Metropolitan Economic Decline and Infant Mortality

due to Unintentional Injury

1. Introduction

Infant mortality due to unintentional injury (IMUI) accounts for 3.5 percent of all deaths under age one in the U.S. (Hoyert et al., 2006). Leading causes of IMUI include motor vehicle crashes, falls, drowning, poisoning, and obstructive suffocation (Tomashek et al., 2003). Over the last two decades, IMUI has attracted increasing public health attention as its incidence has remained relatively stable despite the secular decline in overall infant mortality (Hoyert et al., 2006).

Public health professionals assert that IMUI results largely from behavioral factors, and that parents could prevent a substantial portion of these deaths by creating a safe environment for the infant. Pediatricians, for example, recommend that one characteristic of this safe environment include routine infant monitoring by the caregiver (Tomashek et al., 2003). These monitoring tasks consist of behaviors such as attending to a bathing infant, properly securing a child safety seat in a motor vehicle, and removing soft pillows from a crib.

Federal and state policies, such as mandatory vehicular passenger safety laws, reportedly reduce the incidence of IMUI via an increase in caregivers properly securing child safety seats (Berg et al., 2000; Morbidity and Mortality Weekly Report, 1991; Block, 1998). This literature indicates that parenting behaviors respond to ambient events.

The contraction of economies represents another ambient event that reportedly affects salutary behaviors (Catalano et al., 2003). Declines in regional employment precede an increase in deaths due to sudden infant death syndrome among whites, blacks and Hispanics in California (Bruckner and Catalano, 2006). The authors speculate that economic decline may distract parents from the recommended “Back to Sleep” infant placement, thereby elevating the risk of sudden infant death syndrome. Subsequent individual-level analysis of black mothers’ reported infant sleep placement in 26 states of the U.S. appears consistent with parental distraction (Bruckner 2008, in press). I believe that this distraction mechanism may apply to the risk of IMUI.

Much literature in psychology finds that an individual’s ability to perform routine tasks under experimental conditions diminishes with exposure to distracting stimuli (Clark and Greenberg, 1971; Craig, 1981; Takezawa and Miyatani, 2005). Experimental and observational accident research, particularly in the area of driver safety, also supports that multiple demands on attention reduce an individual’s vigilance on both central and peripheral tasks (Beede and Kass, 2006; Harbluk et al., 2007). This work conforms with the notion that individuals possess a finite capacity to attend to demands, and that introduction of new demands may strain one’s attentional capacity.

Downturns in the economy, as measured by the decrease in the number of employed persons, may strain parents’ attentional capacity in several ways. Individuals who unexpectedly lose jobs experience increased anxiety and depressive symptoms and other behavioral correlates of distraction (Dooley and

Catalano, 1980; Kessler et al.,1987; Conger et al., 1992; Dooley et al., 1994; Catalano, 1991). These correlates reportedly include somatization as well as sub-clinical symptoms of mental illness such as demoralization and low self-esteem. In addition, undesirable economic events (e.g., lost wages, assets, or income) resulting from unemployment appear associated with increased incidence of stressful non-economic life events (Catalano et al.,1987). Divorce, trouble with in-laws, arrest, and deterioration in physical health exemplify some of these stressful non-economic life events. These occurrences, in turn, reportedly increase the risk of anxiety and depression, which may prove distracting.

Unemployment may also indirectly distract family networks as well as those who remain working. In a longitudinal study of blue-collar autoworkers, Rook *et al*. found that the spouse of the unemployed suffered increased incidence of depression and demoralization, two correlates of distraction (1991). Furthermore, unexpectedly high levels of unemployment may lead to increased job insecurity, changes in the nature of the work environment, and strained relationships between management and employees (Hartley et al., 1991). Several studies report that regional unemployment results in anxiety, depression, and poor health status among the employed (Ferrie et al., 1995; Dekker and Schaufeli, 1995; Ricklefs and Bennett, 1988). Survivors of corporate “downsizing”, moreover, work harder than before and the fear of layoff further stresses them (Vahtera et al., 1997). This fear and anxiety, as well as other correlates of distraction, may be more prevalent than intuition suggests because employed persons who fear job loss far outnumber those who actually become unemployed (Dua and Smyth, 1993).

Based on the literature described above, economic contraction may plausibly disrupt routine infant monitoring. Economic contraction represents an undesirable stressor that may compete with pre-existing, central tasks for parents' limited energy and attention. Coping with loss of employment in one's household or social network requires energy and attention (Kong et al, 1993). In response to unexpected unemployment, therefore, a routine task that receives little energy or attention may receive even less when new demands strain one's capacity.

These circumstances imply the hypothesis that the monthly incidence of IMUI will vary inversely with the performance of the economy. I test this distraction hypothesis in all 26 metropolitan areas in California.

2. Method

2.1. Variables and Data

I acquired monthly incidence data for IMUI from the California linked birth and infant death cohort file (BCF) for the years spanning from 1999 to 2003. The reporting of births and infant deaths in California are believed to be nearly 100 percent complete (California Department of Health Services, 2004). Beginning in 1999, California required death reporting with the International Classification of Disease, 10^{th} Revision (ICD-10) codes. This administrative coding change induced a discontinuity in cause-specific mortality trends (Anderson et al., 2001).

This discontinuity, and the fact that California did not keep BCF data in 1998, led me to restrict the analysis to cohorts born from 1999 to 2003. These years use consistent definitions for IMUI and include the last year of BCF data available (i.e., 2003) at the time of the tests.

I used as the outcome variable a group of ICD-10 codes that, based on prior literature (Tomashek et al., 2003) and discussions with a pediatric expert in this field (Jeffrey Gould, personal communication 3/10/2007) comprise external causes of injury presumed to be preventable, in part, by improved parental vigilance. I include only cases with a final diagnosis of the ICD-10 unintentional injury classifications ranging from V01 to X59. Table 1 lists the causes of death within this range.

I use the Bureau of Labor Statistics (BLS) unadjusted total employment series to gauge the status of the economy (Local Area Unemployment Statistics, 2007). Each month, state agencies cooperate with the BLS to collect data on employment from a sample of businesses and government agencies. The active sample includes approximately one-third of all nonfarm payroll workers. Sample respondents extract the requested data from their payroll records, which must be maintained for a variety of tax and accounting purposes. California uses nearly 30,000 samples (i.e., an economic unit, such as a factory, which produces goods or services) to estimate monthly MSA employment figures. Local and state governments routinely use these employment estimates for planning and budgetary purposes.

I select unadjusted total employment as the independent variable because a decline in employed persons implies that some fraction of the population has lost income and that this loss will “ripple” through the economy. The BLS, moreover, makes these data publicly available, thereby facilitating replication. Other measures devised for labor economics may introduce interpretational ambiguity when applied to research on parental distraction. Unemployment, for example, measures the number of persons who report wanting to work but have no job. As a result, unemployment (and the unemployment rate) often rises in months in which total employment increases because expanding opportunities to work can entice more persons into the labor market than can be absorbed. This occurrence would not cause undesirable financial and non-financial events that, as hypothesized, could lead to parental distraction.

I retrieve employment counts at the Metropolitan Statistical Area (MSA) level. The BLS defines an MSA as a large population nucleus, together with adjacent communities that have a high degree of economic and social integration with that nucleus (Local Area Unemployment Statistics, 2007). States routinely report data on the MSA units to federal agencies. California includes 26 non-overlapping MSAs. The BLS devises boundaries of each MSA to reflect the fact that persons often work outside their county of residence. As a result, one MSA could include several contiguous counties.

To remove the upward trend in the employment variable over the test period, I transformed each of the 26 MSA employment series into a percent change metric by taking the monthly change in employed persons (i.e., employment in month $_{x+1}$ – employment in month$_x$) and dividing this difference by the number of employed persons in the base month (i.e., month$_x$). Transformation of the series into percent change confers the added benefit of weighting the same absolute differences according to the base level of employed persons.

In addition to trend, employment values may exhibit seasonality or the tendency for unusually high or low monthly values to be followed by diminishing, but still high or low, values in subsequent months. These temporal patterns, referred to collectively as autocorrelation, can induce a spurious association between employment and IMUI if both variables share temporal patterns. Researchers have addressed this autocorrelation problem by "decomposing" time series into temporally predictable and residual components (Fisher, 1921). This approach removes patterns from the dependent variable before testing the effect of the independent variable and precludes spurious associations due to shared trends, seasonality, or cycles. I, as described below, use such a time series approach to identify and remove any autocorrelation in monthly counts of IMUI over the test period.

2.2. Design and Analysis

My test turns on whether the observed values of IMUI in a particular MSA in a particular month differ from expected values, as predicted by distraction theory. Literature that examines spatial and/or temporal distribution of death due to unintentional injury typically treats the expected value of the binomial outcome (i.e., death or non-death) as following a Poisson probability distribution. As it relates to my test, the Poisson probability distribution requires that I divide my spatio-temporal space into a series of non-overlapping units, which I call "MSA-month."

I begin my analysis by assuming that IMUIs in a particular MSA-month follow a Poisson distribution. To ensure that the probability of IMUI in a MSA-month is proportional to the size of the population at risk, I use as an offset variable the number of live births in that MSA in the past year. In addition, characteristics of a particular MSA (e.g., a sub-standard poison control response) may predispose that region to an unusually high or low count of IMUI. I control for these geographic differences by including a fixed-effect indicator variable for each of the 26 MSAs. Then, I use time-series methods, devised by Box *et al*. (1994), to identify and remove autocorrelation in IMUI. These methods detected no seasonality, cycles, or other temporal patterns, which allowed for use of the observed counts of IMUI as the dependent variable.

Next, I add the economic variables of interest to the model. I specify a lagged relation between 0 to 3 months (i.e., change in employment the same month as IMUI, or 1, 2, or 3 months before IMUI) because I hypothesize a proximate behavioral response to economic change. This induction period, moreover, appears consistent with previous research on the economy and distraction (Bruckner, in press; Bruckner and Catalano, 2006; Catalano and Satariano, 1998; Catalano et al., 2003).

The steps described above yield the following test model:

$$\mathrm{Log}(\mu_{jt} \mid \mathrm{S}_j, \mathrm{econ}_{jt}) = \beta_0 + \sum_{j=1}^{26} \beta_j \mathrm{S}_j + \sum_{z=0}^{3} \beta_z \mathrm{econ}_{jt} + \log(\mathrm{N}_{jt})$$

Where:

$\mathrm{Log}(\mu_{jt} \mid \mathrm{S}_j, \mathrm{econ}_{jt})$ is the log- mean count of IMUI in MSA *j* at month *t*, conditional on a fixed set of covariates

β_0 is the overall intercept

β_j is the coefficient for MSA *j*

S_j is an indicator variable for MSA *j*

β_Z is the coefficient for the employment variable at lags 0, 1, 2, and 3 (i.e., 0 through 3 months before IMUI)

econ_{jt} is the de-trended percent change in the number of employed persons in MSA *j* at month *t*

N_{jt} is the population of infants in MSA *j* at month *t* (i.e., offset variable)

I also include a dispersion parameter that allows the true variance of the outcome to be greater or less than its mean. If the dispersion parameter reaches statistical significance, then the computational program (i.e., PROC GENMOD, LINK= NB command in SAS) assumes a negative binomial, rather than a Poisson, error structure.

An inverse association between any of the four employment lags and the log-count of IMUI would support the distraction hypothesis. If any statistically significant economic coefficients were found, I re-analyzed the data with conditional logistic regression methods to determine whether individual-level results converged with those of the ecological Poisson regression.

3. Results

3.1. Descriptive Results

Table 2 describes the characteristics of infants included in the BCF dataset from 1999 to 2003. Women residing in the 26 MSAs gave birth to 2 618 752 live infants, which comprise 98.7 percent of all infant live births in California. Of these births, 280 infants with information on region and date of birth died of unintentional injury before age one. Live births to Hispanic mothers account for almost half of the study population. Almost 30 percent of mothers did not complete high school; about 10 percent gave birth before age 20.

Figure 1 plots the monthly incidence of IMUI in California over the test period. The series does not exhibit trend, seasonality, or any other autocorrelation, as detected by Box-Jenkins time-series routines (Box et al., 1994). Of the 26 MSAs, the Vallejo-Fairfield region exhibits the lowest, whereas Yuba City yields the highest, mean annual incidence of IMUI.

The median value of the percent change in employed persons in an MSA-month (i.e., the independent variable of interest), is 0.16. Values span from 14.4 to -9.5, with an inner quartile range from 1.0 to -0.7. Employment change in Hanford-Corcoran shows the greatest variability, whereas employment change in Los Angeles-Long Beach varies the least.

3.2. Regression Analyses

Table 3 shows the results from the Poisson regression model in which I include four lags of the economic variable, the population offset term, and (in the Final Model) MSA fixed effects. The dispersion parameter in the Final Model was non-significant, which indicates that the Poisson model offered a sufficient fit for the data. The Final Model supports the distraction hypothesis in that the economic coefficient at lag 0 is negative and statistically significant (-.07862, SE = .04726, $p < .05$, 1-tailed test).

I used the antilog of the economic coefficient to estimate the effect on the count of IMUI for a one percent decrease of employed persons in an MSA. Using this conversion, the result at lag 0 implies that a one percent decline in employed persons coincides with a 1.08 fold increase of IMUI during that same month.

I tested the possibility that the net performance of the economy over four months, rather than in a particular month, precedes an increase of IMUIs. I summed the economic variables at lags 0,1,2, and 3 and re-estimated the equation. Results do not indicate an association between the economic performance over the four months and the count of IMUI (coefficient= -.0210, SE = .0724, p=0.77).

To evaluate the robustness of the ecological findings, I re-analyzed the significant coefficient at lag 0 using conditional logistic regression. This individual-level approach confers the added benefit of controlling for individual covariates that could confound the ecological association. The literature indicates, for example, that mothers under 20 years of age and mothers who report less that a high school education appear more likely to experience an IMUI (Brenner et al., 1999; Scholer et al., 1999). Econometric research, moreover, finds that during economic decline a reduced proportion of mothers with these characteristics give birth (Dehejia and Lleras-Muney, 2003). As a result, these variables could confound the association between employment change and IMUI in a MSA-month. Due to the computational burden of analyzing individual data of over 2 million births, I instead analyze all 280 IMUIs and only a subset of the non-event births (i.e., a random sample of 10,000 non-IMUI live births). I match case and referent infants by each MSA stratum to control for potential confounding due to time-invariant factors unique to area of residence.

The individual-level model appears as follows:

$$\text{Logit } \text{P}(\text{U}_{it}) = \beta_0 + \beta_1 \text{ econ}_{jt} + \mathbf{X'}_i \boldsymbol{\beta} + \sum_{j=1}^{26} \text{S}_j$$

Where:

$\text{Logit } \text{P}(\text{U}_{it})$ is the log odds of IMUI for subject *i* in month *t*

β_0 is the overall intercept

β_1 is the coefficient for the employment variable at lag 0 (i.e., same month as IMUI)

econ_{jt} is the de-trended percent change in the number of employed persons in MSA *j* at month *t*

$\mathbf{X'}_i \boldsymbol{\beta}$ is a vector of covariates for subject *i* (maternal age, education, ethnicity, infant sex, infant birth weight) and their attending coefficients

S_j is an indicator variable for MSA *j* on which referent subjects are matched to IMUI cases

I exploit the longitudinal structure of the BCF data by including person-time information on infant-months at risk of IMUI. This data structure allows the log(odds) metric to estimate the hazard odds of IMUI (PROC PHREG command in SAS).

Consistent with previous reports, the logistic regression results show that black infants appear at increased risk (hazard odds ratio = 1.57, 95% CI: 1.05, 2.36), whereas Hispanics appear at reduced risk (hazard odds ratio = 0.57, 95% CI: 0.42, 0.77), of IMUI relative to white infants (Scholer et al., 1999). Mothers less than 20 years of age also exhibit an elevated odds of IMUI when compared to mothers age 25 to 29 (hazard odds ratio = 1.54, 95% CI: 1.07, 2.21).

As with the ecological test, the logistic regression results support the distraction hypothesis in that percent change in MSA employment varies inversely with the hazard odds of IMUI. A one percent decline in employed persons coincides with a 1.09 fold increased hazard odds ratio of IMUI during that same month (95% CI: = 1.00, 1.18, $p < .05$). The magnitude of the economic coefficient appeared quite similar to that in the Poisson regression.

There remains a possibility that random sampling of 10,000 control subjects failed in that the selected non-IMUI births do not represent the person-time experience of the over two million live births. To address this concern, I resampled 10,000 non-IMUI births and estimated the conditional logistic regression equation again. Results remained essentially unchanged.

I used the economic coefficient at lag 0 in the Poisson analysis (Table 3) to gauge the proportion of IMUI statistically attributable to economic decline. A total of 280 IMUIs appeared in 243 distinct MSA-months. 135 of these IMUIs occurred in MSA-months that exhibited negative values of economic change. The mean monthly change in the economic variable over these months was .00956 (i.e., approximately a one percent decline in the labor force). Applying the coefficient at lag 0 to these 135 IMUIs implies an excess of 10 deaths, or about 3.6 percent of all IMUI, statistically attributable to economic decline.

4. Discussion

Analyses of California infants born in 26 MSAs from 1999 to 2003 find that mortality due to unintentional injury increases when the economy declines. Ecological and individual-level regression models converge in that, for both tests, the percent change in employed persons in an MSA at varies inversely with IMUI in the same month. These results support the distraction hypothesis in that regional economic decline may perturb otherwise healthy parenting behaviors.

Strengths of the ecological and individual tests include adjustment for time-invariant factors unique to any of the 26 MSAs. I also rule out the rival explanation of individual-level confounding due to socio-demographic factors by controlling these variables in the logistic regression. Furthermore, I minimize confounding due to endogeneity by using the monthly change in employed persons as the independent variable, which presumably is not associated with unmeasured maternal characteristics that cause IMUI. The observed associations, moreover, cannot be attributed to shared seasonality or other forms of autocorrelation that occur generally across all MSAs because I detected no such autocorrelation in IMUI.

My approach benefits from the broad coverage of the BCF data. Analyses include 98.7 percent of all California births over the test period, thereby limiting the likelihood of bias due to selection. The BCF also employs a standardized data collection and birth-death certificate linkage methodology across MSAs and years, thereby permitting multi-MSA and multi-year analyses.

Results do not indicate that the net performance of the metropolitan economy over four months precedes an increase of IMUIs. This finding implies that responses to extended economic downturns may differ from initial reactions to acute shocks. Over time, populations may habituate to adverse economic circumstances and recalibrate their behaviors (see, for example, Kasl et al., 1975). This *post hoc* explanation should be refined and tested before being taken as anything other that informed speculation.

The discovered inverse association between employment and IMUI appears consistent with previous ecological and individual-level tests of parental distraction (Bruckner and Catalano, 2006; Bruckner, in press). My results, however, do not preclude that regional economic expansion may threaten health via increased risk of injury. Indeed, the epidemiologic and economic literatures report that vehicular fatalities (Kopits and Cropper, 2005; Ruhm, 2000) and manufacturing accidents (Catalano, 1979) rise with economic upturns. During economic prosperity, moreover, individuals may use disposable income to support unhealthy behaviors (e.g., binge drinking), which may increase the risk of injury (Dehejia and Lleras-Muney, 2004). I, however, know of no reports that examine whether economic expansion increases IMUI, or more generally, infant and child injury. I await further development of theory as well as empirical tests that will address this gap in the literature.

The reader should consider the results in light of several limitations. Aggregation of several causes of infant death into one “unintentional injury” category assumes that these deaths share a common, distracting, antecedent. Researchers disagree on this issue. Agran *et al.* (2003), for example, have devised sub-categories that they believe group deaths in a more appropriate manner with respect to specific etiology, prevention strategies, and the phases of infant development. If there exists heterogeneity in the relation between the economy and distinct causes of IMUI (e.g., falls, vehicular crashes), then my results may obscure this heterogeneity. The welcomed rarity of specific causes of IMUI, however, did not permit a satisfactory statistical test of distraction for each cause. Similarly, the relatively few IMUIs among ethnic subgroups precluded a race-specific analysis. Results, therefore, represent the average effect across ethnicity and may not describe the experience of any particular ethnic group.

The classification of all vehicular-related accidental infant deaths (n=78) as IMUIs may have resulted in the inclusion of deaths whose etiology does not include parental distraction. Therefore, a possibility remains that the observed association between economic decline and IMUI arises from coincident movements in employment away from expected values over 60 months in 26 MSAs in California with movements in the number of non-distracting causes of vehicle-related infant mortality away from its expected value. I invite the reader to judge the relative parsimony of my theory and this alternative.

In addition, I cannot rule out mechanisms other than distraction that may connect the economy to IMUI. Parents may not receive health insurance after employment loss, thereby impeding access to injury prevention information or educational campaigns. Alternatively, parents may respond to economic decline by increasing risk-taking behavior (e.g., illicit drug use, driving a vehicle at greater speed) that independently increases IMUI. Metropolitan employment decline, moreover, may disrupt routine activities (e.g., driving patterns) that render the infant more accident prone. Researchers, therefore, should consider my findings suggestive since I do not have information on the level of parental monitoring for any of the IMUIs. Further analyses on the time use patterns and behaviors of caregivers during regional economic perturbations should help clarify which of these mechanisms summarized above best fits individual-level data.

I should also caution against using the economic coefficients to estimate the impact of individual employment loss on IMUI. The change in employed persons in an MSA, rather, gauges ambient economic circumstances which should be considered similar to studies of the effect of air pollution or heat waves on health.

Societies regulate the economies to which they are subjected. Economists have argued that pro-employment policies may be more likely to occur if researchers could better account for the negative consequences of legislative decisions (Dooley and Catalano, 1980). My findings, which indicate that declines in the ambient economy in 26 MSAs in California coincide with unexpectedly high values of IMUI, should encourage further investigation of the infant health sequelae and behavioral costs of economic decline.

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References

[no authors listed] 1991. Child passenger restraint use and motor-vehicle--related fatalities among children--United States, 1982-1990. Morb. Mortal. Wkly. Rep. 40, 600-602.

Agran, P.F., Anderson, C., Winn, D., Trent, R., Walton-Haynes, L., Thayer, S., 2003. Rates of pediatric injuries by 3-month intervals for children 0 to 3 years of age. Pediatrics 111, e683-692.

Anderson, R.N., Minino, A.M., Hoyert, D.L., Rosenberg, H.M., 2001. Comparability of cause of death between ICD-9 and ICD-10: preliminary estimates. Natl. Vital. Stat. Rep. 49, 1-32.

Beede, K.E., Kass, S.J., 2006. Engrossed in conversation: the impact of cell phones on simulated driving performance. Accid. Anal. Prev. 38, 415-421.

Berg, M.D., Cook, L., Corneli, H.M., Vernon, D.D., Dean, J.M., 2000. Effect of seating position and restraint use on injuries to children in motor vehicle crashes. Pediatrics 105, 831-835.

Block, A.W., 1998. Motor Vehicle Occupant Safety Survey: Volume 3. Child Safety Seat Report. US Dept of Transportation, National Highway Traffic Safety Administration, Washington D.C.

Box, G., Jenkins, G., Reinsel, G., 1994. Time Series Analysis: Forecasting and Control (Third edition). Prentice-Hall, London.

Brenner, R.A., Overpeck, M.D., Trumble, A.C., DerSimonian, R., Berendes, H., 1999. Deaths attributable to injuries in infants, United States, 1983-1991. Pediatrics 103, 968-974.

Bruckner, T. Economic antecedents of prone infant sleep placement among black mothers. Ann Epidemiol., in press.

Bruckner, T., Catalano, R.A., 2006. Economic antecedents of sudden infant death syndrome. Ann. Epidemiol. 16, 415-422.

California Department of Health Services, Center for Health Statistics, 2004. Linked Birth and Infant Death Cohort File, 1989-2001. Sacramento, CA.

Catalano, R, 1979. Health costs of economic expansion: the case of manufacturing accident injuries. Am J Public Health 69, 789-794.

Catalano, R., 1991. The health effects of economic insecurity. Am. J. Public Health 81, 1148-1152.

Catalano, R., Dooley, D., Rook, K., 1987. A test of reciprocal risk between undesirable economic and noneconomic life events. Am. J. Community Psychol. 15, 633-651.

Catalano, R.A., Satariano, W.A., 1998. Unemployment and the likelihood of detecting early-stage breast cancer. Am. J. Public Health 88, 586-589.

Catalano, R.A., Satariano, W.A., Ciemins, E.L., 2003. Unemployment and the detection of early stage breast tumors among African Americans and non-Hispanic whites. Ann. Epidemiol. 13, 8-15.

Clark, W.C., Greenberg, D.B., 1971. Effect of stress, knowledge of results, and proactive inhibition on verbal recognition memory (d') and response criterion (Lx). J. Pers. Soc. Psychol. 17, 42-47.

Conger, R.D., Conger, K.J., Elder, G.H., Jr., Lorenz, F.O., Simons, R.L., Whitbeck, L.B., 1992. A family process model of economic hardship and adjustment of early adolescent boys. Child. Dev. 63, 526-541.

Craig, A., 1981. Monitoring for one kind of signal in the presence of another: the effects of signal mix on detectability. Hum. Factors 23, 191-197.

Dehejia, R., Lleras-Muney, A., 2004. Booms, busts, and babies' health. Q J Econ 119, 1091–1130.

Dekker, S.W.A., Schaufeli, W.B., 1995. The effects of job insecurity on psychological health and withdrawal: a longitudinal study. Aust. Psychol. 30, 57-63.

Dooley, D., Catalano, R., 1980. Economic change as a cause of behavioral disorder. Psychol. Bull. 87, 450-468.

Dooley, D., Catalano, R., Wilson, G., 1994. Depression and unemployment: panel findings from the Epidemiologic Catchment Area study. Am. J. Community Psychol. 22, 745-765.

Dua, P., Smyth, D.J., 1993. Survey evidence on excessive public pessimism about the future behavior of unemployment. Public Opin. Q. 57, 566 - 574.

Ferrie, J.E., Shipley, M.J., Marmot, M.G., Stansfeld, S., Smith, G.D., 1995. Health effects of anticipation of job change and non-employment: longitudinal data from the Whitehall II study. Bmj. 311, 1264-1269.

Fisher, R.A., 1921. Studies in crop variation: an examination of the yield of dressed grain from Broadbalk. J Agri Sci 11, 107–135.

Harbluk, J.L., Noy, Y.I., Trbovich, P.L., Eizenman, M., 2007. An on-road assessment of cognitive distraction: impacts on drivers' visual behavior and braking performance. Accid. Anal. Prev. 39, 372-379.

Hartley, J., Jacobson, D., Klandermans, B., van Vuuren, T., Greenhalgh, L., Sutton, R., eds, 1991. Job insecurity: coping with jobs at risk. Sage, London.

Hoyert, D.L., Heron, M.P., Murphy, S.L., Kung, H.C., 2006. Deaths: final data for 2003. Natl. Vital. Stat. Rep. 54, 1-120.

Kasl, S.V., Gore, S., Cobb, S., 1975. The experience of losing a job: reported changes in health, symptoms and illness behavior. Psychosom Med 37, 106-122.

Kessler, R.C., House, J.S., Turner, J.B., 1987. Unemployment and health in a community sample. J. Health Soc. Behav. 28, 51-59.

Kong, F., Perrucci, C.C., Perrucci, R., 1993. The impact of unemployment and economic stress on social support. Community Ment. Health J. 29, 205-221.

Kopits, E., Cropper, M., 2005. Traffic fatalities and economic growth, Accid Anal Prev 37, 169-178

Local Area Unemployment Statistics, United States Bureau of Labor Statistics web site. Available at: http://data.bls.gov Accessed February 20, 2007.

Ricklefs, R., Bennett, A., 1998. Market's crash continues to take psychological toll. The Wall Street Journal, March 31.

Rook, K., Dooley, D., Catalano, R., 1991. Stress transmission: the effects of husbands' job stressors on the emotional health of their wives. J. Marriage Fam. 53, 165-177.

Ruhm, C.J., 2000. Are recessions good for your health? Q J Econ 115, 617-650.

Scholer, S.J., Hickson, G.B., Ray, W.A., 1999. Sociodemographic factors identify US infants at high risk of injury mortality. Pediatrics 103, 1183-1188.

Takezawa, T., Miyatani, M., 2005. Quantitative relation between conflict and response inhibition in the Flanker task. Psychol. Rep. 97, 515-526.

Tomashek, K.M., Hsia, J., Iyasu, S., 2003. Trends in postneonatal mortality attributable to injury, United States, 1988-1998. Pediatrics 111, 1219-1225.

Vahtera, J., Kivimaki, M., Pentti, J., 1997. Effect of organisational downsizing on health of employees. Lancet 350, 1124-1128.

Table 1. ICD-10 codes that comprise infant mortality due to unintentional injury (IMUI)

Description	ICD-10 Code
Transport accidents	V01–V99
Motor vehicle accidents	V02–V04,V09.0,V09.2,V12–V14,V19.0–V19.2,V19.4–V19.6,V20–V79,V80.3–V80.5,V81.0–V81.1,V82.0–V82.1,V83–V86,V87.0–V87.8,V88.0–V88.8,V89.0,V89.2
Other and unspecified transport accidents	V01,V05–V06,V09.1,V09.3–V09.9,V10–V11,V15–V18,V19.3,V19.8,V19.9,V80.0–V80.2,V80.6–V80.9,V81.2–V81.9,V82.2–V82.9,V87.9,V88.9,V89.1,V89.3,V89.9,V90–V99
Falls	W00–W19
Accidental discharge of firearms	W32–W34
Accidental drowning and submersion	W65–W74
Accidental suffocation and strangulation in bed	W75
Other accidental suffocation and strangulation	W76–W77,W81–W84
Accidental inhalation and ingestion of food or other objects	W78–W80
Accidents caused by exposure to smoke, fire and flames	X00–X09
Accidental poisoning and exposure to noxious substances	X40–X49
Other and unspecified accidents	W20–W31,W35–W64,W85–W99,X10–X39,X50–X59

Table 2. Socio-demographic characteristics of mothers in California who gave birth to live infants from 1999 to 2003

Characteristic	Study Population* n= 2 618 752	(%)
Ethnicity		
White	819 286	(31.3)
Black	162 574	(6.2)
Hispanic	1 297 073	(49.5)
Other	28 526	(13.0)
Maternal Education		
< High school graduate	755 991	(29.4)
High school graduate	734 502	(28.6)
Some college	504 152	(19.6)
College graduate	576 470	(22.4)
Maternal Age		
< 20 yrs	264 650	(10.1)
20-24 yrs	603 968	(23.1)
25-29 yrs	684 425	(26.1)
≥30 yrs	1 065 266	(40.7)
Infant sex		
Male	1 339 292	(51.1)
Female	1 279 460	(48.9)
Infant birth weight		
> 2,500gms	2 452 307	(93.6)
< 2,500gms	166 445	(6.4)

* column totals may not sum to 2 618 752 due to missing values

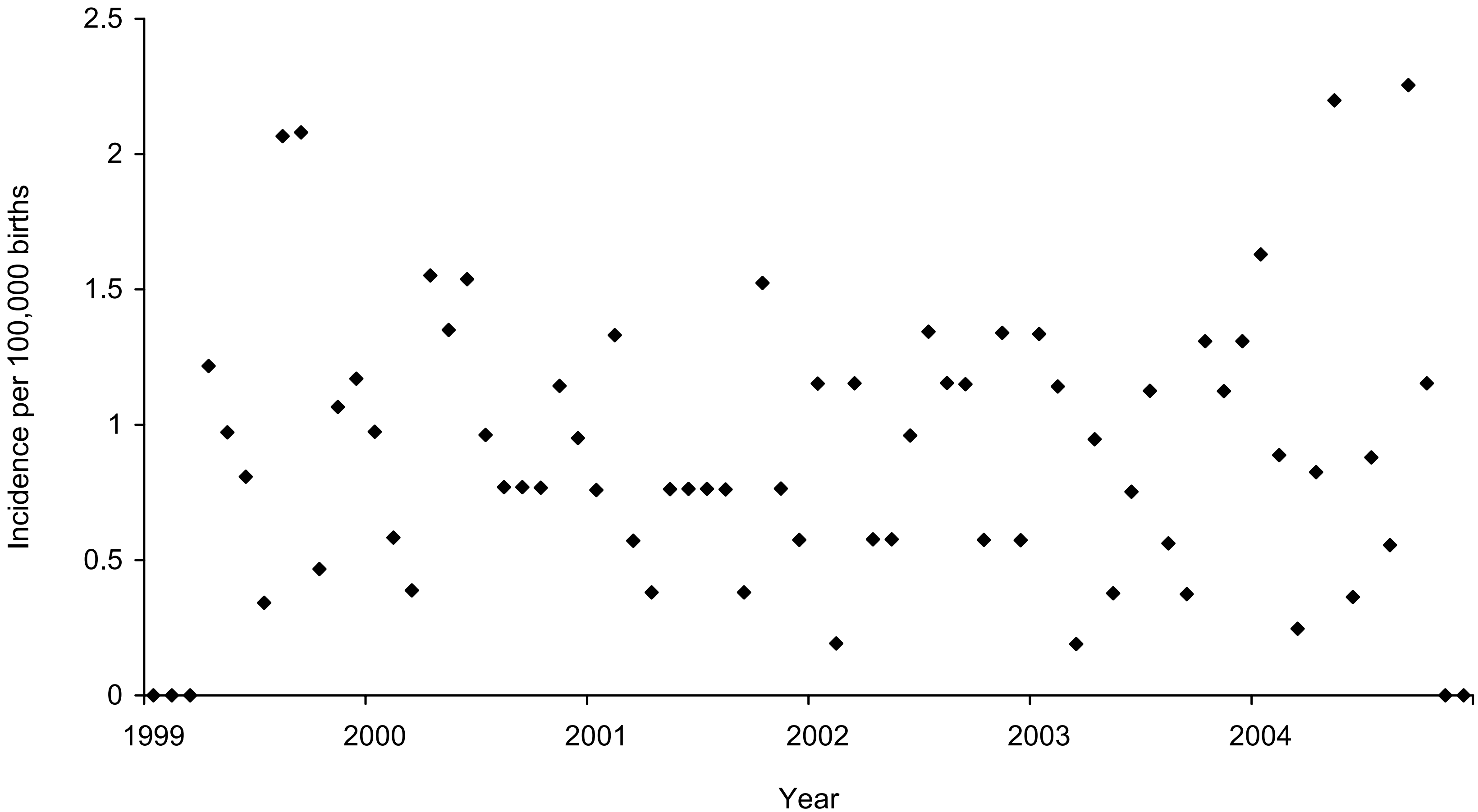

Figure 1. Incidence of infant mortality due to unintentional injury (per 100 000 live births) over 72 months among cohorts born in California from 1999 to 2003

Table 3. Poisson regression coefficients for economic variables associated with IMUI in an MSA-month for infants born in 26 MSAs of California, 1999-2003 (standard errors in parentheses)

	Base Model	Final Model
MSA employment variable lagged at:		
0 months	-.0898 (.0546)*	-.0786 (.0473)*
1 month	.0012 (.0559)	-.0110 (.0479)
2 months	.0537 (.0547)	.0290 (.0466)
3 months	-.0235 (.0549)	-.0379 (.0468)
Population Offset Term	Yes	Yes
Dispersion Parameter	Yes	Yes
26 MSA Fixed Effects	--	Yes

***** $p < 0.05$, 1-tailed test

Table 4: Hazard Odds Ratios (95% Confidence Intervals) for economic and socio-demographic variables associated with infant mortality due to unintentional injury, California birth cohorts, 1999-2003[a]

	OR	(95% CI)
MSA employment variable lagged at:		
0 months	0.92	(0.85, 1.00)*
Ethnicity		
White†	1.00	
Black	1.58	(1.05, 2.36)*
Hispanic	0.57	(0.42, 0.77)**
Other	0.92	(0.60, 1.41)
Maternal Education		
< High school graduate	1.26	(0.95, 1.67)
High school graduate†	1.00	
Some college	0.60	(0.41, 0.87)**
College graduate	0.43	(0.27, 0.68)**
Infant sex		
Male†	1.00	
Female	0.71	(0.56, 0.90)**
Maternal Age		
< 20 yrs	1.54	(1.07, 2.21)*
20-24 yrs	1.16	(0.84, 1.61)
25-29 yrs†	1.00	
>30 yrs	0.73	(0.51, 1.02)

[a] cases and controls are matched by MSA; conditional maximum likelihood estimation was used.
† referent category
***** $p < 0.05$
**$p < 0.01$