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PERCEIVED AND OBJECTIVE NEIGHBORHOOD CONDITIONS: RELATIONS WITH PRETERM DELIVERY

presented by

MARY JACQUELINE KLEYN

has been accepted towards fulfillment
of the requirements for the

M.S. degree in Epidemiology

Claudia Holzman
Major Professor's Signature

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PERCEIVED AND OBJECTIVE NEIGHBORHOOD CONDITIONS: RELATIONS WITH PRETERM DELIVERY

By

Mary Jacqueline Kleyn

A THESIS

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ABSTRACT

PERCEIVED AND OBJECTIVE NEIGHBORHOOD CONDITIONS: RELATIONS WITH PRETERM DELIVERY

By

Mary Jacqueline Kleyn

The Pregnancy Outcomes and Community Health Study was used to explore the relations between perceptions of neighborhood disorder, objective measures of neighborhood deprivation and preterm delivery (PTD) grouped by week (<35, 35-36 weeks) and clinical circumstance (spontaneous, medically indicated).

Due to differing distributions of disorder and deprivation scores, race/ethnic-specific groups were used: Black/Hispanic (B/H) (743 term, 127 preterm) and White/Other (W/O) (1852 term, 200 preterm).

In the B/H group, the top decile of neighborhood disorder score was associated with increased odds of medically indicated PTD (OR=2.8 95% CI: 1.2, 6.1), and the highest compared to the lowest tertile of neighborhood deprivation score was associated with increased risk of all PTD <35 weeks (OR=2.3 95% CI: 1.1, 4.9). Disorder and deprivation were not associated with PTD in the W/O group.

These results suggest unique associations between perceived and objective neighborhood conditions and PTD in black and Hispanic women.

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I want to thank Dr. Claudia Holzman for all of her advice and encouragement during my graduate study. She has truly made my time at Michigan State University a wonderful experience.

I also appreciate the support of the other members of my graduate committee. Dr. Sue Grady provided invaluable help with the geocoding process and provided me with insightful comments that greatly improved this manuscript. Dr. Hwan Chung gave me advice on statistical approaches. Dr. Janet Eyster served as an "unofficial" committee member and also helped with the geocoding process.

To Andrew-Thanks for all of your love, support, and editing!

I would also to thank the entire POUCH team. I have been blessed to work with such a wonderful group of kind and talented researchers for the past two years.

Lastly, I would like to thank my family-especially my husband and my parents. Their love and support has allowed me to achieve all of my academic goals.

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LITERATURE REVIEW

Preterm birth, defined by the World Health Organization as the delivery of an infant between 20 and 37 weeks of gestation, is a leading cause of perinatal mortality in Europe and North America (Berkowitz & Papiernik, 1993). Preterm delivery (PTD) is a major problem in developing countries. Determining the exact rates of PTD has been difficult, but estimates have placed PTD rates as high as 25% in developing countries (Steer, 2005). Among industrialized countries, the United States has dramatically higher rates of PTD (Joseph, Huang, Liu, Ananth, Allen, Sauve et al., 2007). In 2004, more than 500,000 babies in the United States were born preterm. This represents 12.5% of all births in that year. PTD may result in pulmonary dysfunction or visual impairment in the neonate, as well as nearly one-half of all perinatal-related neurological disabilities (Martin, Hamilton, & Sutton, 2006; Wen, Smith, Yang, & Walker, 2004). In the United States, PTD is responsible for 75% of neonatal morbidity and 70% of neonatal mortality (Challis, Lye, Gibb, Whittle, Patel, & Alfaidy, 2001).

In addition to cost in terms of human life, PTD is also very costly for the health-care system. The hospital costs of caring for preterm infants in the United States have been estimated to be $5.8 billion for the first year of life alone (Russell, Green, Steiner, Meikle, Howse, Poschman et al., 2007)

PTD may be further divided by clinical circumstances. Approximately 40-50% of all preterm births occur due to spontaneous preterm labor of unknown etiology, while premature rupture of membranes is implicated in 25-40% of all

PTD (Tucker, Goldenberg, Davis, Copper, Winkler, & Hauth, 1991). Although these medical risk pathways may be distinct, spontaneous preterm labor and premature rupture of membranes have many common risk factors and may be grouped together to form a category consisting of all spontaneous PTD (Pickett, Abrams, & Selvin, 2000). The remaining 20-25% of all preterm deliveries are medically indicated to decrease adverse maternal or fetal outcomes. Maternal hypertension, preeclampsia, poor fetal growth, and fetal distress are all possible reasons for medically intervening in pregnancy before a woman has completed 37 weeks' gestation (Ananth & Vintzileos, 2006).

Despite medical advances and efforts directed towards reducing the incidence of PTD, the PTD rate in the United States has risen from 10.6% in 1990 to 12.7% in 2005 (Goldenberg & Rouse, 1998; Hamilton, Martin, & Ventura, 2006). Multifetal gestations may exert a strong influence on the rate of preterm birth due to the elevated risk of PTD associated with multifetal gestations and the increasing frequency of multiple births. However, among singleton births only, the rate of PTD still increased from 9.7% in 1990 to 10.8% in 2004 (Martin, Hamilton, & Sutton, 2006).

The most dramatic increase in PTD rate was seen in infants delivered at 34-36 weeks (Hamilton, Martin, & Ventura, 2006). These late-term preterm infants comprise over 70% of all preterm births (Martin, Hamilton, & Sutton, 2006). Although these infants are at lower risk than infants born <34 weeks, late preterm infants have more medical problems than infants born >37 weeks gestation (McIntire & Leveno, 2008; Wang, Dorer, Fleming, & Catlin, 2004).

According to the National Center for Health Statistics, preterm birth is more common in younger and older mothers. For women younger than 20 years of age, the average PTD rate from 2002-2004 was 14.3%. During the same time period, the PTD rate was 16.3% for women aged 40 or greater, and the rate was lowest for women 20 to 29 years of age (11.7%) (National Center for Health Statistics).

Preterm birth is also more common in certain racial and ethnic groups. For example, from 2002-2004, Black women experienced a PTD rate of 17.8%. In that same time period, White and Asian women had rates of PTD 11.3% and 10.4%, respectively (National Center for Health Statistics).

Although there have been many mechanistic studies about the etiology of PTD, many questions remain-especially about the pathophysiological mechanisms of PTD. Several mechanisms that have been proposed include: activation of the maternal or fetal hypothalamic-pituitary-adrenal (HPA) axis; inflammation and/or infection; decidual hemorrhage; and, pathologic uterine distention (Lockwood & Kuczynski, 1999). Whether these mechanisms work independently or jointly is still an area of active investigation.

Many risk factors for PTD have been previously identified through epidemiological studies, though some are more strongly and/or consistently associated with PTD. Multifetal pregnancy has been reliably identified as a risk factor for PTD (Strauss, Paek, Genzel-Boroviczeny, Schulze, Janssen, & Hepp, 2002; Wen, Demissie, Yang, & Walker, 2004). Previous preterm delivery is another strong risk factor for PTD (Adams, Elam-Evans, Wilson, & Gilbertz,

2000; Adams, Sarno, Harlass, Rawlings, & Read, 1995). Black race is also a strong risk factor for PTD, as Black women experience rates of PTD that are nearly double the rates of any other racial/ethnic group (Mercer, Goldenberg, Das, Moawad, Iams, Meis et al., 1996; Schieve & Handler, 1996). Infections have also been shown to be a risk factor for early PTD (Goldenberg, Iams, Mercer, Meis, Moawad, Copper et al., 1998). While these maternal (i.e., individual-level) risk factors are very important, they still do not fully explain the etiology of PTD and why the rates of PTD are so high in the United States, particularly among Black women.

In recent years, neighborhood context (i.e., the neighborhood in which mothers live and infants are born into) has been hypothesized to affect the risk of PTD, even after controlling for the effects of maternal and infant risk factors. Neighborhood context, typically described by level of deprivation or group-level variables, has been linked to PTD. For example, in the United Kingdom, Smith (2007) reported a dose-response relationship between decile of deprivation and incidence rate ratio for PTD. When compared to women living in the least deprived decile, women living in the most deprived decile had an incidence rate for PTD almost twice as high. This result was found in both extremely preterm births (22-28 weeks) and very preterm births (22-32 weeks) and remained consistent throughout the 10-year period of study (1994-2003). This study, however, did not have access to data on maternal age or parity, and therefore, could not control for these potentially important individual-level variables which may have slightly attenuated the association between deprivation

and PTD. A similar study controlled for individual-level covariates and found a smaller, but still significant, increased risk (adjusted OR=1.16, 95% CI 1.03, 1.32) of PTD for women living in the highest deprivation category compared to women living in the lowest (Smith, Shah, White, Pell, Crossley, & Dobbie, 2006). This study included all preterm births, and not only very preterm births as in the previous study, which may also partially explain the weaker association.

While some studies have found significant associations between neighborhood deprivation and PTD (Janghorbani, Stenhouse, Millward, & Jones, 2006; Smith, Shah, White et al., 2006; Smith, Draper, Manktelow et al., 2007), others have not found these associations. Craig (2002) studied the relation between neighborhood deprivation and PTD in New Zealand. This study found that between 1980 and 1999, PTD rates among singletons, particularly infants >28 weeks of gestation, increased more dramatically among women living in less deprived areas than among women living in more deprived areas. One possible explanation for the increased PTD rates among more affluent women is an increase in the use of assisted reproductive technology. This technology may result in an increased number of multifetal gestations. As a result of the uneven increase in rates, the deprivation disparity in PTD that existed in New Zealand in 1980 disappeared in the 1990s. These individual-level studies have failed to consistently demonstrate or fully explain the possible association between neighborhood conditions and PTD.

A limitation in the previous studies is a failure to report on the clustering of the study population within neighborhoods. If clustering of women and infants is

present, multilevel modeling should be used, so that both individual-level and neighborhood-level factors may be considered simultaneously. On the individual-level, PTD could result from various pathways if biological and behavioral factors are influenced by neighborhood-level variables. For example, the characteristics of a neighborhood, both physical and social, may induce or alleviate stress in the lives of its inhabitants (Farley, Mason, Rice, Habel, Scribner, & Cohen, 2006). Stress induced by feeling unsafe in one's neighborhood may be reduced by the introduction of street lights to improve the physical environment or by the formation of neighborhood watch groups to improve the social environment. Neighborhoods may also affect other aspects of life such as nutrition or substance abuse through access to grocery stores or ease of obtaining illegal substances. Neighborhoods may affect prenatal care utilization, as women who live in neighborhoods with high deprivation are at increased risk for receiving delayed or no prenatal care (Cubbin, Marchi, Lin, Bell, Marshall, Miller et al., 2008). Since neighborhood characteristics affect risk factors for PTD, multi-level analysis is often used to account for population-level, as well as individual-level, factors when studying what role neighborhoods play in PTD.

Previously, multilevel modeling has been used to study the relation between neighborhood context and mortality or self-rated health (Bosma, van de Mheen, Borsboom, & Mackenbach, 2001; Jaffe, Eisenbach, Neumark, & Manor, 2005; Singh & Siahpush, 2002; van Jaarsveld, Miles, & Wardle, 2007). Multilevel modeling is now being used to explore the relation between neighborhoods, by

type (rural vs. urban) or characteristics (high vs. low deprivation), and birth outcomes.

The effects of neighborhoods on PTD may differ by the type of community. For example, women living in relatively large rural cities in central Pennsylvania had a decreased risk of PTD compared to women living in urban communities (aOR=0.73, 95% CI 0.60, 0.89), although this protective rural effect was only seen in women living in more populated rural areas and not in women living in small rural towns or women living in isolated small rural areas (Hillemeier, Weisman, Chase, & Dyer, 2007). For both urban and rural areas, a significant trend of increasing PTD has been found when neighborhood median income decreases, although trends for other adverse birth outcomes are more consistent in the urban areas (Luo, Kierans, Wilkins, Liston, Mohamed, & Kramer, 2004).

Race/ethnicity may also affect the degree to which neighborhood conditions influence the risk of PTD. Messer (2006) found that the largest proportion of White women lived in block groups in the lowest neighborhood deprivation quartile, and increasing neighborhood deprivation was not associated with PTD among White women. In contrast, the largest proportion of Black women lived in block groups in the highest neighborhood deprivation quartile, and neighborhood deprivation was associated with PTD among Black women. This study suggests that neighborhood deprivation may affect the risk of PTD more strongly for Black women than for White women, perhaps due to the larger number of Black women living in neighborhoods with high deprivation levels. However, a different study found a stronger association between neighborhood

deprivation and PTD among non-Hispanic Whites than among non-Hispanic Blacks (O'Campo, Burke, Culhane, Elo, Eyster, Holzman et al., 2008). The discrepancy in that finding compared to the results of other studies was attributed to differences in the methods of assigning deprivation, study design, and sample sizes. Other studies have found that neighborhoods may affect Black women and White women in different ways. For Black women, living in a wealthier census tract (i.e., > $30,000/year median income) was associated with a reduced risk for PTD (Kaufman, Dole, Savitz, & Herring, 2003). However, this reduced risk based on wealth of census tract was not found among White women.

While the majority of studies on neighborhood context characterize neighborhood deprivation using census data, one study sought to describe neighborhoods without the use of census data. The Pregnancy, Infection, and Nutrition (PIN) study used trained personnel to qualitatively assess the neighborhood conditions of low-income pregnant non-Hispanic White and non-Hispanic Black women (Laraia, Messer, Kaufman, Dole, Caughy, O'Campo et al., 2006). This study also found that more Black women compared to White women lived in neighborhoods with poorer conditions. Non-Hispanic White women lived in neighborhoods with less litter and graffiti and more sidewalks than neighborhoods of non-Hispanic Black women.

In addition to the general neighborhood context, specific neighborhood conditions may not influence the risk of PTD for Black and White women in the same manner. For example, among Black women, a significant positive association between neighborhood poverty and very preterm birth was found

(Reagan & Salsberry, 2005), but among White women in the same study, an increasing fraction of workers in professional occupations was associated with decreased risk of PTD. For White women, neighborhood poverty was not a risk factor for PTD. In another study, median household income was found to be significantly associated with PTD among Black women, but not among White women (Pickett, Ahern, Selvin, & Abrams, 2002).

The lack of consistency in the findings regarding neighborhood deprivation and PTD may be due to several factors. First, the term "neighborhood" in these studies may indicate areas of very different sizes. For example, two of the studies defined neighborhoods as block groups, which are typically comprised of approximately 1,500 people (Laraia, Messer, Kaufman et al., 2006; Messer, Kaufman, Dole et al., 2006). Several other studies defined neighborhoods as census tracts or census area units (Ahern, Pickett, Selvin, & Abrams, 2003; Craig, Thompson, & Mitchell, 2002; Farley, Mason, Rice et al., 2006; Kaufman, Dole, Savitz et al., 2003; O'Campo, Burke, Culhane et al., 2008; Pickett, Ahern, Selvin et al., 2002; Reagan & Salsberry, 2005). Block groups form census tracts, and census tracts typically contain around 4,000 people. Neighborhoods may also be assigned using zip codes, which encompass areas of approximately 30,000 people (Smith, Shah, White et al., 2006; Smith, Draper, Manktelow et al., 2007). Other unique methods have also been used to divide the populations into area-based neighborhoods (Janghorbani, Stenhouse, Millward et al., 2006; Luo, Kierans, Wilkins et al., 2004; Luo, Wilkins, & Kramer, 2006).

The neighborhood size has been found to affect the results obtained. Krieger (2003) compared socioeconomic measures at the census block group, census tract, and zip code level and found that measures at the zip code level detected attenuated effects than measures at the block group or census tract level. Subramanian (2006) conducted a similar study and found that census tract socioeconomic measures and block group socioeconomic measures were stronger predictors of birth weight than zip code measure. Furthermore, census tract measures were even stronger predictors of birth weight than block group socioeconomic measures. That study demonstrates that census tracts, rather than block groups, may be the better neighborhood unit when examining pregnancy outcomes. According to Subramanian (2006), this may be "due to the importance of pregnancy and maternal health-related services and their policy relevance for identifying low income areas or medically underserved areas, both of which tend to operate in relatively larger than smaller spaces."

The term "deprivation" may also differ in meaning. Of the studies examined, only two used the same definition of deprivation (Luo, Kierans, Wilkins et al., 2004; Luo, Wilkins, & Kramer, 2006). Deprivation may be assigned using the Townsend Material Deprivation Index, Carstair's Socioeconomic Deprivation Index, median tract income, household size-adjusted average income per single person, or many other ways. Variables used to assign a deprivation status may be used alone or may be included in a composite index with other variables.

Additionally, the method of modeling deprivation may affect the results. A study in the United Kingdom found an association between neighborhood

deprivation, modeled continuously, and risk of PTD. Janghorbani (2006) used the Townsend score to calculate neighborhood deprivation and found a 7% increase in the relative risk of PTD for every unit increase in the Townsend score. When deprivation was categorized into tertiles, no significant association was found between deprivation and PTD. In addition to continuous and tertiles used by Janghorbani (2006), neighborhood deprivation has been modeled using quartiles, quintiles, 7 levels, and deciles (Craig, Thompson, & Mitchell, 2002; Luo, Wilkins, & Kramer, 2006; Messer, Kaufman, Dole et al., 2006; O'Campo, Burke, Culhane et al., 2008; Smith, Shah, White et al., 2006; Smith, Draper, Manktelow et al., 2007).

In addition to using census data to objectively measure neighborhood context, residents' perceptions of their own neighborhoods have been used to examine how neighborhoods may affect health (Aneshensel & Sucoff, 1996; Chandola, 2001; Feldman & Steptoe, 2004; Wen, Hawkley, & Cacioppo, 2006; Wilcox, Bopp, Oberrecht, Kammermann, & McElmurray, 2003; Wilson, Elliott, Law, Eyles, Jerrett, & Keller-Olaman, 2004). In the field of perinatal epidemiology, however, this method has been rarely used. Petrou (2007) found that women living in neighborhoods of medium or high self-perceived deprivation 9 months after giving birth were more likely to report fair or poor health status than women living in neighborhoods of low self-perceived deprivation. A case-control study of very low birth weight infants born to Black mothers found a significant association between maternal self-rated unfavorable residential environment and delivery of a very low birth weight infant (Collins, David,

Symons, Handler, Wall, & Andes, 1998). This association remained significant after adjusting for negative maternal behaviors (smoking, alcohol use, and illicit drug use). To the best of my knowledge, the association between prospectively-assessed perceived neighborhood conditions and PTD has only been examined in one study. Dole (2003) studied maternal stressors, including perception of neighborhood safety, in relation to PTD. The study found no significant associations between perceived neighborhood safety and PTD grouped by clinical circumstances (spontaneous and medically indicated).

Like objective neighborhood conditions, the use of subjective neighborhood perceptions encounters difficulties defining a "neighborhood." To the best of my knowledge, no study has provided a clear definition of "neighborhood" to the participants. Therefore, the responses may vary based on what each participant deems to be her "neighborhood."

Another difficulty in using neighborhood perceptions to characterize a neighborhood is that a different questionnaire is used in each study. One study asked participants to rate the safety of neighborhoods using 6 questions (Wilcox, Bopp, Oberrecht et al., 2003), while another study focused on perceived neighborhood strain using 10 questions (Feldman & Steptoe, 2004). Petrou (2007) used a composite measure from 6 questions, and Collins (1998) used a composite measure from 8 questions to obtain a neighborhood deprivation score. Further complicating the difficulties in comparing results across studies, neighborhood conditions may also be divided into physical or social components (Wilson, Elliott, Law et al., 2004).

The correlation between objective and perceived measures of neighborhood conditions has been an issue of debate. Intuitively, the two measures should be highly correlated, as the objective neighborhood context should drive the perceived neighborhood context. Sampson and Raudenbush (2004) conducted a study in Chicago that illustrates the complexity of the relations between these two measures. The study used trained personnel to conduct systematic observations of neighborhoods to obtain objective measures of disorder and surveys designed to obtain perceptions of disorder from residents. The objective measure of disorder was significantly correlated with the perception of disorder, which supports the belief that the two measures should be highly similar. However, after controlling for objective disorder, concentration of poverty and race composition of the neighborhood were significantly positively related to perceptions of disorder. This study suggests that perceptions of neighborhood disorder are influenced by both objective neighborhood disorder and neighborhood racial context.

Several mechanisms have been proposed to describe the link between neighborhood context and PTD. These mechanisms include premature aging, behavioral responses, and stress.

According to Wen (2006), "the 'accelerated aging hypothesis'…specifies that psychological and physiological responses to demanding environmental stimuli operate as key mechanisms linking social conditions with health." The neighborhood environment may also affect risk of PTD by influencing certain behaviors, such as use of illicit drugs or alcohol, which could potentially

contribute to early aging (Farley, Mason, Rice et al., 2006). Cigarette smoking is a behavior that may be modified by neighborhood environment through stress levels, accessibility to cigarettes, or social tolerance of pregnancy smoking (Pickett, Wakschlag, Rathouz, Leventhal, & Abrams, 2002). Thus, cigarette smoking could potentially mediate associations between neighborhood conditions and PTD. However, neighborhood socioeconomic characteristics have been found to affect the risk of PTD for both Black and White women, independent of cigarette smoking, indicating that neighborhood conditions influence risk of PTD through more than just differing levels of pregnancy smoking (Ahern, Pickett, Selvin et al., 2003).

Neighborhood context may influence stress levels. Unfavorable perceptions of one's neighborhood may be a chronic stressor (Collins, David, Symons et al., 1998), and individuals living in lower SES neighborhoods have reported heightened vigilance for future potential threats (Feldman & Steptoe, 2004). High levels of anxiety, perceived stress, depression, and neutral or negative attitudes toward pregnancy have been associated with shorter gestations (Copper, Goldenberg, Das, Elder, Swain, Norman et al., 1996; Dole, Savitz, Hertz-Picciotto, Siega-Riz, McMahon, & Buekens, 2003; Steer, Scholl, Hediger, & Fischer, 1992). However, these findings should be interpreted carefully, since the definitions of the exposure may not be consistent and the studies may not differentiate acute and chronic stress.

Stressful life events, which may be influenced by neighborhood context, have been linked to increased risk of PTD in some studies (Berkowitz & Kasl,

1983; Dole, Savitz, Hertz-Picciotto et al., 2003; Newton, Webster, Binu, Maskrey, & Phillips, 1979). Other studies, however, have not found this association (Stein, Campbell, Day, McPherson, & Cooper, 1987) or found it only in White women (Berkowitz & Kasl, 1983).

Wadhwa (2001) reviewed the role of stress in PTD and concluded that maternal psychosocial stress could influence PTD through several pathways. These pathways include neuroendocrine processes, such as activation of the hypothalamic-pituitary-adrenal axis, immune/inflammatory processes, such as susceptibility to infections, or vascular processes, such as pregnancy-induced hypertension or preeclampsia.

The previous research on objectively-measured neighborhood conditions and PTD suggests significant associations, but invites further studies to continue exploring these associations. Only a few studies have divided PTD by weeks of gestation (Janghorbani, Stenhouse, Millward et al., 2006; Reagan & Salsberry, 2005; Smith, Draper, Manktelow et al., 2007). Also, the vast majority of studies grouped all preterm births together, regardless of clinical circumstances. Of the three studies that addressed clinical circumstances, two restricted their study populations to include only spontaneous preterm births (Pickett, Ahern, Selvin et al., 2002; Smith, Shah, White et al., 2006). Only one study included both spontaneous and medically indicated preterm deliveries as separate groups (Dole, Savitz, Hertz-Picciotto et al., 2003). Examining the associations between neighborhood conditions and PTD, grouped by week of gestation at birth and by

clinical circumstances, may elucidate the mechanisms(s) by which neighborhood context affects risk of PTD.

Also, the use of perceptions of neighborhood environment, in addition to objective measures, will be useful for several reasons. Many of the previous studies of neighborhood perception and health have been cross-sectional, so causal inference has been difficult to establish. A prospective study may alleviate some of this difficulty. Also, the correlation between objective and subjective measures of neighborhood conditions has been a source of debate, and this needs further exploration. Lastly, if perceptions truly do reflect more than just objective neighborhood conditions, the associations with PTD may differ between the two measures. The following study was designed to shed light on the complex roles that neighborhoods play as potential determinants of PTD.

AIMS AND HYPOTHESES

The overall aim of this thesis was to examine the associations between risk of preterm delivery subtypes, grouped by clinical circumstances (spontaneous, medically indicated) and by week (<35, 35-36 weeks), in relation to two measures of neighborhood conditions: 1) perceived neighborhood disorder ascertained at mid-pregnancy; and 2) an objective measure of neighborhood deprivation based on 2000 US census data. Additional analyses considered the concordance/discordance of the neighborhood disorder and neighborhood deprivation measures. I hypothesized that, of the two measures, deprivation would be more strongly associated with PTD. Census tract information is an objective method used to summarize neighborhood conditions. In contrast, a woman's opinion of her neighborhood may be altered differentially by neighborhood conditions, by specific personality traits, or by individual characteristics such as income (Wen, Hawkley, & Cacioppo, 2006).

MATERIALS AND METHODS

Study Population

This study included participants from the Pregnancy Outcomes and Community Health (POUCH) Study, a prospective cohort study (Holzman, Bullen, Fisher, Paneth, & Reuss, 2001). The POUCH study enrolled women in the 15-27th week of pregnancy from five Michigan communities from 1998 to 2004. These communities included urban, suburban, and rural areas. Eligibility

criteria included maternal age ≥15 years, screened for maternal serum alpha-fetoprotein between 15 and 22 weeks' gestation, singleton pregnancy with no known congenital or chromosomal abnormalities, no history of pre-pregnancy diabetes, and English-speaking. Ascertainment of both a neighborhood disorder and deprivation score was also necessary for inclusion in this particular study.

Data Collection

At 15-27 weeks' gestation, participants met with a study nurse in their community. At this meeting, biological samples such as urine, plasma, and serum were collected. The participants also gave a detailed interview and took a self-administered questionnaire to obtain demographic information and information about their current pregnancy, reproductive history, health behaviors, and social and psychosocial experiences.

Covariates

Several covariates were considered in this study, and information on these variables was collected from the questionnaire. These variables were selected to reflect those commonly seen in the literature as potentially confounding the association between neighborhood conditions and PTD. Maternal age at delivery was modeled as a continuous variable (range: 15-48 years old). Race/ethnicity was initially comprised of 6 categories: non-Hispanic White; non-Hispanic Black; Asian; Hispanic; Native American; Other. Maternal education level considered both education and age. The categories were: <20 years old and <high school; ≥20 years old and <high school; ≥high school. Marital status originally had 4 categories. Married and living with partner was combined with married and not

living with partner, because only 19 women were married and not living with their partner. Marital status now had the following categories: married; not married, but living with partner; not married and not living with partner. Smoking status contained the following categories: did not smoke during pregnancy; stopped before enrollment; smoked <1/2 pack/day at enrollment; smoked at least 1/2 pack/day at enrollment. Pre-pregnancy body mass index (BMI) was determined using the CDC BMI guidelines. If pre-pregnancy BMI was not available, the BMI was obtained from the weight and height at the time of prenatal screening. Pre-pregnancy BMI contained 4 categories: low; normal; overweight; obese. Parity was dichotomized as no previous live births or at least one previous live birth. Medicaid status was dichotomized as on Medicaid either prior to or at time of enrollment or never on Medicaid.

Definition of Perception of Neighborhood Disorder

To measure maternal perception of neighborhood conditions, a modified version of section VII of the Korbin and Coulton Instrument was included in a maternal questionnaire given as part of the POUCH study (Korbin & Coulton, 1995) (Figure 1). This section included 15 questions about general disorder and asked the mother how often she saw things occurring in her neighborhood. These things included litter on sidewalks, graffiti on buildings, abandoned cars, or gang activity. The response option was selecting from 1 to 10, with 1 indicating rarely and 10 frequently. To obtain a neighborhood disorder score, the answers to these questions were summed (range: 15-150), with higher scores representing areas of greater perceived disorder. The method of summing the

answers to the questions to obtain a score is consistent with other studies using this instrument (Coulton, Korbin, & Su, 1996; Poortinga, Dunstan, & Fone, 2008).

Of the 3,019 women enrolled in the POUCH Study, a neighborhood disorder score (defined as an answer to all 15 questions) was available on 2,927 women (97%). Sixty-nine women completed the maternal questionnaire before the Korbin and Coulton instrument for neighborhood disorder was added. An additional 23 women were missing answers to one or more of the neighborhood conditions questions and were excluded from analyses.

Definition of Objective Neighborhood Deprivation

To measure neighborhood deprivation, the address of each woman was geocoded (i.e., address matched) in ArcView 3.2, and, using a 'spatial join' geoprocessing command, the census tract identifier in which the mother lived at the time of enrollment in the POUCH Study was assigned to the POUCH records. Once geocoding was complete, a previously validated deprivation index was used to assign each census tract a deprivation score (Messer, Laraia, Kaufman, Eyster, Holzman, Culhane et al., 2006), This index was developed using principal component analysis to identify 8 census variables from 5 domains (income/poverty, education, occupation, housing, and employment) relevant to health outcomes. The loading factors were used to obtain a deprivation score for each census tract (range: -0.1 to 1.1), where higher scores represent areas of higher deprivation.

Of the 2,927 women with neighborhood disorder scores, geocoding was completed on 2,922 women (99.8%). Geocoding was incomplete on 4 women,

because their addresses involved P.O. Boxes (N=3) and residence in college campus housing (N=1). After excluding women without a neighborhood deprivation or disorder score, 2,922 women (96.8% of the total population) were included in the analyses.

PTD Definition and Subtypes

PTD was defined as births before 37 weeks' gestation. Gestational age (GA) was determined by the date of the first day of the last menstrual period (LMP), unless the GA determined by an early ultrasound differed from the LMP GA by 2 weeks or more. In that case, the ultrasound GA was used.

PTD was divided into 2 subgroups by clinical circumstances: 1) spontaneous PTD, which included spontaneous preterm labor with intact membranes or premature rupture of membranes; 2) medically indicated deliveries before onset of spontaneous labor or PROM. PTD was also divided into 2 subgroups by week of gestation at birth: 1) <35 weeks; 2) 35-36 weeks.

Analytical Strategy

Neighborhood disorder score (perceived measure) could not be modeled continuously because 22% of the study population reported a score of 15, which is the minimum disorder score. Disorder was then divided into categories. A threshold effect was seen between neighborhood disorder score and risk of PTD. Therefore, neighborhood disorder score was dichotomized as women in the top decile of disorder score vs. all women less than the top decile of disorder score. For this study, neighborhood deprivation score (objective measure) was divided into tertiles: low, middle, and high levels of deprivation.

When all the race/ethnicity groups were included in the same model, the top decile of neighborhood disorder score contained 5.6% of the W/O women and 20.6% of the B/H women. Also using a model with all race/ethnicity groups, the top tertile of neighborhood deprivation score (i.e., high deprivation) contained 18.7% of the W/O women and 68.1% of the B/H women. Due to differing distributions of both neighborhood disorder and deprivation scores (Figures 2 and 3), the data were stratified on maternal race/ethnicity. Race/ethnicity-specific groups were determined by examining the distributions of the neighborhood scores and combining race/ethnicity groups with similar distributions. A White/Other (W/O) group (N=2,052) contained women of the following race/ethnicity groups: 95.4% non-Hispanic White, 2.7% Asian, 1.7% Native-American, and 0.2% Other. A Black/Hispanic (B/H) group (N=870) contained women of the following race/ethnicity groups: 82.2% non-Hispanic Black and 17.8% Hispanic.

SAS version 9.1 was used to conduct the analyses for this thesis. Logistic regression was used to determine the associations of each independent variable with PTD dichotomized as preterm or term. Polytomous logistic regression was used to further explore these associations with PTD subtype grouped by clinical circumstances or by week with term deliveries serving as the reference group. The following variables may confound or mediate the association between neighborhood conditions and pregnancy outcomes: maternal education, maternal age, BMI, parity, Medicaid status, smoking status, and marital status. Each model is presented both unadjusted and adjusted for these variables.

Logistic regression, rather than multi-level modeling, was used due to the lack of clustering of the study population within census tracts. For both race/ethnic-specific groups, the majority of census tracts had 1 or 2 women per tract. For the W/O group, the women were represented in 565 unique census tracts, with 200 preterm deliveries. For the B/H group, the women were represented in 247 different census tracts, with 127 preterm deliveries. For both groups, the number of preterm deliveries was less than one per tract. Therefore, valid estimates for multi-level modeling would be difficult to obtain (Elliott, 2000; Moineddin, Matheson, & Glazier, 2007). Modeling neighborhood deprivation as an individual-level variable has been used in other studies when clustering was low (Cubbin, Marchi, Lin et al., 2008; Wen, Hawkley, & Cacioppo, 2006). The effect estimates obtained from individual-level logistic regression analysis have been found to be nearly identical to those obtained from multilevel logistic regression analysis when low levels of clustering were present (Luo, Kierans, Wilkins et al., 2004; Luo, Wilkins, & Kramer, 2006).

To study concordance/discordance of the two measures of neighborhood conditions, neighborhood deprivation and disorder scores were divided into tertiles and compared. The four categories of primary interest were women in the following categories: lowest tertile for both measures ('realists'-positive neighborhood); highest tertile for both measures ('realists'-negative neighborhood); highest tertile for disorder and lowest tertile for deprivation ('pessimists'); lowest tertile for disorder and highest tertile for deprivation

('optimists'). Kappa coefficients were calculated to test the level of agreement between the two measures for each race/ethnic-specific group.

RESULTS

Demographics

The demographic characteristics of the study population, stratified by race/ethnicity, are presented in Table 1. The distributions of the 7 maternal characteristics in Table 1 were all substantially different between the race/ethnic-specific groups. Approximately 89% of W/O and 64% of B/H women completed at least high school. Only 15% of W/O women but 54% of B/H were single and not living with a partner. During the pregnancy, 78% of the B/H women and 36% of the W/O women were insured through Medicaid.

Maternal age ≥30 years was the only characteristic significantly associated with increased odds of PTD dichotomized as yes/no among B/H women (data not shown). Having at least one previous birth was associated with increased risk for PTD among B/H women, but the association was not significant (p=0.08). Among W/O women, being obese and having ever been insured by Medicaid conferred a slight, albeit non-significant, increase in odds of PTD (p=0.07 for both).

The distribution of preterm deliveries differed between the race/ethnicity-specific groups (Table 2). The rate of PTD was higher among the B/H women (15%) than among the W/O women (10%). Black and Hispanic women experienced higher rates of PTD <35 weeks (6% overall and 40% of all PTD)

than those seen in the White women and women of other races (3% overall and 30% of all PTD).

Neighborhood Disorder

The associations between the top decile of neighborhood disorder score and PTD by clinical circumstances differed between the race/ethnic-specific groups. In the B/H group, no association was seen between the top decile of neighborhood disorder score and spontaneous PTD (Table 3). However, a significant association was found between the top decile of neighborhood disorder score and medically indicated PTD (OR 2.8, 95% CI 1.3, 6.1). This association remained relatively unchanged after adjusting for many individual-level variables (aOR 2.8, 95% CI 1.2, 6.5). Using the top quintile, instead of the top decile, produced a very similar odds ratio for spontaneous PTD and an attenuated odds ratio for medically indicated PTD (data not shown). Upon adjustment for potential confounders, the top quintile for disorder was associated with a significantly elevated risk for medically indicated PTD (aOR 2.1, 95% CI 1.0, 4.3) for Black and Hispanic mothers. In the W/O group, the top decile of neighborhood disorder was not associated with spontaneous or medically indicated PTD. The risk for medically indicated may be moderately increased, but this increase was not statistically significant. The top decile of neighborhood disorder was not significantly associated with PTD by week for either race/ethnic-specific group (Table 4).

Neighborhood Deprivation

The associations between neighborhood deprivation score and PTD differed by race/ethnicity-specific groups and differed from the associations seen between neighborhood disorder score and PTD. The point estimates for risk of spontaneous and medically indicated PTD were quite similar in the B/H group (Table 5). For women living in the top tertile of neighborhood deprivation compared to women living in the lowest tertile, the risk for both types of PTD bordered on being significantly elevated. In the W/O group, neighborhood deprivation was not significantly associated with either subtype of PTD based on clinical circumstances.

When PTD was grouped by week, B/H women living in the top tertile of neighborhood deprivation had significantly increased risk for PTD <35 weeks (OR=2.3, CI 1.1, 4.9) (Table 6). This point estimate was slightly increased after adjusting for individual-level variables (OR=2.6, CI 1.1, 6.0). The risk for PTD 35-36 weeks also appeared to be slightly elevated (OR=1.6, CI 0.9, 2.8), but the association was not significant. In the W/O group, neighborhood deprivation was not significantly associated with PTD by week. The risk of PTD <35 weeks was slightly, but not significantly, higher for women living in the highest tertile of deprivation (OR=1.3, CI 0.7, 2.4).

Interactions were tested for each model, and no significant interactions were found in any of the models except for one. A significant interaction (p=0.05) was found between Medicaid status and neighborhood deprivation in the B/H group only. The significance appeared to be driven by the women in the middle

tertile of deprivation who had never been on Medicaid. For this group, the odds ratio for PTD at 35-36 weeks was lower than that for women in the middle tertile of deprivation who had ever been on Medicaid. After stratifying on Medicaid status, women in the highest tertile of deprivation still had increased risk of PTD <35 weeks in both models. Therefore, this interaction was not highlighted further, and the models presented were not stratified on Medicaid status.

Concordance of Measures of Neighborhood Conditions

The concordance between the two measures of neighborhood conditions was also examined for each race/ethnic-specific group. Among B/H women, approximately 49% were in the same tertile for both disorder and deprivation (Table 7). The percentage of concordance among W/O women was 45% (Table 8) Extreme discordance (lowest tertile for one measure and highest tertile for other measure) occurred in 10.7% and 11.3% of the Black/Hispanic and White/Other women, respectively. The kappa coefficients for agreement between disorder and deprivation were 0.1806 and 0.2396 for W/O women and B/H women, respectively. Due to insufficient numbers, the associations between level of concordance and risk of PTD could not be examined.

DISCUSSION

The results from this study suggest that perceived and objective neighborhood conditions each have a unique association with risk of PTD among Black and Hispanic women but not among White women and women of other race/ethnicity groups. Among Black and Hispanic women, the link between

neighborhood disorder and PTD was evident after dividing PTD by clinical circumstances. The link between neighborhood deprivation and PTD was evident after dividing PTD by weeks. Specifically, the top decile of neighborhood disorder was significantly associated with increased risk for medically indicated PTD among Black and Hispanic women, but not among White women or women of other races. The top tertile of neighborhood deprivation was associated with an increased risk for both spontaneous and medically indicated PTD and a significantly increased risk for PTD <35 weeks again in the B/H group only.

The results from the B/H and W/O groups may not be directly compared, because group-specific cut points were used for the deprivation tertiles and the top decile of disorder score. Using the same cut points for both groups was explored, but no significant associations were found (Tables 9-12).

The race/ethnic-specific differences in associations may be explained by minimal overlap along the continuum of neighborhood environment in this sample of women. Significant associations between neighborhood measures and PTD may be found in the B/H group and not the W/O group because the distribution of neighborhood conditions differs between the groups. Only 2.5% of the White/Other women had neighborhood disorder scores comparable to those seen in the top decile of neighborhood disorder for Black and Hispanic women. Even more remarkable, only 1.8% of the White/Other women had a neighborhood deprivation score that would place them in the top tertile of neighborhood deprivation for Black and Hispanic women. So, the analyses for both measures of neighborhood conditions used data from different areas along

the continuum of distribution of neighborhood conditions. The highest tertile of deprivation for Black and Hispanic women tended to include neighborhoods near the extreme high end of the deprivation scores, while the highest tertile for the White women and women of other races tended to include neighborhoods with more moderate levels of deprivation. Therefore, significant associations between neighborhood conditions and PTD subtypes were found only in neighborhoods with extremely high levels of objective deprivation or perceived disorder. This suggests that stratifying on race/ethnicity is important to tease out the effects of neighborhood deprivation on health.

Several studies have also found that Black women live in neighborhoods with worse conditions when compared to the neighborhoods of White women (Laraia, Messer, Kaufman et al., 2006; Messer, Kaufman, Dole et al., 2006). It has been argued that the differential exposures to negative neighborhood conditions may influence stress levels. Stress levels may in turn influence the risk of PTD, potentially explaining why neighborhood conditions, measured both objectively and subjectively, were associated with PTD subtypes among Black and Hispanic women only in this study. Also, this differential exposure may contribute to premature aging among Black and Hispanic women (Cassel, 1976). This "weathering" hypothesis has been proposed to explain the increasing disparity seen in Black-White infant mortality as maternal age increases (Geronimus, 1992) and may explain the stronger associations between neighborhood conditions and adverse pregnancy outcomes among Black and Hispanic women found in this study.

The results from this study support the results from previous research that found significant associations between neighborhood environment and PTD among Black women, but not among White women (Kaufman, Dole, Savitz et al., 2003; Messer, Kaufman, Dole et al., 2006). However, other studies have found significant associations among White women. One measure of neighborhood condition, the percent of workers in professional occupations, has been associated with a decreased risk of PTD for White women (Reagan & Salsberry, 2005). Importantly, that study also found other variables to be significantly associated with risk of PTD among Black and Hispanic women, and neighborhood effects were much stronger for Black and Hispanic women than for White women.

One study found significant associations between neighborhood deprivation and PTD for both White and Black women (O'Campo, Burke, Culhane et al., 2008). This study also found that the association was stronger for White women (aOR 1.57, 95% CI 1.41, 1.74) than for Black women (aOR 1.15, 95% CI 1.08, 1.23). Those results do not agree with the results from this study which found no association between neighborhood deprivation and PTD among White women and women of other race/ethnicity groups. The same deprivation index was used in both the study by O'Campo (2008) and this study. However, that study had a much larger sample size than this study and may have had more power to detect associations among White women. More importantly, that study did not subdivide PTD by clinical circumstances or by weeks, or use race/ethnic-specific cut points.

Other studies have found associations between neighborhood deprivation and PTD divided by weeks, particularly early PTD. Of the three studies that have previously examined neighborhood conditions and PTD grouped by week, two were conducted in the United Kingdom. One of these studies found that almost all of the deprivation decile categories were associated with increased risk for extremely (22-28 weeks) and very (22-32 weeks) PTD (Smith, Draper, Manktelow et al., 2007). However, this study did not control for any variables other than year of delivery, so the associations found may have been confounded by other factors. The other study in the UK found a modest, but not significant, increase in risk of PTD <32 weeks with the top tertile of deprivation compared to the lowest (Janghorbani, Stenhouse, Millward et al., 2006). The increase in risk disappeared as gestational age increased. The last study was conducted in the United States and found a significant positive association between census tract poverty and very (<33 weeks) PTD among Black women only (Reagan & Salsberry, 2005). The association was not found for moderate PTD or among White women.

To the best of my knowledge, only one other study has examined the relation between perceptions of neighborhood conditions and PTD (Dole, Savitz, Hertz-Picciotto et al., 2003). That study found no association between perceived neighborhood safety and PTD by clinical circumstances (spontaneous and medically indicated). The use of race/ethnicity-specific groups and cut points in these analyses, but not in the previous study, may explain the differing results, since a significant association in these analyses was found only among Black

and Hispanic women. Also, the focus of the questionnaires was different (neighborhood disorder vs. neighborhood safety), which may have contributed to the conflicting findings.

Care should be taken in interpreting the significant finding between perceived neighborhood disorder and medically indicated PTD for several reasons. Medically indicated preterm deliveries may have become spontaneous preterm or term deliveries had medical intervention not occurred, and the reasons for induction or c-section may be varied and dependent on the attitudes of the health-care provider. Also, a rather stringent cut point for disorder was used (top decile) for these analyses. However, repeating the analyses using the top quintile, rather than the top decile, still resulted in a significant, but attenuated association between disorder and medically indicated PTD among Black and Hispanic women.

The differing associations between the objective and perceived neighborhood conditions and PTD may suggest differing mechanisms. The objective neighborhood deprivation was associated with early (<35 weeks) PTD. Infections are a common finding in early (<30 weeks) PTD, and become more rare as gestational age increases (Goldenberg, Hauth, & Andrews, 2000). The association between neighborhood deprivation and early PTD may be mediated through an infection/inflammation pathway. The perceived neighborhood disorder score was not associated with PTD by week, but was associated with medically indicated PTD. Negative perceptions of neighborhood environment may be a chronic stressor (Collins, David, Symons et al., 1998). In a population

of pregnant Black women, greater perceived stress was a predictor of higher systolic blood pressure at 32-26 weeks' gestation (Stancil, Hertz-Picciotto, Schramm, & Watt-Morse, 2000). Hypertensive disorders, such as chronic hypertension or preeclampsia, have been found to be more strongly associated with medically indicated PTD than with spontaneous PTD (Berkowitz, Blackmore-Prince, Lapinski, & Savitz, 1998). Therefore, perception of neighborhood disorder may possibly be associated with medically indicated PTD through a pathway mediated by stress and hypertensive disorders. Further research is needed to examine whether the different measures of neighborhood environment employ differing mechanisms that lead to PTD.

The kappa coefficients indicated slight to fair agreement between the two measures of neighborhood conditions for both race/ethnic-specific groups. Approximately 11% of the population in each race/ethnic-specific group was in the lowest tertile for one measure and the highest tertile for the other. The presence of extreme discordance and the lack of strong agreement between the 2 measures could be due to several reasons. The questions asked to assess perceived neighborhood disorder differed from the census variables used to assess neighborhood deprivation. Therefore, the two measures may be capturing different elements of neighborhood conditions. Although census tracts were used to identify areas with similar conditions and populations, some heterogeneity in conditions may occur in the tract, particularly around the boundaries. Also, people's personalities and past experiences may affect their perception of disorder. Childhood environment may shape one's perception of

his or her current neighborhood conditions. For example, a person who grew up in an advantaged environment may perceive a middle-class neighborhood in a different way than a person who grew up in a disadvantaged environment. Factors that may explain discordance between objective and perceived neighborhood conditions invite further research.

Limitations of Study

Although clustering within census tracts was small, the variances obtained in this study may be slightly underestimated. When the models were adjusted for community, the significant results remained statistically significant and the confidence intervals were similar. Clustering by community was not a factor, and the communities were heterogeneous.

Due to stratifying on race/ethnicity-specific groups, our significant results found for medically indicated PTD and PTD <35 weeks in the B/H group are based on a relatively small number of cases. Confirming the presence of these associations in studies with larger samples would be important.

The neighborhood deprivation and disorder scores were each based on a single measure at a specific time point. The neighborhood deprivation score was determined using the address at the time of enrollment in the POUCH Study. The neighborhood disorder score was based on current residence. The POUCH participants may have recently moved into a neighborhood or may have moved to a different neighborhood prior to delivery. If so, the scores may not accurately reflect the level of disorder or deprivation experienced by the participants prior to or during pregnancy.

Finally, the association between neighborhood conditions and PTD may involve complex pathways. Although the results were adjusted for both education and Medicaid status, these variables may not adequately capture individual-level SES, and residual confounding may be present. Due to the complexity of the pathways, other potentially confounding variables may be present that were not controlled for in the groups. However, adjustment for a variety of individual-level variables produced estimates very similar to the unadjusted estimates.

Strengths of Study

Many strengths were also present in this study. The study has provided information on how neighborhood conditions, measured two different ways, were associated with the risk of PTD by clinical circumstances and week. Additionally, self-assessment of neighborhood conditions has only been used one time in a population of pregnant women to prospectively study risk of PTD (Dole, Savitz, Hertz-Picciotto et al., 2003). The results from this current study suggest that measures of neighborhood perceptions may by useful in the field of perinatal epidemiology. Another strength of this study is the prospective design. Since women were asked to rate characteristics of their neighborhoods before giving birth, their answers were not biased by the outcome of their pregnancy. In retrospective studies, self-reports may be affected by complications at birth (Stein, Campbell, Day et al., 1987). Lastly, the population included women from a variety of socioeconomic backgrounds, so the results are more generalizable to

other populations and there was a considerable range of distribution for disorder and deprivation scores.

Conclusions

The findings from this study suggest that neighborhood conditions are significantly associated with risk of PTD among Black and Hispanic women, but not among White women and women of other race/ethnicity groups. This may suggest that there is a threshold of deprivation and disorder above which PTD risk increases. This threshold exists in neighborhoods that are common to Black and Hispanic women but uncommon for White women and women of other races. The differing associations found between the two measures of neighborhood conditions and PTD subtypes indicate that different mechanisms may be leading from perceptive and objective measures of neighborhood context to PTD. This study underscores the importance of considering both perceptive and objective measures when studying adverse pregnancy outcomes and examining race/ethnic-specific distributions for neighborhood perceived disorder and objective deprivation.

Table 1. Maternal characteristics of the POUCH study sample (N=2,922)[a] by race/ethnicity group

	Black/Hispanic		White/Other	
Characteristics	N	%	N	%
Education				
Grade <12 and age <20	162	19	119	6
Grade <12 and age ≥20	151	17	109	5
Grade ≥12	557	64	1824	89
Maternal age				
<20 years old	201	23	171	8
20-29 years old	540	62	1141	56
≥30 years old	129	15	740	36
BMI[b]				
Low	44	5	93	4
Normal	358	41	976	48
High	194	22	490	24
Obese	273	31	491	24
Smoking status[c]				
Did not smoke	320	72	1463	71
Stopped before enrollment	78	9	221	11
<1/2 pack/day	140	16	215	11
≥1/2 pack/day	28	3	151	7
Marital status[d]				
Married	162	19	1317	64
Not married, living with partner	238	27	421	21
Not married, not living with partner	467	54	311	15
Medicaid insured[e]				
No	193	22	1310	64
Yes	675	78	742	36
Parity				
No previous livebirths	342	39	909	44
At least one previous livebirth	528	61	1143	56

[a]Information on deprivation and disorder for 2,922 of 3,019 cohort women

[b]Missing information on 1 woman in Black/Hispanic and 2 women in White/Other

[c]Missing information on 4 women in Black/Hispanic and 2 women in White/Other

[d]Missing information on 3 women in Black/Hispanic and 3 women in White/Other

[e]Missing information on 2 women in Black/Hispanic

Table 2. Preterm delivery characteristics of the POUCH study sample (N=2,922) by race/ethnicity group

	Black/Hispanic		White/Other	
Type of delivery	N	%	N	%
Term (≥37 weeks)	743	85	1852	90
Preterm (<37 weeks)	127	15	200	10
Clinical circumstances				
Spontaneous	87	10	136	7
Medically indicated	40	5	64	3
Week				
35-36 weeks	76	9	141	7
<35 weeks	51	6	59	3

Table 3. Associations between neighborhood disorder score and PTD subtypes by clinical circumstances, stratified on race/ethnicity group

	Spontaneous				Medically Indicated			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	1.0	(0.5, 2.1)	0.9	(0.4, 2.1)	**2.8**	**(1.3, 6.1)**	**2.8**	**(1.2, 6.5)**
White/Other								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	1.0	(0.6, 1.8)	0.9	(0.5, 1.6)	1.7	(0.8, 3.3)	1.4	(0.7, 2.9)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

Table 4. Associations between neighborhood disorder and PTD subtypes by week, stratified on race/ethnicity group

	<35 Weeks				35-36 Weeks			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	1.3	(0.5, 3.1)	1.2	(0.5, 3.1)	1.6	(0.8, 3.2)	1.6	(0.8, 3.3)
White/Other								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	1.6	(0.8, 3.3)	1.5	(0.7, 3.3)	1.1	(0.6, 1.9)	0.9	(0.5, 1.6)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

Table 5. Associations between neighborhood deprivation score tertiles and PTD subtypes by clinical circumstances, stratified on race/ethnicity group

	Spontaneous				Medically Indicated			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
Low	1.0		1.0		1.0		1.0	
Middle	1.2	(0.7, 2.2)	1.2	(0.7, 2.3)	0.9	(0.4, 2.3)	1.1	(0.4, 2.8)
High	**1.8**	**(1.0, 3.1)**	1.7	(0.9, 3.1)	1.9	(0.9, 4.1)	2.4	(1.0[b], 5.8)
White/Other								
Low	1.0		1.0		1.0		1.0	
Middle	1.3	(0.8, 1.9)	1.3	(0.8, 2.0)	1.1	(0.6, 2.0)	1.0	(0.5, 1.8)
High	1.2	(0.8, 1.8)	1.1	(0.7, 1.8)	1.2	(0.6, 2.1)	0.9	(0.5, 1.8)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

[b]p=0.06

Table 6. Associations between neighborhood deprivation score tertiles and PTD subtypes by week, stratified on race/ethnicity group

	<35 Weeks				35-36 Weeks			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
Low	1.0		1.0		1.0		1.0	
Middle	1.6	(0.7, 3.5)	1.8	(0.8, 4.0)	0.9	(0.5, 1.7)	0.9	(0.5, 1.8)
High	**2.3**	**(1.1, 4.9)**	**2.6**	**(1.1, 6.0)**	1.6	(0.9, 2.8)	1.5	(0.8, 2.9)
White/Other								
Low	1.0		1.0		1.0		1.0	
Middle	1.0	(0.5, 2.0)	1.1	(0.6, 2.2)	1.3	(0.8, 1.9)	1.2	(0.8, 1.8)
High	1.3	(0.7, 2.4)	1.4	(0.7, 2.7)	1.1	(0.7, 1.7)	0.9	(0.6, 1.5)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

Table 7. Concordance of neighborhood disorder and deprivation score tertiles in Black/Hispanic group, n (cell percentage)

		Deprivation		
	Tertile	Low	Middle	High
Disorder	Low	167 (19)	81 (9)	47 (6)
	Middle	81 (9)	113 (13)	94 (11)
	High	46 (5)	92 (11)	149 (17)

Table 8. Concordance of neighborhood disorder and deprivation score tertiles in White/Other group, n (cell percentage)

		Deprivation		
	Tertile	Low	Middle	High
Disorder	Low	322 (16)	233 (11)	123 (6)
	Middle	253 (12)	242 (12)	200 (10)
	High	109 (5)	203 (10)	367 (18)

Table 9. Associations between neighborhood disorder score and PTD subtypes by clinical circumstances, stratified on race/ethnicity group (same top decile cut point for both groups)

	Spontaneous				Medically Indicated			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	1.0	(0.6, 1.7)	1.0	(0.5, 1.7)	1.9	(1.0, 3.8)[b]	2.0	(1.0, 4.1)[c]
White/Other								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	0.9	(0.4, 2.0)	0.8	(0.3, 1.7)	0.8	(0.3, 2.7)	0.6	(0.2, 2.1)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

[b]p=0.06

[c]p=0.07

Table 10. Associations between neighborhood disorder and PTD subtypes by week, stratified on race/ethnicity group (same top decile cut point for both groups)

	<35 Weeks				35-36 Weeks			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	1.0	(0.5, 2.0)	1.0	(0.5, 2.1)	1.4	(0.8, 2.4)	1.4	(0.8, 2.5)
White/Other								
<Top Decile	1.0		1.0		1.0		1.0	
Top Decile	0.9	(0.3, 2.9)	0.8	(0.2, 2.7)	0.9	(0.4, 1.9)	0.7	(0.3, 1.5)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

Table 11. Associations between neighborhood deprivation score tertiles and PTD subtypes by clinical circumstances, stratified on race/ethnicity group (same tertile cut points for both groups)

	Spontaneous				Medically Indicated			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
Low	1.0		1.0		1.0		1.0	
Middle	1.1	(0.4, 2.7)	1.1	(0.4, 2.7)	0.6	(0.2, 1.9)	0.6	(0.2, 2.2)
High	1.4	(0.6, 3.2)	1.3	(0.6, 3.1)	0.9	(0.3, 2.4)	1.1	(0.4, 3.1)
White/Other								
Low	1.0		1.0		1.0		1.0	
Middle	1.1	(0.7, 1.5)	1.0	(0.7, 1.5)	0.9	(0.5, 1.6)	0.8	(0.4, 1.4)
High	0.9	(0.6, 1.5)	0.8	(0.5, 1.4)	1.1	(0.5, 2.1)	0.8	(0.4, 1.7)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

Table 12. Associations between neighborhood deprivation score tertiles and PTD subtypes by week, stratified on race/ethnicity group (same tertile cut points for both groups)

	<35 Weeks				35-36 Weeks			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Black/Hispanic								
Low	1.0		1.0		1.0		1.0	
Middle	1.3	(0.3, 4.9)	1.4	(0.3, 5.3)	0.7	(0.3, 1.8)	0.7	(0.3, 1.8)
High	2.1	(0.6, 6.9)	2.3	(0.7, 8.2)	0.9	(0.4, 1.9)	0.8	(0.4, 1.9)
White/Other								
Low	1.0		1.0		1.0		1.0	
Middle	0.9	(0.5, 1.6)	0.9	(0.5, 1.6)	1.1	(0.7, 1.5)	1.0	(0.6, 1.4)
High	0.8	(0.4, 1.8)	0.8	(0.4, 1.8)	1.0	(0.6, 1.6)	0.8	(0.5, 1.3)

[a]Adjusted for Medicaid status, marital status, BMI, smoking status, maternal age, maternal education, parity

Figure 1. Modified Version of Section VII of the Korbin and Coulton Instrument

M.2. How often are these things a problem or are found in your neighborhood on a scale from 1 to 10, with 1 being Rarely and 10 being Frequently?

		1	2	3	4	5	6	7	8	9	10
a.	Litter or trash on the sidewalks or streets.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
b.	Graffiti on buildings and walls.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
c.	Abandoned cars.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
d.	Vacant, abandoned, or boarded up buildings.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
e.	Drug dealers or users hanging around.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
f.	Drunks hanging around.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
g.	Unemployed adults loitering.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
h.	Young adults loitering.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
i.	Gang activity.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
j.	Houses and yards not kept up.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
k.	Disorderly or misbehaving groups of young children (younger than teenagers).....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
l.	Disorderly or misbehaving groups of teenagers.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
m.	Disorderly or misbehaving groups of adults.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
n.	Racial slurs or attacks.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
o.	Gunshots.....	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

Figure 2. Comparison of Race/Ethnicity-specific Top Decile of Neighborhood Disorder Score

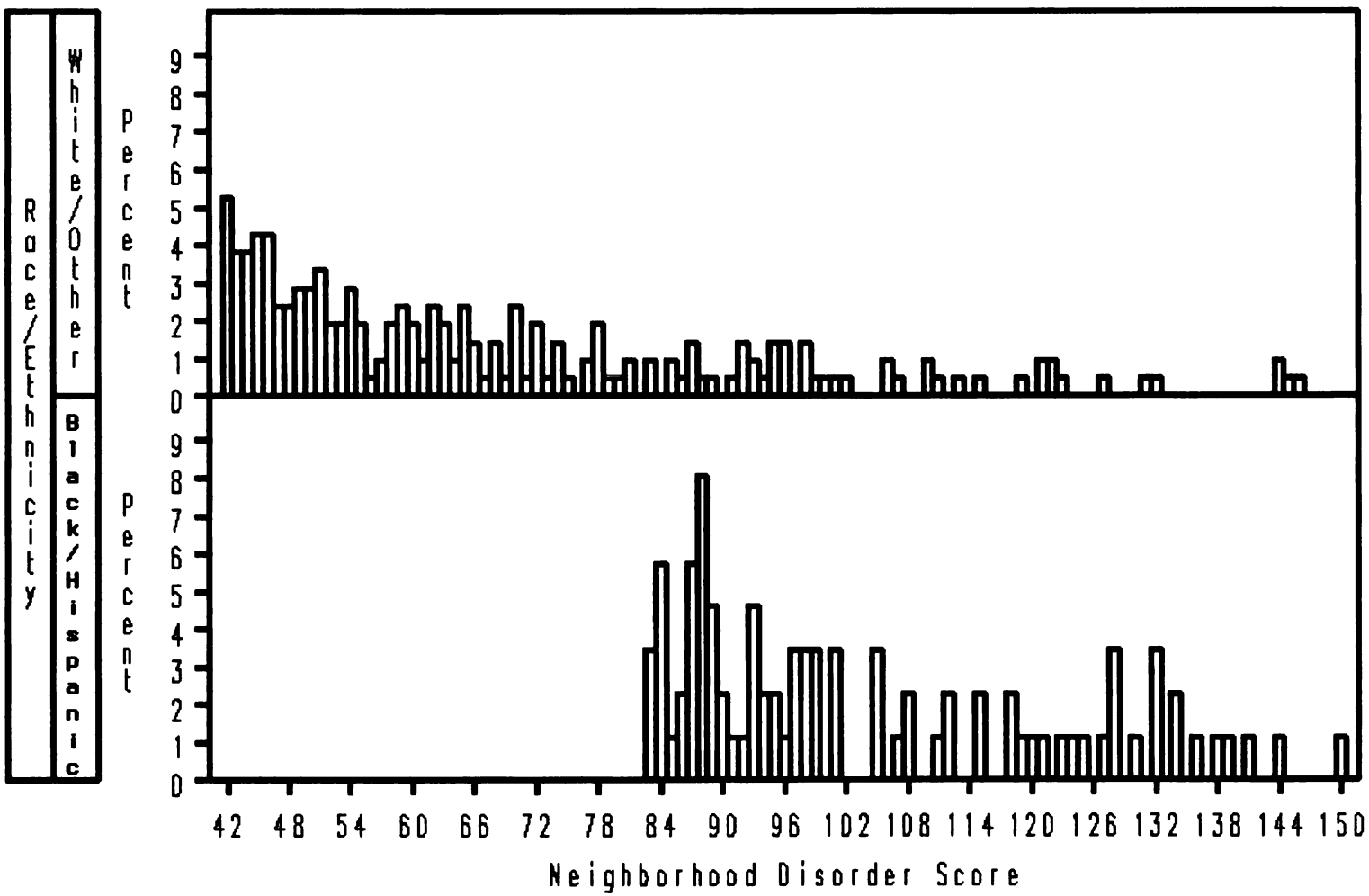
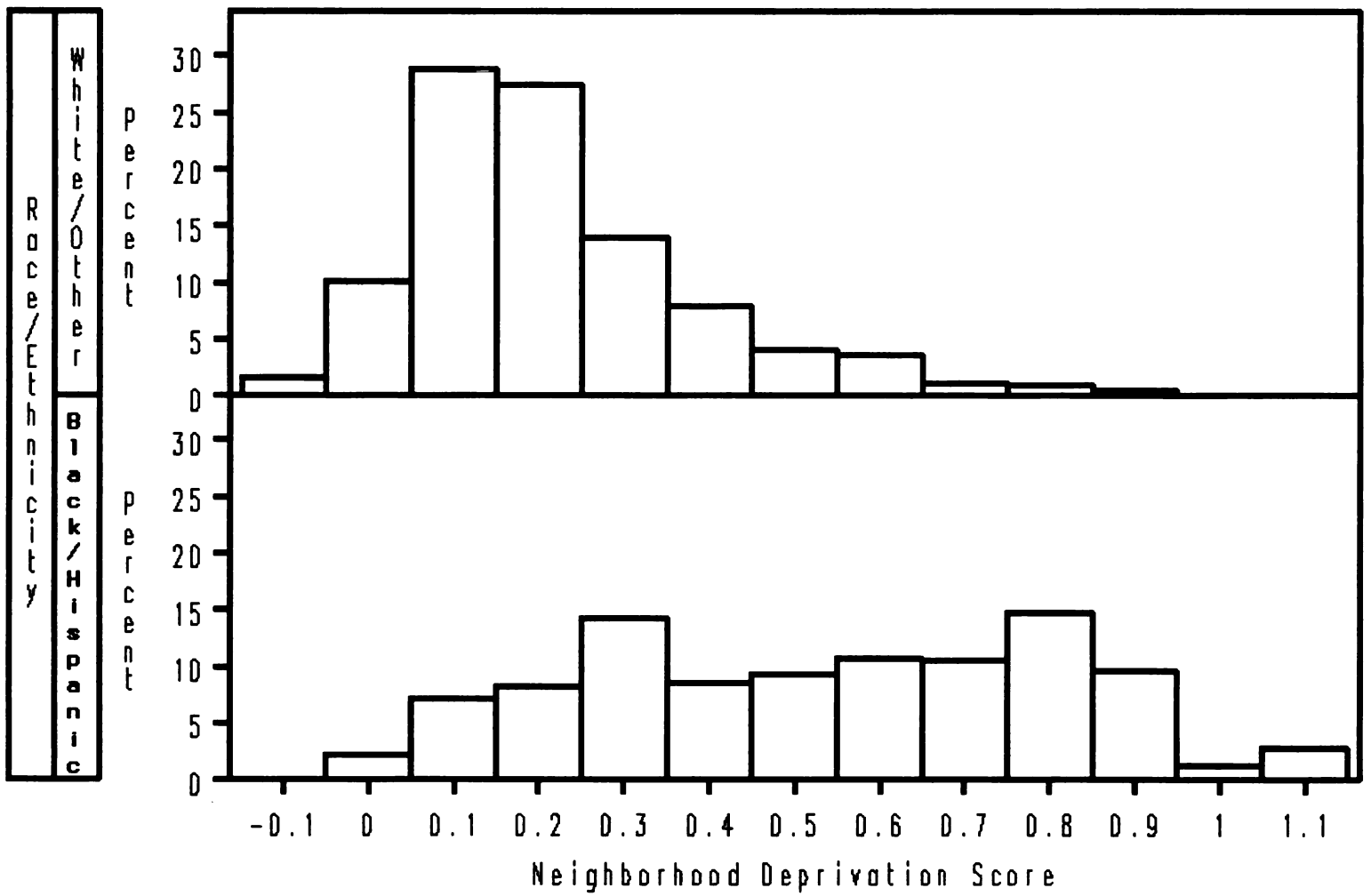


Figure 3. Comparison of Neighborhood Deprivation Score by Race/Ethnicity Group



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