one-year lead of the Super Bowl indicator, $SuperBowl_{at+1}$, provides an additional test of our identifying assumption. If the year in which a team advances to the Super Bowl is as good as randomly assigned, then our estimate of π_2 should be statistically indistinguishable from zero. Because we include indicators for whether a team was eliminated in the divisional or the conference playoffs in Equation 3, the coefficient of interest, π_1, represents the effect of exposure to the Super Bowl on the probability of having a low-birth-weight child as compared to not having been exposed to a Divisional Playoff game.[18] $\boldsymbol{X}_{iat}$ is a vector of controls, including indicators for month of conception, sex of the child, hospital birth, mother's first birth, father's name on birth certificate, mother's race, ethnicity, education, age, and marital status. The regressions also include year fixed effects (w_t), NFL fan base area fixed effects (ν_a), and, where indicated, area specific linear trends ($\theta_a t$). Standard errors are corrected for clustering at the NFL fan base area level (Bertrand, Duflo, and Mullainathan 2004).

Ordinary least squares (OLS) estimates of Equation 3 based on the full sample are reported in the first column of Table 3. In Table 4, we replace LBW with gestation duration. Again, estimates based on the full sample are reported in the first column. Super Bowl exposure is associated with a 0.08 percentage point increase in the probability of LBW, although this estimate is only significant at the 10 percent level. The estimated relationship between Super Bowl exposure and gestation duration is negative, but not significant at conventional levels.

In the remaining columns of Tables 3 and 4, we explore the effect of Super Bowl exposure by month of conception. Again, there is little evidence that Super Bowl exposure affects gestational duration.[19] Nor is there evidence that second- or third-trimester exposure to the Super Bowl leads to LBW. However, estimates of π_1 among children conceived in November and December are positive and statistically significant. Without including area-specific linear trends or the basic set of controls ($\boldsymbol{X}_{iat}$), first-trimester exposure to the Super Bowl is associated with a 0.15 percentage-point increase in the probability of LBW. Consistent with the assumption that Super Bowl exposure is as good as randomly assigned, including the controls and area-specific linear trends leads to an improvement in precision but has little impact on this estimate. Specifically, exposure to the Super Bowl is associated with a 0.13 percentage-point increase in the probability of LBW, a strikingly similar estimate to the one we report in Figure 2C.

18. Not reaching the Divisional Playoffs, losing a Divisional Playoff, losing a Conference Playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. Prior to 1978, the Divisional Playoffs were the first round, and the Conference Playoffs were the second round, of the NFL playoffs. In 1978, the NFL added an additional playoff round, the "Wild Card Playoffs," and the Divisional Playoffs became the second round of the playoffs. It should be noted that the interpretation of the regression estimate, π_1, is slightly different than the corresponding event-study estimate. The event analysis compared the incidence of low birth weight in Super Bowl years to non-Super Bowl years, while the differences-in-differences estimate compares Super Bowl years to nonplayoff years that neither immediately precede nor follow a Super Bowl. In addition, the event analysis gave equal weight to each run, while the regression analysis gives equal weight to each birth.

19. We also estimated the effects of first-trimester exposure to the Super Bowl, Super Bowl wins, and Super Bowl losses on the probability of a premature birth, defined as a birth with less than 37 weeks of gestation. Similar to the results reported in Table 4, these estimates were negative, but small and statistically insignificant. Finally, we estimated the impact of Super Bowl exposure on the fetal growth rate, defined as birth weight divided by gestation in weeks. We found little evidence of a relationship between Super Bowl exposure and the fetal growth rate.

Table 3
The Relationship between Super Bowl and Low Birth Weight (<2,500 g)

		At Risk of Exposure in:				
	Full Sample	First Trimester			Second Trimester	Third Trimester
	(1)	(2)	(3)	(4)	(5)	(6)
Lost in Divisional Playoffs	0.0002	0.0005	–0.00004	0.00004	0.0005	–0.0001
	(0.0002)	(0.0006)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Lost in Conference Playoffs	–0.0008***	–0.0004	–0.0008	–0.0008	–0.0007**	–0.0008***
	(0.0003)	(0.0008)	(0.0007)	(0.0006)	(0.0003)	(0.0003)
Played in Super Bowl	0.0008*	0.0015*	0.0009**	0.0013***	0.0007	0.0006
	(0.0004)	(0.0009)	(0.0004)	(0.0004)	(0.0005)	(0.0005)
Year before Super Bowl	0.0004	–0.0001	0.0005	0.0003	0.0005	0.0002
	(0.0006)	(0.0009)	(0.0004)	(0.0006)	(0.0005)	(0.0006)
NFL Area and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Area-Specific Linear Trends	Yes	No	Yes	Yes	Yes	Yes
Controls	Yes	No	No	Yes	Yes	Yes
Sample size	29,595,333	7,953,443	7,953,443	7,953,443	11,364,724	10,277,166

Notes: Statistically significant at ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. See Table 1 notes for sample definitions. Not reaching the divisional playoffs (the reference category), losing in the divisional playoff, losing in the conference playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. Where indicated, regressions include year fixed effects, area fixed effects, and area-specific linear time trends. Controls include indicators for month of conception, sex of the child, hospital birth, mother's first birth, father indicated on birth certificate, mother's race, ethnicity, education, age, and marital status.

Table 4
The Relationship between Super Bowl and Gestational Length in Weeks

		At Risk of Exposure in:		
	Full Sample (1)	First Trimester (2)	Second Trimester (3)	Third Trimester (4)
Lost in Divisional Playoffs	0.0064	0.0049	0.0045	0.0101
	(0.0138)	(0.0130)	(0.0123)	(0.0172)
Lost in Conference Playoffs	–0.0119	–0.0017	–0.0149	–0.0161
	(0.0240)	(0.0195)	(0.0235)	(0.0289)
Played in Super Bowl	–0.0415	–0.0413	–0.0445	–0.0384
	(0.0379)	(0.0346)	(0.0363)	(0.0428)
Year before Super Bowl	–0.0367	–0.0381	–0.0383	–0.0342
	(0.0339)	(0.0327)	(0.0323)	(0.0375)
Sample size	29,595,333	7,953,443	11,364,724	10,277,166

Notes: Statistically significant at $^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. See Table 1 notes for sample definitions. Not reaching the divisional playoffs (the reference category), losing in the divisional playoff, losing in the conference playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. All regressions include year fixed effects, area fixed effects, and area-specific linear time trends. In addition, they include indicators for the year before and year after a Super Bowl, month of conception, sex of the child, hospital birth, mother's first birth, father indicated on birth certificate, mother's race, ethnicity, education, age, and marital status.

To summarize, the results reported in Table 3 provide evidence that the relationship between Super Bowl exposure and LBW is strongest among children conceived in November or December. We focus our attention on these children, all of whom were at risk of exposure in their first trimester, for the remainder of the study.

D. Super Bowl Wins vs. Losses

Super Bowl wins can trigger raucous celebrations lasting for days. For instance, after the Seattle Seahawks won the Super Bowl in 2014, thousands of revelers gathered downtown. The impromptu party turned into a "riot" that continued until Monday morning and involved drinking, acts of vandalism, and confrontations with police (Dejohn 2014). On the Wednesday following their Super Bowl win, an estimated 700,000 Seattle Seahawks fans attended a victory parade (Lacitis 2014). In contrast, the reaction was much more subdued when the Seattle Seahawks lost the Super Bowl in 2015. Fans were denied access to the airport when the team arrived, and the team busses avoided the parade route from the previous year in order to discourage fans from gathering downtown (Hirschhorn 2015).

In Table 5, we replace the Super Bowl indicator variable in Equation 3 with indicators for whether the NFL team located in area a won or lost the Super Bowl in year t (that is,

Table 5
Super Bowl Wins vs. Losses and Birth Outcomes. Sample Restricted to Children at Risk of Exposure in the First Trimester

	Low Birth Weight (<2,500 g)		Gestational Length in Weeks	
	(1)	(2)	(3)	(4)
Lost in Divisional Playoffs	0.00004	0.0001	0.0049	0.0048
	(0.0003)	(0.0003)	(0.0130)	(0.0130)
Lost in Conference Playoffs	–0.0008	–0.0008	–0.0017	–0.0019
	(0.0006)	(0.0006)	(0.0195)	(0.0197)
Played in Super Bowl	0.0013***		–0.0413	
	(0.0004)		(0.0346)	
Lost Super Bowl		–0.0002		–0.0280
		(0.0007)		(0.0599)
Won Super Bowl		0.0025***		–0.0523*
		(0.0007)		(0.0273)
Sample size	7,953,443	7,953,443	7,953,443	7,953,443

Notes: Statistically significant at ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. Not reaching the divisional playoffs (the reference category), losing in the divisional playoff, losing in the conference playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. All regressions include year fixed effects, area fixed effects, and area-specific linear time trends. In addition, they include indicators for the year before and year after a Super Bowl, month of conception, sex of the child, hospital birth, mother's first birth, father indicated on birth certificate, mother's race, ethnicity, education, age, and marital status.

$LostSuperBowl_{at}$ and $WonSuperBowl_{at}$).[20] The odd-numbered columns of Table 5 reproduce estimates of first-trimester exposure originally reported in Table 3.[21] Estimates of being exposed to a win versus a loss are shown in the even-numbered columns. First-trimester exposure to a Super Bowl win is associated with an almost 4 percent increase (0.25/6.4 = 0.039) in the probability of LBW, while the estimated coefficient of $LostSuperBowl_{at}$ is small and statistically insignificant.[22] First-trimester exposure to a Super Bowl win is also associated with a 0.052 reduction in weeks of gestation, but we cannot reject the hypothesis that winning and losing the Super Bowl has the same effect on gestation duration.

20. A priori, it is not clear whether winning or losing the Super Bowl should have a larger impact on LBW. Stress is caused by a wide variety of events and circumstances (Hubert, Moller, and de Jong-Meyer 1993; Kirschbaum et al. 1995; Gerra et al. 1998), and the intensity of any behavioral response is likely to depend upon the outcome of the game.
21. Although the coefficients of the Super Bowl leads are not reported in Table 5 or subsequent tables, they are consistently insignificant and their exclusion does not change the coefficients reported below.
22. The hypothesis that the estimates of Super Bowl win and loss are equal can be rejected at the 0.05 level.

It is helpful to focus on a particular NFL area to put the magnitude of the estimated relationship between first-trimester exposure to a Super Bowl win and LBW in perspective. During the period under study, a team from New York won the Super Bowl three times (in 1969, 1987, and 2001), and a total of 67,570 children from the New York area were exposed to a Super Bowl win during their first trimester. If, on average, exposure led to a 0.0025 increase in the probability of LBW, then 169 of these children were pushed below the 2,500 gram cutoff.[23] Although earthquakes and terrorist attacks appear to have much larger effects on LBW, it is important to note that almost half of women in the United States do not consider themselves to be fans of professional football (Jones 2001), and although viewership has risen above 100 million in recent years, the popularity of the Super Bowl arguably peaked in the mid-1980s (Gorman 2009).[24]

E. Heterogeneous Effects

We report estimates of the effect of first-trimester Super Bowl exposure by mother's educational attainment, race, ethnicity, and marital status in Table 6. Despite the fact that NFL fans are more likely to have graduated from high school than nonfans (Jones 2001; Scarborough Research 2004), there is little evidence that first-trimester exposure to the Super Bowl is associated with LBW among children whose mothers had at least four years of secondary schooling (Panel A). In contrast, among children whose mothers did not complete high school, first-trimester exposure to a Super Bowl win is associated with a 0.36 percentage-point increase in the probability of LBW. One potential explanation for this pattern of results is that women who did not complete high school are more likely to engage in risky behaviors such as drinking or smoking.[25]

Professional football appears to be especially popular among nonwhites. According to a Gallup poll conducted in 2004, 71 percent of nonwhites said that they were NFL fans as compared to 62 percent of whites (Jones 2005). Panel B of Table 6 provides estimates of the relationship between first-trimester Super Bowl exposure and LBW by the mother's race and ethnicity. When the sample is restricted to the children of white mothers, first-trimester exposure to the Super Bowl is associated with a (statistically

23. To take another example, the Denver Broncos won the Super Bowl twice (in 1998 and 1999), and a total of 9,739 children from the Denver area were exposed to a Super Bowl win in their first trimester. If Super Bowl exposure led to an increase of 0.0025 in the probability of LBW, then roughly 24 of these children were pushed below the 2,500 gram cutoff.

24. A number of studies have found evidence that birth weight negatively impacts long-run outcomes such as educational attainment and earnings (Currie and Hyson 1999; Currie and Moretti 2007; Royer 2009). For instance, using data on Norwegian twins, Black, Devereux, and Salvanes (2007, p. 422) found that a 10 percent decrease in birth weight was associated with a 0.9 percentage point decrease in the probability of graduating from high school and a 1.2 percent decrease in earnings. Based on these results (and the results of regressing the natural log of birth weight on Super Bowl outcome indicators), we estimate that first-trimester exposure to a Super Bowl win would lead to a 0.025 percentage point decease in the probability of high school completion and a 0.034 percent decrease in earnings.

25. Farmer and Tiefenthaler (2003) provide evidence that women without a high school degree are at greater risk of IPV than their counterparts with a high school or college education. It is possible that women who did not complete high school were at greater risk of intimate partner violence (IPV) in the event of a loss (Card and Dahl 2011). However, the estimated coefficient on *LostSuperBowl is* actually negative and statistically insignificant.

Table 6
Super Bowl Exposure and Low Birth Weight, by Mother's Characteristics. Sample Restricted to Children at Risk of Exposure in the First Trimester

Panel A	No High School Degree		High School		College	
Played in Super Bowl	0.0013		0.0002		–0.0006	
	(0.0008)		(0.0006)		(0.0008)	
Lost Super Bowl		–0.0017		–0.0008		–0.0012
		(0.0019)		(0.0009)		(0.0011)
Won Super Bowl		0.0036***		0.0011		0.00001
		(0.0010)		(0.0011)		(0.0009)
Sample size	1,658,337	1,658,337	3,620,539	3,620,539	1,343,520	1,343,520
Panel B	White		Black		Hispanic	
Played in Super Bowl	0.0004		0.0041***		0.0024*	
	(0.0004)		(0.0011)		(0.0013)	
Lost Super Bowl		–0.0011*		0.0022		0.0018
		(0.0006)		(0.0023)		(0.0023)
Won Super Bowl		0.0016***		0.0054***		0.0028*
		(0.0005)		(0.0012)		(0.0015)
Sample size	5,979,104	5,979,104	1,556,558	1,556,558	1,561,358	1,561,358
Panel C	Married		Single			
Played in Super Bowl	0.0005		0.0035***			
	(0.0004)		(0.0010)			
Lost Super Bowl		0.0001		–0.0018		
		(0.0008)		(0.0034)		
Won Super Bowl		0.0004		0.0067***		
		(0.0008)		(0.0024)		
Sample size	5,071,938	5,071,938	2,179,426	2,179,426		

Notes: Statistically significant at ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. Not reaching the divisional playoffs (the reference category), losing in the divisional playoff, losing in the conference playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. All regressions include year fixed effects, area fixed effects, and area-specific linear time trends. In addition, they include indicators for the year before and year after a Super Bowl, month of conception, sex of the child, hospital birth, mother's first birth, father indicated on birth certificate, mother's race, ethnicity, education, age, and marital status.

insignificant) 0.04 percentage-point increase in the probability of LBW, and first-trimester exposure to a Super Bowl win is associated with a 0.16 percentage-point increase in this probability. When the sample is restricted to the children of black mothers, the estimated effect of first-trimester Super Bowl exposure increases to 0.41 percentage points, and the estimated effect of winning increases to 0.54 percentage points, both significant at the 1 percent level. Although professional football is not particularly popular among Hispanics (Scarborough Research 2004), a similar pattern of results is obtained when we restrict the sample to the children of mothers who identified themselves as Hispanic: First-trimester Super Bowl exposure is associated with a 0.24 percentage-point increase in the probability of LBW, and first-trimester exposure to a Super Bowl win is associated with a 0.28 percentage-point increase in this probability.

Finally, the sample is divided based on the mother's marital status in Panel C of Table 6. We find that first-trimester Super Bowl exposure is associated with an increased probability of LBW only for single mothers. First-trimester exposure to a Super Bowl win is associated with a 0.67 percentage-point increase in the probability of LBW among single women, but we find no such evidence for married mothers.

F. Unexpected vs. Expected Super Bowl Outcomes

One of the advantages to using the Super Bowl as a natural experiment is that we know the pregame Las Vegas point spread. With this information, we can identify upset (that is, unexpected) wins and losses. There is evidence that upsets generate particularly strong emotional responses (Rees and Schnepel 2009; Card and Dahl 2011). Moreover, they are, by definition, difficult to predict and therefore could not have affected fertility decisions occurring in November and December.

In this section, we extend our analysis by replacing $SuperBowl_{at}$ in Equation 3 with six mutually exclusive variables based on the Las Vegas point spread and the work of Card and Dahl (2011). A "predictable" game outcome occurs when a team wins (or loses) the Super Bowl when they were predicted to win (or lose) by four or more points. An "upset" occurs when a team wins (or loses) the Super Bowl when they were predicted to lose (or win) by four or more points. An "unpredictable" win or loss occurs when the point spread was less than four points.

Thirty-six Super Bowls were played during the period under study. Nineteen of these Super Bowls produced an expected outcome (in other words, the closing Las Vegas point spread was greater than or equal to four and the favored team won). Six of these Super Bowls produced an upset (in other words, the closing Las Vegas point spread was greater than or equal to four and the underdog team won). The outcome of the remaining games was unpredictable. Appendix Table 1 presents the Las Vegas point spreads and the outcomes of the 36 Super Bowls played over the period 1969–2004.

The results of this exercise are reported in Column 3 of Table 7; to facilitate comparison, Columns 1 and 2 of Table 7 reproduce estimates originally reported in Tables 3 and 5. Among children at risk of exposure in their first trimester, losses (whether predicted or not) are essentially unrelated to LBW, while upset wins are associated with a sharp increase the probability of LBW. Specifically, first-trimester exposure to an upset win is associated with a 0.49 percentage-point increase in the probability of having a child who weighed less than the 2,500 gram cutoff, which corresponds to a 7.7 percent

Table 7
The Effects of Expected vs. Unexpected Super Bowl Outcomes on Low Birth Weight. Sample Restricted to Children at Risk of Exposure in the First Trimester

	(1)	(2)	(3)
Lost in Divisional Playoffs	0.00004	0.0001	0.00005
	(0.0003)	(0.0003)	(0.0003)
Lost in Conference Playoffs	–0.0008	–0.0008	–0.0008
	(0.0006)	(0.0006)	(0.0006)
Played in Super Bowl	0.0013***		
	(0.0004)		
Lost Super Bowl		–0.0002	
		(0.0007)	
Upset Loss			0.0002
			(0.0011)
Unpredictable Loss			–0.00004
			(0.0015)
Predicted Loss			–0.0005
			(0.0009)
Won Super Bowl		0.0025***	
		(0.0007)	
Upset Win			0.0049***
			(0.0006)
Unpredictable Win			0.0007
			(0.0014)
Predicted Win			0.0021***
			(0.0005)
Sample size	7,953,443	7,953,443	7,953,443

Notes: Statistically significant at ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. Not reaching the divisional playoffs (the reference category), losing in the divisional playoff, losing in the conference playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. An upset/predicted win/loss occurred when the Las Vegas point spread was greater than or equal to four points. An unpredictable win/loss occurred when the Las Vegas point spread was less than four points. All regressions include year fixed effects, area fixed effects, and area-specific linear time trends. In addition, they include indicators for the year before and year after a Super Bowl, month of conception, sex of the child, hospital birth, mother's first birth, father indicated on birth certificate, mother's race, ethnicity, education, age, and marital status.

increase in the incidence of LBW.[26] Although the estimated coefficient of *Unpredictable Win* is small and statistically insignificant, first-trimester exposure to a predicted win is associated with a 0.21 percentage-point increase in the probability of LBW.[27]

G. Behavioral Responses

Eskenazi et al. (2007, p. 3014) argued that the 2001 terrorist attack on the World Trade Center could have resulted in "maladaptive coping behaviors" such as smoking and drinking, both of which have been linked to LBW. Could exposure to the Super Bowl have encouraged or somehow triggered these same behaviors among pregnant women?[28]

In the first two columns of Table 8, we present estimates of the relationship between first-trimester Super Bowl exposure and *Tobacco Use* (equal to one if the mother of child *i* reported smoking while pregnant, and equal to zero otherwise).[29] Because the NVSS did not include information on tobacco use prior to the 1989 revision of the Standard Certificate of Birth (Friedman 2007), these estimates are based on NVSS data for the period 1989–2004. The estimated relationship between first-trimester Super Bowl exposure and tobacco use is positive, but not statistically significant at conventional levels. When *SuperBowl* is replaced with *WonSuperBowl* and *LostSuperBowl* in Column 2, we find that first-trimester exposure to a Super Bowl win is associated with a 4.5 percent increase in the probability that child *i*'s mother smoked during pregnancy (0.49/10.84 = 0.045); first-trimester exposure to a Super Bowl loss is associated with a small, statistically insignificant, reduction in this probability.

Alcohol consumption represents another potential behavioral response to Super Bowl exposure.[30] We report estimates of the relationship between first-trimester Super Bowl exposure and alcohol consumption in the remaining columns of Table 8. The

26. Teams at risk of experiencing an upset win are by definition Super Bowl underdogs, a fact that is known in advance of the game. These underdogs go on to experience either a predicted loss or an upset win. However, because an upset win is unpredictable, conditions prior to the game (including fertility decisions) cannot explain why the estimated coefficient of *Upset Win* is statistically different from that of *Predicted Loss* ($p < 0.0001$).

27. The estimated coefficients of predicted win, unpredictable win, and upset win are significantly different from each other at the 0.05 level.

28. It is possible that these behaviors were adopted in an effort to cope with Super Bowl-induced stress. Alternatively, Super Bowl parties and postgame celebrations could have led to these behaviors, ultimately affecting the health of the fetus. Super Bowl parties and postgame celebrations could also, in theory, have exposed pregnant women to more second-hand smoke or affected their sleep patterns.

29. Almost 11 percent of mothers in our sample who conceived in November or December reported smoking while pregnant, but it should be noted that researchers have, by examining medical records, found that tobacco use is underreported on birth certificates (Reichman and Hade 2001). Although there is little evidence that smoking during early pregnancy reduces birth weight (Bernstein et al. 2005; Jaddoe et al. 2008; Prabhu et al. 2010), first-trimester exposure to a Super Bowl win could have caused ex-smokers to relapse, and there is strong evidence that smoking in the second and third trimesters substantially increases the risk of LBW (Bernstein et al. 2005; Jaddoe et al. 2008). Between 57 and 77 percent of women smokers in the United States fail to quit smoking when they become pregnant (Schneider et al. 2010, p. 83).

30. Moderate drinking, typically defined as a maximum of one drink per day, is only weakly related to birth weight, but there is evidence that heavy drinking leads to an increased risk of having a low-birth-weight child (Patra et al. 2011).

Table 8
Super Bowl Exposure and Substance Use During Pregnancy. Sample Restricted to Children at Risk of Exposure in the First Trimester in the Years 1989–2004

	Tobacco Use		Alcohol Use	
	(1)	(2)	(3)	(4)
Lost in Divisional Playoffs	–0.0017**	–0.0017**	–0.0002	–0.0002
	(0.0008)	(0.0008)	(0.0006)	(0.0006)
Lost in Conference Playoffs	0.0012	0.0011	–0.0008	–0.0008
	(0.0019)	(0.0018)	(0.0008)	(0.0008)
Played in Super Bowl	0.0023		0.0022*	
	(0.0016)		(0.0012)	
Lost Super Bowl		–0.0006		–0.0015
		(0.0025)		(0.0017)
Won Super Bowl		0.0049**		0.0055**
		(0.0024)		(0.0023)
Average tobacco/alcohol use	0.1084	0.1084	0.0159	0.0159
	(0.0010)	(0.0010)	(0.0001)	(0.0001)
Sample size	2,815,001	2,815,001	2,875,165	2,875,165

Notes: Statistically significant at ***$p < 0.01$, **$p < 0.05$, *$p < 0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. Not reaching the divisional playoffs (the reference category), losing in the divisional playoff, losing in the conference playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. All regressions include year fixed effects, area fixed effects, and area-specific linear time trends. In addition, they include indicators for the year before and year after a Super Bowl, month of conception, sex of the child, hospital birth, mother's first birth, father indicated on birth certificate, mother's race, ethnicity, education, age, and marital status.

estimated relationship between first-trimester Super Bowl exposure and alcohol use is positive and significant at the 10 percent level; first-trimester exposure to a Super Bowl win is associated with a 34 percent increase in the probability of alcohol use ($0.55/1.6 = 0.34$).[31] These estimates, however, should be interpreted with caution. According to the Centers for Disease Control (2009), approximately 12 percent of pregnant women drink, while less than 2 percent of children in our sample were born to mothers who reported consuming alcohol.

31. Stoecker, Sanders, and Barrecca (2016) found that advancing to the Super Bowl was associated with more influenza deaths among the elderly, a result these authors attributed to increased "local socialization." However, there is no evidence of a relationship between first-trimester exposure to influenza and birth weight. In fact, Kelly (2011) found that second-trimester exposure to influenza reduced birth weight, whereas Currie and Schwandt (2013) and Schwandt (2014) found that third-trimester exposure to influenza was associated with LBW.

V. Conclusion

In-utero exposure to events such as earthquakes (Glyn et al. 2001; Torche 2011), terrorist attacks (Eskenazi et al. 2007), weather extremes (Simeonova 2011; Currie and Rossin-Slater 2013), and the loss of a close relative (Black, Devereux, and Salvanes 2016; Persson and Rossin-Slater 2016) is associated with lower birth weight. Although obvious sources of distress, natural disasters, and unexpected acts of violence could have direct effects on the environment and access to prenatal care, while the death of a parent or sibling could affect the financial resources available to a family.

Drawing on publicly available data from the National Vital Statistics System (NVSS) for the period 1969–2004, we examine the effect of Super Bowl exposure on low birth weight. We find that first-trimester exposure to the Super Bowl is associated with a 2 percent increase in the probability of low birth weight (defined as weighing less than 2,500 grams at birth). First-trimester exposure to a Super win is associated with an almost 4 percent increase in this probability.

Although the Super Bowl clearly elicits intense emotions, it is played at a neutral location and does not expose pregnant women to pollution, prevent them from seeking prenatal care, or threaten them with loss of livelihood. Nevertheless, the Super Bowl could affect the behavior of pregnant women as well as the behavior of their partners and friends. In fact, we find that first-trimester exposure to a Super Bowl win is associated with increased use of alcohol and tobacco, but, because of data limitations, we cannot explore the effect of Super Bowl exposure on other behaviors such as intimate-partner violence (IPV) or the use of illegal substances. Whether the reduced-form relationship between first-trimester Super Bowl exposure and low birth weight is due to psychological stress or to behavioral responses such as substance use and IPV is an open question we leave for future researchers.

Almond and Currie (2011, p. 164) argue that commonplace intra-uterine shocks are more policy-relevant than dramatic, but infrequent, natural disasters, and in fact most American women routinely engage in activities similar to watching a sporting event (or celebrating a victory) than experience an earthquake. Our results suggest that informational campaigns aimed at encouraging pregnant women to avoid emotionally charged, but otherwise ordinary, events could lead to healthier babies.

Appendix

Appendix Table 1
Super Bowl Outcomes, 1969–2004

Super Bowl	Date	Winning Team	Losing Team	Winner's Line
XXXVIII	2/1/2004	New England Patriots 32	Carolina Panthers 29	–7 (P)
XXXVII	1/26/2003	Tampa Bay Buccaneers 48	Oakland Raiders 21	+4 (U)
XXXVI	2/3/2002	New England Patriots 20	St. Louis Rams 17	+14 (U)
XXXV	1/28/2001	Baltimore Ravens 34	New York Giants 7	–3
XXXIV	1/30/2000	St. Louis Rams 23	Tennessee Titans 16	–7 (P)
XXXIII	1/31/1999	Denver Broncos 34	Atlanta Falcons 19	–7½ (P)
XXXII	1/25/1998	Denver Broncos 31	Green Bay Packers 24	+11 (U)
XXXI	1/26/1997	Green Bay Packers 35	New England Patriots 21	–14 (P)
XXX	1/28/1996	Dallas Cowboys 27	Pittsburgh Steelers 17	–13½ (P)
XXIX	1/29/1995	San Francisco 49ers 49	San Diego Chargers 26	–18½ (P)
XXVIII	1/30/1994	Dallas Cowboys 30	Buffalo Bills 13	–10½ (P)
XXVII	1/31/1993	Dallas Cowboys 52	Buffalo Bills 17	–6½ (P)
XXVI	1/26/1992	Washington Redskins 37	Buffalo Bills 24	–7 (P)
XXV	1/27/1991	New York Giants 20	Buffalo Bills 19	+7 (U)
XXIV	1/28/1990	San Francisco 49ers 55	Denver Broncos 10	–12 (P)
XXIII	1/22/1989	San Francisco 49ers 20	Cincinnati Bengals 16	–7 (P)
XXII	1/31/1988	Washington Redskins 42	Denver Broncos 10	+3
XXI	1/25/1987	New York Giants 39	Denver Broncos 20	–9½ (P)
XX	1/26/1986	Chicago Bears 46	New England Patriots 10	–10 (P)
XIX	1/20/1985	San Francisco 49ers 38	Miami Dolphins 16	–3½

(*continued*)

Appendix Table 1 (*continued*)

Super Bowl	Date	Winning Team	Losing Team	Winner's Line
XVIII	1/22/1984	LA Raiders 38	Washington Redskins 9	+3
XVII	1/30/1983	Washington Redskins 27	Miami Dolphins 17	+3
XVI	1/24/1982	San Francisco 49ers 26	Cincinnati Bengals 21	–1
XV	1/25/1981	Oakland Raiders 27	Philadelphia Eagles 10	+3
XIV	1/20/1980	Pittsburgh Steelers 31	Los Angeles Rams 19	–10½ (P)
XIII	1/21/1979	Pittsburgh Steelers 35	Dallas Cowboys 31	–3½
XII	1/15/1978	Dallas Cowboys 27	Denver Broncos 10	–6 (P)
XI	1/9/1977	Oakland Raiders 32	Minnesota Vikings 14	–4 (P)
X	1/18/1976	Pittsburgh Steelers 21	Dallas Cowboys 17	–7 (P)
IX	1/12/1975	Pittsburgh Steelers 16	Minnesota Vikings 6	–3
VIII	1/13/1974	Miami Dolphins 24	Minnesota Vikings 7	–6½ (P)
VII	1/14/1973	Miami Dolphins 14	Washington Redskins 7	–1
VI	1/16/1972	Dallas Cowboys 24	Miami Dolphins 3	–6 (P)
V	1/17/1971	Baltimore Colts 16	Dallas Cowboys 13	–2½
IV	1/11/1970	Kansas City Chiefs 23	Minnesota Vikings 7	+12 (U)
III	1/12/1969	New York Jets 16	Baltimore Colts 7	+18 (U)

Notes: The winner's line, also known as the point spread, is the predicted margin of victory. (It is actually the predicted margin of victory odds makers believe will elicit an equal amount of betting on both teams.) A negative line indicates that the team is a favorite, whereas a positive line indicates the team is an underdog (for example, a positive number in the winner's line column indicates that the underdog team won the Super Bowl). A predicted outcome (P) occurs when the winner's line is less than or equal to –4. An upset (U) occurs when the winner's line is greater than or equal to +4. The outcomes of games with a point spread between –4 and +4 are considered unpredictable.

Appendix Table 2

The Relationship between Exposure to the Super Bowl and the Number of Conceptions (in logs) in NFL Fan Base Areas in January and February

		Mother's Race			Mother Marital Status	
	All Conceptions	White	Black	Hispanic	Married	Single
Played in Super Bowl	–0.016	–0.029	0.027	0.313	0.103	0.045
	(0.029)	(0.032)	(0.034)	(0.242)	(0.165)	(0.188)
Lost Super Bowl	–0.004	–0.015	0.049	0.369	0.097	0.175
	(0.031)	(0.033)	(0.031)	(0.344)	(0.158)	(0.192)
Won Super Bowl	–0.028	–0.042	0.005	0.256	0.109	–0.085
	(0.038)	(0.040)	(0.047)	(0.225)	(0.243)	(0.258)
	Mother's Age					
	14–16	17–19	20–24	25–29	30–34	35–39
Played in Super Bowl	–0.012	–0.008	–0.010	–0.026	–0.022	0.004
	(0.035)	(0.031)	(0.032)	(0.030)	(0.029)	(0.031)
Lost Super Bowl	–0.011	0.012	–0.008	–0.012	0.003	0.003
	(0.044)	(0.032)	(0.036)	(0.031)	(0.029)	(0.029)
Won Super Bowl	–0.013	–0.028	–0.012	–0.039	–0.046	0.005
	(0.040)	(0.043)	(0.041)	(0.039)	(0.037)	(0.045)

(*continued*)

Appendix Table 2 (*continued*)

	Mother's Education			
	No HS	HS	College	First Birth
Played in Super Bowl	0.037	0.085	0.072	–0.017
	(0.215)	(0.191)	(0.175)	(0.034)
Lost Super Bowl	0.012	0.027	0.065	–0.012
	(0.210)	(0.185)	(0.151)	(0.034)
Won Super Bowl	0.062	0.143	0.080	–0.022
	(0.253)	(0.237)	(0.245)	(0.043)

Notes: Statistically significant at ***$p<0.01$, **$p<0.05$, *$p<0.10$. Standard errors clustered at the NFL fan base level are shown in parentheses. Each column reports an individual regression with the dependent being the natural log of the number of conceptions among the indicated group in each NFL fan base area in January and February. The sample size of each regression is 1,152 (32 areas×36 years). Not reaching the divisional playoffs (the reference category), losing in the divisional playoff, losing in the conference playoff, and going to the Super Bowl are mutually exclusive and exhaustive events. All regressions include year fixed effects, area fixed effects and area-specific linear time trends.

References

Aizer, Anna, Laura Stroud, and Stephen Buka. 2016. "Maternal Stress and Child Outcomes: Evidence from Siblings." *Journal of Human Resources* 51(3):523–555.

Almond, Douglas, and Janet Currie. 2011. "Killing Me Softly: The Fetal Origins Hypothesis." *Journal of Economic Perspectives* 25(3):153–72.

Almond, Douglas, and Bhashkar Mazumder. 2011. "Health Capital and the Prenatal Environment: The Effect of Ramadan Observance during Pregnancy." *American Economic Journal: Applied Economics* 3(4):56–85.

Bernstein, Ira M., Joan A. Mongeon, Gary J. Badger, Laura Solomon, Sarah H. Heil, and Stephen T. Higgins. 2005. "Maternal Smoking and Its Association with Birth Weight." *Obstetrics and Gynecology* 106(5):986–91.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119(1):249–76.

Beydoun, Hind, and Audrey F. Saftlas. 2008. "Physical and Mental Health Outcomes of Prenatal Maternal Stress in Human and Animal Studies: A Review of Recent Evidence." *Paediatric and Perinatal Epidemiology* 22(5):438–66.

Bien, Louis. 2015. "The 2015 Salary Cap Explained." *SB Nation*, March 2. Retrieved from http://www.sbnation.com/nfl/2015/3/2/8134891/nfl-salary-cap-2015-franchise-tag-explained

Black, Sandra, Paul Devereux, and Kjell Salvanes. 2007. "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes." *Quarterly Journal of Economics* 122(1):409–39.

Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes. 2016. "Does Grief Transfer Across Generations? Bereavements during Pregnancy and Child Outcomes." *American Economic Journal: Applied Economics* 8(1):193–223.

Brown, Ryan. 2014. "The Intergenerational Impact of Terror: Does the 9/11 Tragedy Reverberate into the Outcomes of the Next Generation?" HiCN Working Paper 165.

———. 2015. "The Mexican Drug war and Early-Life Health: The Impact of Violent Crime on Birth Outcomes." Working Paper, University of Colorado Denver. Retrieved from http://www.econ.ucdenver.edu/rbrown/working-papers

Camacho, Adriana. 2008. "Stress and Birth Weight: Evidence from Terrorist Attacks." *The American Economic Review* 98(2):511–5.

Card, David, and Gordon B. Dahl. 2011. "Family Violence and Football: The Effect of Unexpected Emotional Cues on Violent Behavior" *Quarterly Journal of Economics* 126(1):103–43.

Carlson, Kyle. 2014. "Red Alert: Prenatal Stress and Plans to Close Military Bases." Working Paper, California Institute of Technology. Retrieved from http://people.hss.caltech.edu/~kcarlson/carlson_brac_paper.pdf

Centers for Disease Control and Prevention. 2009. "Alcohol Use among Pregnant and Nonpregnant Women of Childbearing Age—United States, 1991–2005." *MMWR* 58(19):529–32.

Currie, Janet, and Rosemary Hyson. 1999. "Is the Impact of Health Shocks Cushioned by Socioeconomic Status? The Case of Low Birth Weight." *American Economic Review* 89(2):245–50.

Currie, Janet, and Enrico Moretti. 2007. "Biology as Destiny? Short- and Long-Run Determinants of Intergenerational Transmission of Birth Weight." *Journal of Labor Economics* 25(2):231–64.

Currie, Janet, and Maya Rossin-Slater. 2013. "Weathering the Storm: Hurricanes and Birth Outcomes." *Journal of Health Economics* 32(3):487–503.

Currie, Janet, and Hannes Schwandt. 2013. "Within-Mother Analysis of Seasonal Patterns in Health at Birth." *Proceedings of the National Academy of Sciences of the United States of America* 110(30):12265–70.

———. 2016. "The 9/11 Dust Cloud and Pregnancy Outcomes: A Reconsideration." *Journal of Human Resources* 51(4):805–31.

Currie, Janet, and Reed W. Walker. 2011. "Traffic Congestion and Infant Health: Evidence from E-ZPass." *American Economic Journal: Applied Economics* 3(1):65–90.
Currie, Janet, Michael Greenstone, and Enrico Moretti. 2011. "Superfund Cleanups and Infant Health." *American Economic Review* 101(3):435–41.
Dejohn, Irving. 2014. "Sleepless in Seattle: Seahawks Fans Celebrate Super Bowl XLVIII Victory with All Night Party and Riots." *The Daily News*, February 3. Retrieved from http://www.nydailynews.com/news/national/seattle-residents-celebrate-seahawks-super-bowl-win-article-1.1600079
Eskenazi, Brenda, Amy R. Marks, Ralph Catalano, Tim Bruckner, and Paolo G. Toniolo. 2007. "Low Birthweight in New York City and Upstate New York Following the Events of September 11th." *Human Reproduction* 22(11):3013–20.
Farmer, Amy, and Jill Tiefenthaler. 2003. "Explaining the Recent Decline in Domestic Violence." *Contemporary Economic Policy* 21(2):158–72.
Friedman, Daniel J. 2007. "Assessing Changes in the Vital Statistics Records and Statistics Infrastructure." Final Report, National Association for Population and Public Health Statistics and Information Systems. Silver Spring, MD.
Gandar, John, Richard Zuber, Thomas O'Brien, and Ben Russo. 1988. "Testing Rationality in the Point Spread Betting Market." *Journal of Finance* 43(4):995–1008.
Gerra, G., A. Zaimovic, D. Franchini, M. Palladino, G. Giucastro, N. Reali, D. Maestric, R. Caccavaria, R. Delsignored, and F. Brambillae 1998. "Neuroendocrine Responses of Healthy Volunteers to 'Techno-Music': Relationships with Personality Traits and Emotional State." *International Journal of Psychophysiology* 28(1):99–111.
Glyn, Laura M., Pathik D. Wadha, Christine Dunkel-Schetter, Aleksandra Chicz-Demet, and Curt A. Sandman. 2001. "When Stress Happens Matters: Effects of Earthquake Timing on Stress Responsivity in Pregnancy." *American Journal of Obstetrics and Gynecology* 184(4):637–42.
Gorman, Bill. 2009. "Super Bowl TV Ratings." *TV by the Numbers*, January 18. Retrieved from http://tvbythenumbers.zap2it.com/2009/01/18/historical-super-bowl-tv-ratings/11044
Hirschhorn, Jason. 2015. "City of Seattle Plans Post-Super Bowl Celebration." *SB Nation*, February 2. Retrieved from: http://www.sbnation.com/nfl/2015/2/2/7964719/city-seattle-seahawks-plans-post-super-bowl-2015-celebration
Hubert, Walter, Mathilde Moller, and Renate de Jong-Meyer. 1993. "Film-Induced Amusement Changes in Saliva Cortisol Levels." *Psychoneuroendocrinology* 18(4):265–72.
Jaddoe, Vincent W., Ernst-Jan W. M. Troe, Albert Hofman, Johan P. Mackenbach, Henriette A. Moll, Eric A. P. Steegers, and Jacqueline C. M. Witteman. 2008. "Active and Passive Maternal Smoking during Pregnancy and the Risks of Low Birthweight and Preterm Birth: The Generation R Study." *Paediatric and Perinatal Epidemiology* 22(2):162–71.
Johnson, Bradley. 2016. "Super Bowl, Supersized: $4.5 Billion in Ad Spending Over 50 Years." *Advertising Age*, January 26. Retrieved from http://adage.com/article/news/super-bowl-supersized-4-5-b-ad-spending-50-years/302180/
Jones, Jeffrey M. 2001. "More Americans Are Fans of Pro Football than Any Other Sport." *Gallup News Service,* April 20. Retrieved from http://www.gallup.com/poll/1786/more-americans-fans-pro-football-than-any-other-sport.aspx
———. 2005. "Six in 10 Americans Are Pro Football Fans." *Gallup News Service*, February 4. Retrieved from http://www.gallup.com/poll/14812/six-americans-pro-football-fans.aspx
Kelly, Elaine. 2011. "The Scourge of Asian Flu: In Utero Exposure to Pandemic Influenza and the Development of a Cohort of British Children." *The Journal of Human Resources* 46(4):669–94.
Khashan, Ali S., Roseanne McNamee, Kathryn M. Abel, Marianne G. Pedersen, Roger T. Webb, Louise C. Kenny, Preben Bo Mortensen, and Philip N. Baker. 2008. "Reduced Infant Birthweight Consequent Upon Maternal Exposure to Severe Life Events." *Psychosomatic Medicine* 70(6):688–94.

Kirschbaum, Clemens, Jens C. Prussner, Arthur A. Stone, Ilona Federenko, Jens Gaab, Doris Lintz, Nicole Schommer, and Dirk H. Hellhammer. 1995. "Persistent High Cortisol Responses to Repeated Psychological Stress in a Subpopulation of Healthy Men." *Psychosomatic Medicine* 57(5):468–74.

Kissell, Rick. 2015. "Update: Oscar Ratings Down 16%, Lowest in Six Years." *Variety*, February 23. Retrieved from http://variety.com/2015/tv/ratings/oscar-ratings-abc-telecast-down-10-in-overnights-to-four-year-low-1201439543/

Kloner, Robert A., Scott A. McDonald, Justin Leekaa, and W. Kenneth Poole. 2009. "Comparison of Total and Cardiovascular Death Rates in the Same City during a Losing versus Winning Super Bowl Championship." *American Journal of Cardiology* 103(12):1647–50.

Lacitis, Erik. 2014. "700,000 at Seahawks Parade? Doesn't Add Up, Experts Say." *The Seattle Times*, February 8. Retrieved from http://www.seattletimes.com/seattle-news/700000-at-seahawks-parade-doesnrsquot-add-up-experts-say

Liu, Elaine M., Jin-Tan Liu, and Tzu-Yin Hazel Tseng. 2015. "The Impact of a Natural Disaster on the Incidence of Fetal Losses and Pregnancy Outcomes." Working Paper, University of Houston. Retrieved from http://www.class.uh.edu/Faculty/emliu/research.htm

Lumey, L. H., and Aryeh D. Stein. 1997. "Offspring Birth Weights after Maternal Intrauterine Undernutrition: A Comparison within Sibships." *American Journal of Epidemiology* 146(10):810–9.

Mansour, Hani, and Daniel I. Rees. 2012. "Armed Conflict and Birth Weight: Evidence from the al-Aqsa Intifada." *Journal of Development Economics* 99(1):190–9.

Martin, Joyce A., Brady E. Hamilton, Paul D. Sutton, Stephanie J. Ventura, Fay Menacker, and Martha L. Munson. 2005. "Births: Final Data for 2003." *National Vital Statistics Reports* 54(2).

Mulder, E.J.H., P.G. Robles de Medina, A.C. Huizink, B.R.H. Van den Bergh, J.K. Buitelaar, and G.H.A. Visser. 2002. "Prenatal Maternal Stress: Effects on Pregnancy and the (Unborn) Child." *Early Human Development* 70(1–2):3–14.

Muret, Don. 2014. "Merchandise Record in NFL's Sights." *Sports Business Journal*, January 20. Retrieved from http://www.sportsbusinessdaily.com/Journal/Issues/2014/01/20/Super-Bowl/SB-merchandise.aspx

Patra, J., R. Bakker, H. Irving, V. Jaddoe, S. Malini, and J. Rehm. 2011. "Dose–Response Relationship between Alcohol Consumption before and during Pregnancy and the Risks of Low Birthweight, Preterm Birth and Small for Gestational Age (SGA)—A Systematic Review and Meta-Analyses." *BJOG* 118(12):1411–21.

Persson, Petra, and Maya Rossin-Slater. 2016. "Family Ruptures, Stress, and the Mental Health of the Next Generation." NBER Working Paper w22229.

Prabhu, Nanda, Norman Smith, Doris Campbell, Leone C Craig, Anthony Seaton, Peter J. Helms, Graham Devereux, and Stephen W Turner. 2010. "First Trimester Maternal Tobacco Smoking Habits and Fetal Growth." *Thorax* 65(3):235–40.

Rees, Daniel I., and Kevin T. Schnepel. 2009. "College Football Games and Crime." *Journal of Sports Economics* 10(1):168–87.

Reichman, Nancy E., and Erinn M. Hade. 2001. "Validation of Birth Certificate Data: A Study of Women in New Jersey's Health Start Program." *Annals of Epidemiology* 11(3):186–93.

Royer, Heather. N. 2009. "Separated at Girth: US Twin Estimates of the Long-Run and Intergenerational Effects of Fetal Nutrients." *American Economic Journal: Applied Economics* 1(1):49–85.

Scarborough Research. 2004. "Get to Know the NFL Fan." *Street & Smith Sports Business Daily*, September 6. Retrieved from http://www.sportsbusinessdaily.com/article/106148

Schneider Mary L., Elizabeth C. Roughton, Alyssa J. Koehler, and Gabriele R. Lubach. 1999. "Growth and Development Following Prenatal Stress Exposure in Primates: An Examination of Ontogenetic Vulnerability." *Child Development* 70(2):263–74.

Schneider, Sven, Christina Huy, Jessica Schutz, and Katharina Diehl. 2010. "Smoking Cessation during Pregnancy: A Systematic Literature Review." *Drug and Alcohol Review* 29(1):81–90.
Schwandt, Hannes. 2014. "The Lasting Legacy of Seasonal Influenza: In-Utero Exposure and Human Capital Development." Working paper, Princeton University, Center for Health and Wellbeing. Available at: http://scholar.princeton.edu/schwandt/job-market-paper
Simeonova, Emilia. 2011. "Out of Sight, Out of Mind? Natural Disasters and Pregnancy Outcomes in the USA." *CESifo Economic Studies* 57(3):403–31.
Smits, Luc, Lydia Krabbendam, Rob de Bie, Gerard Essed, and Jim van Os. 2006. "Lower Birth Weight of Dutch Neonates Who Were in Utero at the Time of the 9/11 Attacks." *Journal of Psychosomatic Research* 61(5):715–17.
Stoecker, Charles, Nicholas J. Sanders, and Alan Barreca. 2016. "Success Is Something to Sneeze At: Influenza Mortality in Cities that Participate in the Super Bowl." *American Journal of Health Economics* 2(1):125–43.
Torche, Florencia. 2011. "The Effect of Maternal Stress on Birth Outcomes: Exploiting a Natural Experiment." *Demography* 48(4):1473–91.
Wilbert-Lampen, Ute, David Leistner, Sonja Greven, Tilman Pohl, Sebastian Sper, Christoph Völker, Denise Güthlin, Andrea Plasse, Andreas Knez, Helmut Küchenhoff, and Gerhard Steinbeck. 2008. "Cardiovascular Events during World Cup Soccer." *The New England Journal of Medicine* 358(5):475–83.
White, F. Garland, Janet Katz, and Kathryn E. Scarborough. 1992. "The Impact of Football Games Upon Violent Assaults on Women." *Violence and Victims* 7(2):157–71.
Woodyard, Chris. 2016. "Super Bowl Ad Costs Soar—But So Does Buzz." *USA Today*, February 7. Retrieved from http://www.usatoday.com/story/money/2016/02/07/super-bowl-ad-costs-soar----but-so-does-buzz/79903058/
Young, David. 2014. "Congrats, NFL, You Own Parity." *Sports Grid.* November, 20. Retrieved from http://www.sportsgrid.com/nfl/congrats-nfl-you-own-parity/