# 低出生体重リスクと近隣住環境要因：
## 米国カリフォルニア州ロサンゼルス都市圏を対象に
## 山田 育穂

# Risk of Low Birthweight and Neighborhood Contextual Factors: A Case Study in the Greater Los Angeles Area, California, USA
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**Abstract**: 低出生体重（出生体重 2,500g 未満）は乳児の死亡・罹患の主原因の一つである。米国では 1980 年以降、低出生体重の割合は徐々に増加を続け、人種民族間に著しいリスク格差が存在することからも、大きな社会問題となっている。本研究では、カリフォルニア州出生届データと米国国勢調査データを用いて、ロサンゼルス都市圏における低出生体重リスクの空間分布と地域の社会経済属性の関連性を、特に人種民族間の差違に着目して解析する。

**Keywords**: 低出生体重（low birthweight），近隣住環境要因（neighborhood contextual factors），空間スキャン統計（spatial scan statistic），人種民族間格差（racial/ethnical disparities）

## 1. Introduction

Low birthweight (LBW; defined as a weight of less than 2,500g at birth) is an important cause of infant mortality and morbidity, and a high rate of LBW in the U.S. is a long-standing public health problem (Center for Disease Control and Prevention 2002). Births to African-American mothers are at disproportionally high risk of LBW in comparison with births to white mothers. While a number of maternal risk factors such as age, parity, weight and weight gain during pregnancy, smoking and other substance use, and education have been identified in the literature, increasing research attention has been directed toward neighborhood

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contextual factors (English et al. 2003; Bell et al. 2006).

This study first detects regions where the risk of LBW is significantly high or low when adjusted for known individual-level risk factors; a specific focus is placed on racial/ethnical disparities. Second, assessed are socioeconomic and demographic characteristics of neighborhoods in the detected high-risk and low-risk regions. Third, generalized estimating equation (GEE) models are constructed to explain birthweight in relation to individual-level and neighborhood contextual factors.

## 2. Data and Methods
### 2.1 Data

This study uses California Birth Statistical Master File 1999-2001 obtained from the Center for Health Statistics, California Department of Health Services. This database contains all live births registered in the

State of California.  The study region is set to the Greater Los Angeles Area, consisting of Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties.  Singleton birth records that have birthweight of 500-6,000g and information on maternal age, parity, race/ethnicity, and length of gestation are selected and geocoded at the census tract (CT) level.  Fifteen variables are extracted from U.S. Census 2000 to capture contextual elements of neighborhood.  The variables cover urbanization factors, racial and ethnic compositions, age, income, education, and employment status of residents, and housing occupancy and tenure.

*2.2 Methods*

Spatial scan statistic with Poisson model (Kulldorff 1997) is used to identify contiguous sets of CT's that have significantly high or low risk of LBW than the rest of the study region.  The analysis incorporates three known risk factors of LBW (mother's age, parity, and preterm or not) and child's gender as covariates.

One-way ANOVA tests are next conducted to examine whether the neighborhood contextual factors significantly differ between CT's that are classified as high-risk, low-risk, and others.

Finally, GEE models are constructed to explain individual birthweight by the known individual-level risk factors as well as neighborhood contextual factors examined above. GEE is designed for longitudinal and/or correlated data (Liang and Zeger 1986) and therefore suitable for the present sample in which birth records in the same CT are correlated with one another.

All analysis is conducted separately for three race/ethnicity groups of mothers, namely non-Hispanic white, Hispanic white, and African-American (referred to as white, Hispanic, and black, respectively, for short hereinafter).

# 3. Results

## 3.1 Spatial clusters of high and low LBW risk

Basic descriptive statistics for the sample birth certificate data are presented in Table 1.  It shows that the risk of LBW among black mothers is more than twice the risk among white and Hispanic mothers.

Figure 1 presents high-risk and low-risk clusters of LBW detected for the three race/ethnicity groups at the significance level of 5%.  It is worth pointing out that only a low-risk cluster is detected for black mothers despite their considerably high risk of LBW.  This implies that the LBW risk for black mothers is constantly high regardless of their residential location, with limited exception along the northern coast.  On the other hand, the risk for white mothers is significantly high in the eastern rural area and low in the western coastal part of L.A. County.  The spatial risk pattern for Hispanic mothers is to some extent similar to that for white mothers, but has an extra low-risk cluster extending over Orange and Riverside Counties.

**Table 1:** Descriptive summary for the sample data

|  | White | Hispanic | Black | Total |
|---|---|---|---|---|
| # of records | 177,639 | 400,944 | 48,829 | 627,412 |
| Average birthweight | 3447.48 | 3384.9 | 3209.48 | 3388.97 |
| % of LBW | 3.78% | 4.49% | 9.26% | 4.66% |
| Average age of mothers | 29.79 | 26.38 | 26.57 | 27.36 |
| % of first pregnancy (*) | 36.63% | 31.10% | 32.56% | 32.78% |
| % of preterm birth (**) | 8.73% | 10.85% | 15.58% | 10.62% |

\* First pregnancy = parity of 1

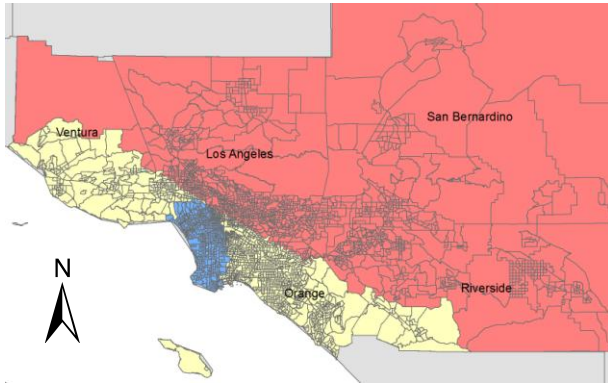\*\* Preterm birth = gestation less than 37 weeks

## 3.2 ANOVA for neighborhood contextual factors

When means are compared between CT's in high-risk or low-risk clusters and CT's not in the clusters, the majority of the fifteen census variables are found to have significant differences at the Bonferroni-adjusted
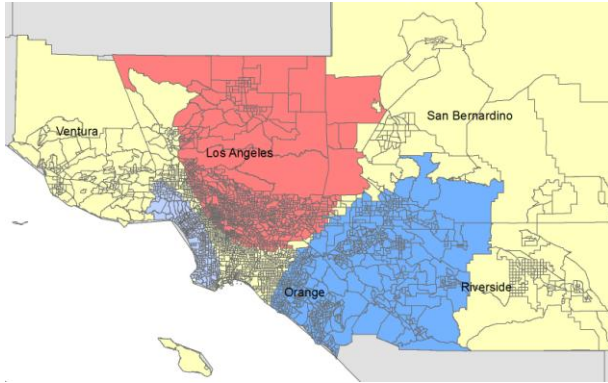


(a) White mothers



(b) Hispanic mothers



(c) Black mothers

**Figure 1:** High- and low-risk clusters of LBW in the Greater L.A. Area, 1999-2001. (Red = high; blue = low)

significance level of 0.33% (=5%/15). Table 2 summarizes significance and direction of such differences. Since all factors are significant for at least one of the five comparisons, they are all included in the GEE model below.

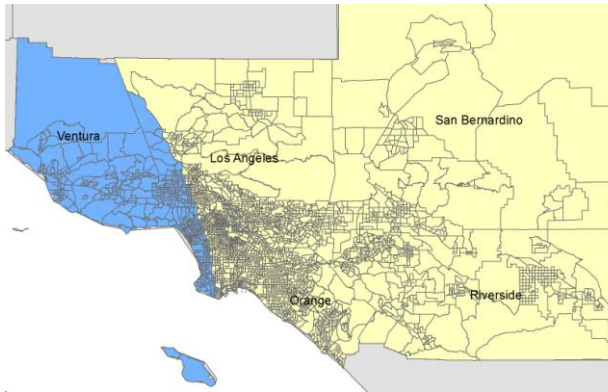## 3.3 GEE models for individual birthweight

Results of the GEE modeling are presented in Table 3. Among the four individual-level factors, three other than mother's age are identified as significant factors, which is consistent with the literature. Influence of mother's age might be absorbed by race/ethnicity-specific modeling. As for neighborhood contextual factors, the urbanization variables (i.e., population density and % of urban population) and median age of residents are constantly insignificant for all the race/ethnicity groups.

**Table 2:** ANOVA results for CT-level census variables

| Census variable | White High-risk | White Low-risk | Hispanic High-risk | Hispanic Low-risk | Black Low-risk |
|---|---|---|---|---|---|
| Pop_Density | — | + | + | — | — |
| % Urban | — | + | NS | + | NS |
| % White | — | — | — | + | + |
| % Black | + | + | — | — | — |
| % AIAN | + | — | + | NS | — |
| % Asian | NS | NS | + | NS | NS |
| % NHPI | — | NS | — | NS | — |
| % Hispanic | NS | NS | + | — | — |
| Med_age | NS | NS | — | + | + |
| % VacantH | + | + | — | — | — |
| % RentHU | — | + | + | — | NS |
| % wo Diplom | NS | + | + | — | — |
| % Unemplo | + | + | NS | — | — |
| Med_HHInc | — | — | — | + | + |
| % belowPV | + | + | + | — | — |

NS: not significant; +: high in clusters; —: low in clusters

White contrast between urban and rural neighborhoods is clear especially for white mothers in Figure 1, the GEE models suggest that it may be attributable to racial and ethnic compositions of neighborhoods. Most of the neighborhood contextual factors are insignificant for Hispanic and black mothers, which might imply that individual-level factors not examined here have stronger influence on the high LBW risk of those populations.

## 4. Summary

This study indicated clear racial/ethnical disparities in the risk of LBW in terms of not only spatial patterns but also risk factor structures. Detailed information on individual-level economic and behavioral factors and more comprehensive search for neighborhood-level factors is essential to further our understanding of the LBW risk among different population groups.

**Table 3:** Beta coefficients for GEE models

| Independent variable | White | Hispanic | Black |
|---|---|---|---|
| (Intercept) | 2790.2 | 2818.4 | 2583.7 |
| Child = female (binary) | -124.1 | -102.7 | -119.5 |
| Parity ≠ 1 (binary) | 88.1 | 105.0 | 52.0 |
| Not preterm birth (binary) | 474.2 | 416.3 | 558.1 |
| Mother's age | NS | 4.6 | NS |
| Population density | NS | NS | NS |
| % Urban population | NS | NS | NS |
| % White | 253.4 | NS | NS |
| % Black | 196.3 | NS | NS |
| % AIAN | 583.0 | NS | NS |
| % Asian | 253.3 | NS | NS |
| % NHPI | 3442.2 | 1467.7 | NS |
| % Hispanic | 198.4 | NS | NS |
| Median age | NS | NS | NS |
| % Vacant housing | -152.3 | NS | NS |
| % Renter-occupied housing | NS | NS | 101.1 |
| % w/o High school diploma | -122.6 | NS | NS |
| % Unemployed | -219.8 | NS | NS |
| Median household income | -.0004 | NS | .0018 |
| % below poverty | -91.9 | -98.4 | -146.7 |

NS: not significant (at the 5% level)

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