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The Impact of Household Crowding During Pregnancy on Term Low Birth Weight

Author
Benitez Santos, Nayelie Yuliana

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The Impact of Household Crowding During Pregnancy on Low Birth Weight

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By

Nayelie Benitez Santos

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ABSTRACT OF THE THESIS

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by

Nayelie Benitez Santos

Master of Science of Epidemiology

University of California, Los Angeles, 2021

Professor Julia Heck, Co-Chair

Professor Roch Nianogo, Co-Chair

Multiple studies have found that neighborhood conditions and characteristics impact people's health. The present study examines the association of household crowding during pregnancy on term low birth weight. This cross-sectional study was conducted using secondary data assembled from the California Department of Public Health Electronic Birth Registration System (EBRS) and the USC Neighborhood Data for Social Change. A total of 96,092 mother-child pairs were used in the analysis. It was found that there is not a statistically significant association among household crowding and TLBW (OR: 0.8, 95% CI: 0.5, 1.5; aOR: 0.45, 95% CI: .09, 2.1). There was no statistical significance found when evaluating the association when comparing among Latinas born in the U.S. (OR: 0.96 95% CI: 0.85, 1.1; aOR: 0.03, 95% CI: <0.001, 2.1) and those foreign-born (OR:0.95, 95% CI: 0.82, 1.1; aOR: 0.26, 95% CI: .01, 5.7). Further exploration needs to be conducted, ideally using primary data to investigate this association.

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INTRODUCTION

Like many health outcomes, pregnancy and birth outcomes are socially and geographically patterned (Dara, et al., 2014). Multiple studies have found that neighborhood conditions and characteristics impact people's health (Ellen & Turner, 1997). There are good reasons to explore the impact of the environment within a neighborhood on pregnancy and birth, as these conditions may present preventable risks that could be intervened on and environments that are protective for pregnant women and their offspring can be identified (Mendez et al., 2016). Unfavorable neighborhoods may cause stress during pregnancy leading to adverse birth outcomes, as has been suggested for low birth weight and neural tube defects (Ellen & Turner, 1997). However, some neighborhood characteristics, such as household density, have only been the focus of a limited number of studies that investigated health implications, such as mental health, children's developmental health, and reproductive health (Melki et al, 2014; San San Kyaw, 2020).

Household density also referred to as household crowding, indicates low socioeconomic status and can cause individuals to experience stressors that lead to adverse health effects, such as high morbidity and mortality risks (Melki, 2004). The 1948 Universal Declaration of Human Rights acknowledges "adequate housing" as a fundamental human right (WHO, 2018). However, if one does not have protection from health threats, then the housing is deemed inadequate. When considering the severity of this issue on health, the WHO identified crowding as one of the housing and health challenges. WHO reported that household crowding is associated with close contact infectious diseases, gastroenteritis and diarrheal diseases, mental health, which includes psychological stress, and sleep disturbances.

Unlike studies on the impact of other types of neighborhood characteristics on birth outcomes such as air pollution and greenspace (Shah et al, 2011), there are very few studies

available on the impact of household crowding on adverse birth outcomes, such as low birth weight. A 2006 study focusing on the impact of crowding during pregnancy on a child's risk of developing schizophrenia found no association (Kimhy et al., 2006). The birth outcome studies have reported mixed findings on the impact of household density (Johnson & Booth, 1976; Melki et al., 2004). Specifically, these studies investigated the impact of household crowding on psychological and physiological distress. They found that both short and long inter-pregnancy spacing impacted by household crowding is a risk for adverse pregnancy outcomes, affecting a child's survival and wellbeing.

It is important to start examining the impact of housing crowdedness conditions, as now more than ever due to affordable housing shortage especially in Southern California, individuals of reproductive age continue to live with their parents, which increases the number of individuals in single-family homes and even apartments (California Department of Housing and Community Development, 2021; United States Census Bureau, 2020). It is of interest whether household density impacts birth outcomes positively (through increased social support) or negatively (through infection risk, family stressors and behaviors) not only because adult children live with their parents, but also because due to economic conditions more and more often multiple families may live within a single household. These changes in family dynamics can have an adverse effect on birth outcomes.

The present study examines the association of household crowding during pregnancy on term low birth weight (TLBW). Given the extensive makeup of the Hispanic and immigrant population in Los Angeles, it is also necessary to consider the ‘‘Latina epidemiologic paradox.” This paradox refers to the observation that - despite socioeconomic disadvantages - Latina mothers in the United States (US) have a similar or lower risk for delivering an infant with low birth weight (LBW)

compared to non-Latina White mothers (Hoggatt, 2012). While cultural norms and economic conditions in minority groups result in a greater number of individuals within a single household (Landale, 2006), these distal causes leading to crowding cannot be evaluated in this study. Instead, we will concentrate here on assessing whether women likely to live in a crowded household during pregnancy are at a greater risk for giving birth to a child at term (≥37 gestational weeks) that is low birth weight.

LITERATURE REVIEW

Crowding in a household can be considered a hazard associated with inadequate living space, sleeping, and household activities (WHO, 2018). The United Nations identifies crowding as one of the five deprivations to consider it an informal settlement. As individuals within a household progress through their life course, the addition of new family members usually leads to buying larger homes due to the need for more space (Clark et al., 2002). Nevertheless, for low-income households, the inability to afford larger homes increases crowding within the household. It is also likely that immigrant households are more overcrowded in California due to economic reasons and housing shortages (California Department of Housing and Community Development, 2021). Cultural norms also influence this crowding phenomenon. In immigrant-heavy cities, competition for housing results in an increased cost of living, and the solution to this problem is often to combine multiple families in a single household (Clark et al., 2002).

Crowding within households has been studied within different contexts, such as its impact on children's education and their physical health outcomes (Marsh, 2019). Other studies have reported on specific adverse effects to people's health from household crowding, including poor mental health status, reduction of coping strategies, increased risk of childhood injuries, exposure to respiratory issues and infectious diseases (Kimhy et al., 2010; Inglis, 2015).

LBW was chosen as the outcome due to its established association with socioeconomic deprivation, and its higher risks of infant mortality, childhood morbidity and developmental disability, as well as contributions to chronic diseases in adulthood (Nkansah-Amankra, 2010). Within developed countries it is estimated that the prevalence of LBW is about 5–7% while it is 19% in developing countries (Wang et al., 2020). Given the high prevalence, the adverse consequences, and the disparities across and within countries for LBW, there is a need for more research to reduce the prevalence of children being born with LBW. Here, we concentrate on term LBW (LBW after 37 weeks of gestation) as this outcome has been shown to reflect intra-uterine growth retardation that may affect child health adversely (Mervis et al., 1995).

METHODS

Data Sources

This cross-sectional study was conducted using secondary data assembled from two independent sources. The birth weight data was collected using the birth data obtained through the California Department of Public Health Electronic Birth Registration System (EBRS). The registered birth data are births that occurred in Los Angeles County from January 1st, 2019, through December 31st, 2019. The maternal addresses of residence collected from the birth certificates were geocoded using the Countywide Address Management System (CAMS) locator (see details at https://cams-lacounty.hub.arcgis.com/pages/cams-geocoder). Birth certificates were not geocoded if their addresses showed as a P.O box, were unknown, or were left unanswered, which was the case for 2% of the total population of women giving birth. The household crowding data was collected from the University of Southern California (USC) Neighborhood Data for Social Change (see details at https://usc.data.socrata.com/stories/s/Learn-More-Overcrowding-LA-/7bwa-87rn/). For the purposes of this study per the World Health Organization's definition,

household crowding is defined as a condition where the number of individuals exceeds the capacity in each dwelling space available, such as rooms, bedrooms, or floor area, such that adverse health effects may result. The data was compiled using the percentage of households that fall into the criteria of overcrowding (households with more than one individual per room) within each Los Angeles County census tract.

Study Population

The study population was comprised by a total of 107,208 mother-child pairs from the EBRS. As we are interested in TLBW, the inclusion criteria for this study are that the women had to have given birth on or after thirty-seven weeks of gestational age. Low birth weight was defined as children born at term who weighed under or equal to 2,500 grams. After removing those who do not meet the gestational week inclusion criteria a total of 96,092 mother-child pairs were left for analysis. The basic characteristics of the mother-child pairs are shown in Table 1.

Table 1. Characteristics of study subjecting in each outcome group by household crowding

	Houshold Crowding														No Household Crowding	
	<10%		<20%		<30%		<40%		<50%		<60%		<70%			
	LBW (≤ 2,500)	Control (>2,500)	LBW (≤ 2,500)	Control (>2,500)	LBW (≤ 2,500)	Control (>2,500)	LBW (≤ 2,500)	Control (>2,500)	LBW (≤ 2,500)	Control (>2,500)	LBW (≤ 2,500)	Control (>2,500)	LBW (≤ 2,500)	Control (>2,500)	LBW (≤ 2,500)	Control (>2,500)
Maternal age (%)																
<20	7 (2)	340 (1)	12 (4)	772 (4)	16 (8)	751 (6)	6 (9)	299 (7)	1 (9)	76 (7)	0 (0)	12 (7)	0 (0)	5 (6)	0 (0)	5 (.5)
20 - 29	87 (26)	6,660 (28)	124 (43)	8,137 (44)	86 (45)	6,355 (50)	41 (64)	2,384 (52)	7 (64)	563 (49)	2 (100)	84 (47)	1 (33)	34 (43)	4 (25)	202 (16)
30 - 34	125 (37)	8,717 (36)	84 (29)	5,350 (29)	52 (27)	3,225 (25)	6 (9)	1,082 (24)	0 (0)	250 (22)	0 (0)	46 (25)	0 (0)	22 (28)	6 (37.5)	466 (36.5)
≥ 35	118 (13)	8,193 (34)	68 (24)	4,147 (23)	36 (19)	2,385 (19)	11 (17)	766 (17)	3 (27)	224 (20)	0 (0)	38 (21)	2 (67)	18 (23)	6 (37.5)	598 (47)
Maternal race (%)																
White	153 (39)	15007 (51)	160 (39)	11,698 (42)	101 (37)	8,459 (41)	42 (40)	3146 (41)	5 (31)	725 (38)	1 (25)	96 (30)	2 (50)	33 (23)	10 (63)	922 (68)
Hispanic	82 (21)	6846 (23)	152 (37)	10,829 (39)	111 (40)	8,846 (43)	51 (50)	3544 (46)	8 (50)	880 (47)	2 (50)	148 (47)	2 (50)	68 (48)	0 (0)	168 (12)
African American	36 (9)	1408 (5)	28 (7)	1,185 (4)	23 (8)	721 (4)	4 (3)	205 (3)	0 (0)	48 (3)	0 (0)	11 (3)	0 (0)	2 (1)	0 (0)	55 (4)
Other	121 (31)	6033 (21)	70 (17)	4,031 (15)	41 (15)	2358 (12)	8 (6)	761 (10)	3 (19)	238 (12)	1 (25)	62 (20)	0 (0)	39 (27)	6 (37)	219 (16)
Hispanic foreign born (%)																
Yes	67 (82)	4,916 (72)	104 (68)	7,036 (65)	73 (66)	5229 (59)	30 (58)	1822 (51)	3 (38)	361 (41)	2 (100)	39 (26)	0 (0)	6 (9)	0 (0)	124 (74)
No	15 (18)	1,930 (28)	48 (32)	3,793 (35)	38 (34)	3617 (41)	21 (42)	1722 (49)	5 (62)	519 (59)	0 (0)	109 (74)	2 (100)	62 (91)	0 (0)	44 (26)
Maternal Prepregnancy BMI (%)																
< 18.5	30 (9)	1,154 (5)	16 (6)	589 (3)	14 (8)	336 (3)	4 (6)	102 (2)	1 (9)	22 (2)	1 (50)	2 (1)	0 (0)	2 (3)	3 (20)	75 (6)
18.5 - 24.9	184 (55)	12,952 (55)	140 (49)	7,227 (40)	97 (52)	4,417 (35)	28 (44)	1,469 (32)	4 (36)	374 (33)	1 (50)	55 (31)	1 (33)	26 (34)	11 (73)	76 (6)
25 - 29.9	69 (21)	5,520 (23)	78 (27)	5,277 (29)	44 (23)	3,952 (31)	20 (31)	1,460 (32)	4 (36)	378 (34)	0 (0)	63 (35)	1 (33)	32 (42)	1 (7)	77 (6)
≥ 30	50 (15)	3,923 (17)	51 (18)	5,133 (28)	33 (17)	3,932 (31)	12 (19)	1,509 (33)	2 (18)	349 (31)	0 (0)	59 (33)	1 (33)	17 (22)	0 (0)	78 (6)
Maternal education, years (%)																
<9	0 (0)	325 (1)	3 (1)	890 (5)	8 (5)	1056 (9)	10 (19)	556 (14)	3 (33)	248 (25)	0 (0)	73 (43)	2 (67)	43 (57)	0 (0)	2 (.16)
9 - 11	0 (0)	566 (3)	6 (2)	1373 (8)	21 (13)	1509 (13)	11 (20)	597 (15)	2 (22)	159 (16)	0 (0)	18 (11)	0 (0)	8 (11)	0 (0)	11 (.9)
12	1 (6)	4370 (20)	57 (19)	6272 (37)	72 (44)	4883 (43)	23 (43)	1870 (46)	2 (22)	381 (38)	1 (50)	51 (30)	1 (33)	18 (24)	1 (6)	146 (12)
13 - 15	3 (19)	5178 (23)	74 (24)	4218 (25)	35 (22)	2388 (21)	5 (9)	739 (18)	1 (11)	136 (14)	1 (50)	22 (13)	0 (0)	3 (4)	3 (19)	180 (15)
≥16	12 (75)	11789 (53)	166 (54)	3925 (24)	26 (16)	1484 (14)	5 (9)	287 (7)	1 (11)	73 (7)	0 (0)	4 (2)	0 (0)	3 (4)	12 (75)	854 (72)
Payment for delivery (%)																
Private insurance	219 (66)	15631 (66)	120 (41)	7466 (41)	42 (22)	3498 (28)	6 (9)	960 (21)	2 (18)	156 (14)	0 (0)	18 (10)	0 (0)	4 (5)	10 (66)	1,065 (85)
Government insurance	83 (25)	5888 (25)	159 (55)	9859 (54)	133 (72)	8658 (68)	57 (89)	3,541 (78)	8 (73)	964 (85)	2 (100)	165 (89)	3 (100)	74 (95)	4 (26)	117 (9)
Self/uninsured	31 (9)	2047 (9)	11 (4)	946 (5)	12 (6)	557 (4)	1 (2)	52 (1)	1 (9)	11 (1)	0 (0)	2 (1)	0 (0)	0 (0)	1 (8)	75 (6)
Parity, those ≥ 37 gestational weeks (%)																
First	322 (94)	23890 (99)	284 (96)	18496 (99)	187 (98)	12821 (99)	62 (96)	4599 (99)	11 (100)	1143 (99)	2 (100)	186 (100)	3 (100)	80 (100)	16 (100)	1265 (99)
Second or subsequent birth	19 (6)	84 (1)	11 (4)	39 (1)	4 (2)	25 (1)	2 (4)	7 (1)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (1)
Smoked during pregnancy																
Yes	4 (3)	131 (.5)	4 (1)	84 (.45)	3 (2)	54(.42)	0 (0)	14 (.30)	1 (1)	2 (.1)	0 (0)	1 (.5)	0 (0)	1 (1)	0 (0)	7 (.5)
No	144 (97)	23,779 (99.5)	284 (99)	18,322 (99)	187 (98)	12662 (99.5)	64 (100)	4517 (99)	10 (9)	1111 (99)	2 (100)	179 (99)	3 (100)	78 (99)	16 (100)	1264 (99)
WIC																
Yes	82 (24)	5,798	157 (54)	10229 (55)	137 (72)	9028 (70)	52 (83)	3602 (78)	8 (73)	965 (85)	2 (100)	169 (91)	2 (66)	73 (91)	0 (0)	103 (8)
No	258 (76)	18,063	135 (46)	8243 (45)	54 (28)	3784 (30)	11 (17)	989 (22)	3 (27)	175 (15)	0 (0)	17 (9)	1 (33)	7 (9)	16 (100)	1165 (92)

Note: some percentages may not sum to 100% due to missing values or rounding.

Analytical strategy

All analyses were conducted using the SAS 9.4 system (SAS 9.4; https://support.sas.com/software/94/). ArcGIS Pro (https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview) was used to link the census tract data from the USC Neighborhood Data for Social Change with the CDPH birth certificate data.

The effect of household crowding on term low birth weight (TLBW) was estimated by logistic regression. The analysis was conducted on births that occurred on or after thirty-seven weeks of gestational age and comparing household crowding (see Table 1 for household crowding categories) to no household crowding (0%). The crude and adjusted odds rations (ORs) were calculated for LBW, adjusting for age group in years (13 -19, 20 - 29, 30 - 34, and ≥35), prepregnancy maternal BMI (<18.5, 18.5-24.9, 25-29.9, and ≥30) maternal education in years (<9, 9-11, 12, 13-15, ≥16), payment for delivery (private insurance, government insurance, and self/uninsured), and race (White, Black, Hispanic, and Other), smoking status (ever to never smoker), WIC status, parity (first versus second or subsequent birth).

There was also crude and adjusted prevalence odds ratios (ORs) and 95% confidence intervals (CIs) for LBW using logistic regression models to compare: (1) U.S. born Latinas to Whites and (2) foreign born Latinas to Whites (Devika et al., 2016). The models were adjusted for factors associated with either household crowding status, birth weight (TLBW vs. TNBW), or both; namely, age group in years (13-19, 20-29, 30-34, and ≥35), prepregnancy maternal BMI (<18.5, 18.5-24.9, 25-29.9, and ≥30) maternal education in years (<9, 9-11, 12, 13-15, ≥16), payment for delivery (private insurance, government insurance, and self/uninsured), WIC status, smoking status (ever or never smoker). A logistic regression with the firth procedure was used due to the small sample size when comparing Latinas born in the U.S. versus being foreign-born.

(Mansourni et al., 2018; Devika, 2016). The firth procedure reduces the bias of maximum likelihood estimators in the logistic regression model. Before applying the firth procedure model there was the presence of high ORs and wide 95% confidence intervals (CI) (OR: >999.999, 95% CI: <0.001, >999.999) when using a regular logistic regression model.

RESULTS

The mean BW of all newborns was 3351± 450.2 g, while the TLBW was 2309 ± 450 g and the mean household crowding percentage was 17.5% ± 11.6%. Among term low BW children, the mean percentage of household crowding experienced by the pregnant women was 18% ± 11.7%, while 11.6% of women with children who were term and normal birthweight experienced crowding. Among Latina mothers, the mean TLBW for their child was 2,310 ± 213 g; those who identified as Latinas and were born in the U.S. the TLBW mean was 2,313 ± 198, while for those who were foreign-born had a TLBW of 2,302 ± 137.

The estimates from crude and covariate-adjusted models to determine if an association among household crowding and TLBW existed were varying, and suggestive of a being a protective factor; there was no strong association given the wide 95% CI and the inclusion of 1 (see Table 2a). To further explore whether the Latina paradox has an effect on the outcome of choice, there was an investigation of heterogeneity in the relations to place of birth (U.S. born versus foreign born). Both crude and adjusted estimates for U.S. born and foreign-born Latinas were suggestive of being protective factors (see Table 2b). However, the 95% CI were both wide and include 1, which suggest these results are not statistically significant.

Table 2a. Crude and adjusted odds ratios of the effect of household crowding on term low birth weight, 2019.

	Crude Odds Ratio (cOR)		Adjusted Odds Ratio (aOR)*	
	cOR	95% CL	aOR	95% CL
Household Crowding				
Yes	0.884	0.5 , 1.5	0.45	0.09, 2.1
No	1.0	--	1.0	--

*Adjusted for the effect of age, education, race, prepregnacy BMI, smoking status, WIC status, birth order, and payment for delivery.

Table 2b. Crude and adjusted odds ratios of the effect of household crowding on term low birth weight among Latinas born within the U.S. versus outside of the US, 2019.

Latinas born within the U.S.

	Crude Odds Ratio (cOR)		Adjusted Odds Ratio (aOR)*	
	cOR	95% CL	aOR	95% CL
Household Crowding				
Yes	0.96	0.85, 1.1	0.03	<0.001 , 2.1
No	1.0	--	1.0	--

Latinas born outside of the U.S.

	Crude Odds Ratio (cOR)		Adjusted Odds Ratio (aOR)*	
	cOR	95% CL	aOR	95% CL
Household Crowding				
Yes	0.95	0.82, 1.1	0.26	0.01, 5.7
No	1.0	--	1.0	--

*Adjusted for the effect of age, education, Prepregnancy BMI, smoking status, WIC status, and payment for delivery.

DISCUSSION

This paper constitutes as one of the few studies that has looked at the association of household crowding and low birthweight. Studies have focused on the impact of household crowding on reproduction or other health factors, but none have explored the adverse effects that crowding has on pregnant women's health ultimately affecting their child. The focus of this study was to investigate household crowding impact on TLBW, and whether it is a concerning factor to address moving forward to minimize LBW.

The interpretation of these results is that there is some limited evidence to suggest that household crowding during pregnancy is associated with TLBW. Although the estimates focusing on Latinas (U.S. and foreign-born) were not statistically significant, the low values (protective factor) could warrant for further exploration by conducting other studies and taking into consideration in collecting data on familial and cultural norms that could further explain the low estimates. The imprecision of some of the estimates does not allow for a complete rule out of the possibility to detect an association.

LIMITATION

There are several limitations to this study. Secondary data does not allow for further exploration of the factors of living in a crowded household during pregnancy that could potentially be associated with LBW, such as infection, stress, socioeconomic factors, family behaviors, etc. Using two different data sources also creates restrictions to the types of study designs that could get carried out, which in this case being cross-sectional, lowering the study's validity. The only method of linking the data was by using census tracts versus at the individual level compromising the validity of the data. The limitations of the data make this study more ecological. There is also

limited literature to suggest an appropriate method to suggest cutoff points for categories of crowding percentages to analyze the data and maintain statistical power.

CONCLUSION

As the living arrangements of families in the U.S. change, it is important to consider whether it negatively impacts the health of pregnant women as it can also affects the health of their child. Although a strong association was not found in this study, it is necessary to collect primary data to be able to conduct a study that allows for causal inference and increase validity. The goal would be to establish temporality and know whether someone lived in a crowded household during their pregnancy before giving birth to a child with LBW or normal BW.

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