Western University

Scholarship@Western

Human Environments Analysis Lab (HEAL)

4-2018

The association between alcohol outlet accessibility and adverse birth outcomes: A retrospective cohort study

Jamie A. Seabrook

N Woods

Andrew F. Clark

Barbra De Vrijer

Debbie Penava

See next page for additional authors

Authors
Jamie A. Seabrook, N Woods, Andrew F. Clark, Barbra De Vrijer, Debbie Penava, and Jason A. Gilliland

Journal of Neonatal-Perinatal Medicine 11 (2018) 71–77
DOI:10.3233/NPM-181741
IOS Press

Original Research

The association between alcohol outlet accessibility and adverse birth outcomes: A retrospective cohort study

J.A. Seabrook[a,b,c,d,e,f,*], N. Woods[a], A. Clark[f,g], B. de Vrijer[d,i], D. Penava[d,i] and J. Gilliland[b,c,d,e,f,g]
[a]*School of Food and Nutritional Sciences, Brescia University College, London, ON, Canada*
[b]*Department of Paediatrics, Western University, London, ON, Canada*
[c]*Department of Epidemiology and Biostatistics, Western University, London, ON, Canada*
[d]*Children's Health Research Institute, London, ON, Canada*
[e]*Lawson Health Research Institute, London, ON, Canada*
[f]*Human Environments Analysis Laboratory, London, ON, Canada*
[g]*Department of Geography, Western University, London, ON, Canada*
[h]*School of Health Studies, Western University, London, ON, Canada*
[i]*Department of Obstetrics and Gynaecology, Western University, London, ON, Canada*

Received 12 March 2017
Revised 17 July 2017
Accepted 18 September 2017

Abstract.
BACKGROUND: Alcohol outlet accessibility is positively associated with alcohol consumption, although this relationship has not been thoroughly examined in pregnant women. The present study examines the relationship between proximity and density of alcohol outlets and risk for low birth weight (LBW: <2,500 grams) and preterm birth (PTB: <37 weeks gestational age), and is the first Canadian study to investigate this association.
METHODS: Maternal accessibility to alcohol outlets was specified using a gravity-type measure of accessibility, which provides the amount of accessibility that a given household has to liquor stores within 30-minutes of their home. All singleton newborns without congenital anomalies that were born between February 2009 and February 2014 at London Health Sciences Centre in London, Ontario, were included in this cohort.
RESULTS: The sample consisted of 25,734 live births, of which 5.8% were LBW and 7.6% were PTB. Only 2.0% of women reported alcohol use during pregnancy. Alcohol outlet gravity was positively correlated with the percentage of mothers living in poverty ($r_s = 0.33$, $p < 0.001$) and in single-parent families ($r_s = 0.39$, $p < 0.001$), and who self-identify as visible minorities ($r_s = 0.45$, $p < 0.001$). Alcohol outlet gravity increased the odds that mothers drank alcohol during pregnancy (OR 1.05; 95% CI: 1.02, 1.07), although the association was weak. Furthermore, alcohol outlet gravity did not increase the likelihood of a LBW or PTB infant.
CONCLUSIONS: Women with high accessibility to alcohol outlets are more likely to consume alcohol during pregnancy, but greater alcohol outlet accessibility does not translate into poor birth outcomes.

Keywords: Alcohol outlets, alcohol use, pregnancy, low birth weight, preterm birth

*Address for correspondence: Dr. Jamie A. Seabrook, Brescia University College at Western University, 1285 Western Road, London, ON N6G 1H2, Canada. Tel.: +1 519 432 8353/Ext. 28284; Fax: +1 519 858 5137; E-mail: jseabro2@uwo.ca.

1. Introduction

Adverse birth outcomes, including low birth weight (LBW) and preterm birth (PTB) are more common among women of low socioeconomic status (SES). In a recent review of the literature, Campbell and Seabrook [1] found that neighborhood socioeconomic disadvantage, low maternal education, occupational status, and household income are all associated with adverse birth outcomes. Additionally, new and emerging research in epigenetics and the developmental origins of health and disease (DOHaD) demonstrates that many adult chronic diseases, including diabetes, obesity, and cardiovascular disease are largely attributable to what happens between conception and two years of age [2–5]. Yet, despite the consistent association between socioeconomic disadvantage and adverse birth outcomes, it remains unclear how SES contributes to these disparities. While stress exposure and risk-taking behavior remain the two most common explanations for the persistent association between SES and health, [6] socioeconomic differences in birth outcomes are not well explained by biological or individual-level behavioral risk factors [7].

Population-level risk factors may play a fundamental role in contributing to variations in birth outcomes: stress exposure and risk-taking behavior may mediate the relationship between the physical environment and health. For example, people living in neighborhoods characterized by high income inequality and poor living conditions tend to have greater stress exposure, which in turn, adversely affects health [1, 8, 9]. Indeed, prior research has found that neighborhood socioeconomic disadvantage increases the probability of a LBW infant, even after controlling for individual-level risk factors, including SES [10, 11].

One trait of the built environment that may contribute to variations in birth outcomes is density of alcohol outlets. It is plausible that higher alcohol outlet density in specific geographic regions increases the frequency of alcohol consumption among pregnant women, which in turn affects birth outcomes. Although very little research has been conducted on alcohol outlet density and drinking behavior among pregnant women per se, considerable research has investigated the association between proximity and density of alcohol outlets and health outcomes in general. In a recent systematic review, [12] Roche et al. found positive associations between alcohol outlet availability and alcohol consumption, and SES and drinking frequency, and found that maternal alcohol use during pregnancy increased the odds of physical, developmental, learning and behavioral problems in children. Similarly, Brenner et al. [13] found that women living near the highest density of alcohol outlets had significantly higher alcohol consumption than women who lived in areas with low density, and that female drinkers above the 75th percentile were more likely to have high education and income. In a retrospective population-based study of 140 neighborhoods from Toronto, Ontario, [14] premature all-cause mortality was higher among adults aged 20–59 years when they lived in the highest quintile of alcohol outlet availability compared with the lowest quintile.

At this time, the association between alcohol use during pregnancy and adverse birth outcomes is not clearly understood. While some studies find a higher risk of LBW and PTB among women who drank alcohol, [15–17] others show a reduced risk of PTB [18]. In fact, in a systematic review of low-moderate drinking behavior (up to 10.4 UK units or 83 g/week), only 1/19 studies ($n = 175{,}882$ women) found a significant increase in LBW, whereas 15/16 studies ($n = 178{,}639$ women) showed no effect or a reduced rate of PTB [19]. On the other hand, although there is no threshold to define low-risk drinking during pregnancy [20], there is sufficient evidence that high-risk alcohol exposure during pregnancy is associated with neurodevelopmental effects and abnormalities of development [21]. Furthermore, in the sole study that investigated the impact of neighborhood density of alcohol outlets on birth outcomes, Farley et al. [7] found no association with gestational age or birth weight-for-gestational age in rural and urban areas in Louisiana, or in the state as a whole. This study, however, was limited by its cross-sectional design, and by the fact that the number of off-premise alcohol outlets per capita was used as a proxy for the actual availability of alcohol in neighborhoods.

The primary objective of the present study was to assess the relationship between proximity and density of alcohol outlets in Southwestern Ontario and risk for LBW (<2,500 grams) and PTB (<37 completed weeks in gestational age), after controlling for socioeconomic and epidemiological risk factors also known to be associated with adverse birth outcomes. Alcohol outlets included Liquor Control Board of Ontario (LCBO) and Beer Store outlets of any size. To our knowledge, our study is the first Canadian study to investigate this association.

2. Methods

This retrospective cohort study comprised a large, population-based sample from Southwestern Ontario. Data were obtained from the perinatal and neonatal databases at London Health Science Centre (LHSC), a tertiary care facility with a catchment area of approximately 1.5 million patients per year. Data for all births at LHSC are prospectively entered from medical charts, and birth and neonatal records are recorded by a dedicated research assistant.

Maternal postal codes were entered into a Geographic Information System (ArcGIS 10.1, Environmental Systems Research Institute, Redlands, CA) to map the patients to determine mothers' home neighborhoods. Neighborhoods were defined by dissemination areas (DAs), the smallest geographical unit for which Statistics Canada releases the income data required for this study. Data on median household income for each DA in Southwestern Ontario were extracted from the latest Canadian Census (Statistics Canada, 2011) and linked to each mother. A full description of the geographical mapping methodology has been described elsewhere [9].

Maternal accessibility to alcohol outlets, including LCBO outlets and Beer Store outlets, was specified using a gravity-type measure of accessibility, [22] which provides the relative amount of accessibility that a given household has to liquor stores within 30-minutes of their home. Addresses of LCBO liquor stores were provided by the Alcohol and Gaming Commission of Ontario, and Beer Store addresses were downloaded from their website (http://www.thebeerstore.ca/stores), and all addresses were geocoded within ArcGIS 10.3. A 30-minute cut-off was used because purchasing alcohol is considered a "routine" activity, and is not a good that individuals are usually willing to travel farther out of their way to purchase. The alcohol outlet gravity accessibility measure is calculated based on the following formula:

$$A_i = \sum_j W_j f\left(d_{ij}\right),$$

where A_i is the accessibility of household i as defined by a mother's postal code at time of birth to all liquor stores located within 30 minutes; W_j is the weighting to indicate the attractiveness of each location, which we assigned 1, based on the assumption that all alcohol outlet locations are equally attractive; d_{ij} is the shortest path travel time on the road network linking household i to liquor store j; and $f\left(d_{ij}\right)$ is the distance-decay impedance function specified by $exp\left(-\beta d_{ij}\right)$. In this study, the β is given the constant value of –0.1113, which is the value calculated for retail opportunities by Scott and Horner [23].

All singleton newborns without congenital anomalies that were born between February 2009 and February 2014 at LHSC were included in this cohort. LBW infants were classified as those having a birth weight less than 2,500 grams. PTB was defined as a live birth less than 37 weeks gestational age. All SES variables were measured on a continuous scale, whereas the majority of medical history (e.g., previous PTB, chronic hypertension, gestational diabetes) and risk-taking variables (e.g., tobacco, marijuana, and alcohol use) were classified as a dichotomous, yes/no outcome. This study received approval from the University of Western Ontario Research Ethics Board and Lawson Health Research Institute at LHSC in London, Canada.

2.1. Statistical analysis

Data were analyzed using SPSS version 23 (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.). Categorical variables are summarized as percentages, and continuous outcomes are presented as mean ± standard deviation (SD) or median and interquartile range (IQR) where appropriate. The Pearson correlation coefficient, or Spearman rank correlation coefficient, assessed the strength and direction of the association between alcohol outlet gravity and SES variables. Chi-square tests were used to determine the association between categorical independent variables and LBW and PTB as dependent variables, and univariate logistic regressions were used to assess the relationship between continuous predictor variables and the two birth outcomes. All univariate associations that had a significant relationship with LBW and/or PTB ($p < 0.05$) were subsequently included in multivariable logistic regression models. A two-sided p value <0.05 was considered statistically significant.

3. Results

The final sample consisted of 25,734 live births, of which 5.8% were LBW and 7.6% were PTB. Selected maternal characteristics of the sample can be found in

Table 1
Selected maternal characteristics of the sample (2009–2014)

Variables	Measure of central tendency*
Maternal age (years)	29.4 ± 5.4
Body mass index (kg/m^2)	25.4 ± 6.5
Alcohol outlet gravity score	9.5 ± 3.8
% ≤high school diploma	19.9 ± 9.7
% ≤low income cut off (2010)	10.6 (4.5, 22.3)
% lone-parent families	14.5 (9.7, 25.0)
Distance to nearest grocery store (km)	0.9 (0.3, 10.0)
Visible minority prevalence	7.6 (0.0, 19.5)
% Alcohol use during pregnancy	2.0
% Smoking during pregnancy	16.2
% Marijuana use during pregnancy	2.3
% Depression during pregnancy	6.2

*Data are expressed as mean ± SD, median (25th, 75th percentiles), or percentages for dichotomous outcomes.

Table 1. The mean maternal age was 29.4 ± 5.4 years, and the average body mass index (BMI; kg/m^2) was 25.4 ± 6.5. Almost 20% of the women had a high school diploma or less as their highest level of education achieved. While 16.2% of women reported smoking tobacco during pregnancy, only 2.0% and 2.3% used alcohol and marijuana, respectively. The mean alcohol outlet gravity score was 9.5 ± 3.8.

We also examined the association between alcohol outlet gravity and socio-demographic and socioeconomic characteristics (data not shown). Alcohol outlet gravity had a weak positive correlation with the percentage of mothers living in poverty ($r_s = 0.33$, $p < 0.001$) and in single-parent families ($r_s = 0.39$, $p < 0.001$), but had little to no relationship with maternal education ($r = –0.19$, $p < 0.001$). Alcohol outlet gravity was moderately associated with population density ($r_s = 0.54$, $p < 0.001$) and percentage of visible minorities ($r_s = 0.45$, $p < 0.001$). In addition, univariate logistic regression revealed that alcohol outlet gravity increased the odds that mothers drank alcohol during pregnancy (OR 1.05; 95% CI: 1.02, 1.07).

Table 2 presents the results of logistic regression models estimating the relative effects of alcohol outlets, socioeconomic status, clinical history of medical problems, and behavioral risk factors on the probability that mothers will have a LBW infant. In Model 1, alcohol outlet gravity has a significant inverse association with LBW ($p < 0.001$), and this remains consistent throughout all subsequent models. In Model 2, body mass index (BMI) is negatively associated with LBW ($p < 0.001$), and this inverse relationship persists throughout Models 3–5. With the addition of socioeconomic status variables in Model 3, women who are living below the low-income cut-off (LICO) are more likely to have a LBW baby ($p < 0.01$). In Model 4, medical history is added to the regression, and the results indicate that previous PTB, number of previous abortions, pre-pregnancy asthma, pre-existing hepatitis B, chronic hypertension, and gestational diabetes all increase the likelihood of a LBW infant, whereas number of previous caesarean sections are a protective factor for LBW. When behavioral risk factors are considered in Model 5, marijuana use is an even stronger predictor of LBW than smoking tobacco (OR: 2.629 vs. 1.585, respectively), and alcohol use during pregnancy decreased the likelihood of LBW. The same medical variables associated with LBW from Model 4 remain statistically significant, except for number of previous caesarean sections and abortions. Furthermore, low income is the only socioeconomic status variable that continues to be associated with LBW ($p < 0.05$). The top five predictors of LBW are previous PTB (OR: 3.247), pre-existing hepatitis B (OR: 2.962), marijuana use during pregnancy (OR: 2.629), chronic hypertension (OR: 2.537), and gestational diabetes (OR: 1.675).

Table 3 presents results for PTB, the findings of which are similar to those found in Table 2. Once again, alcohol outlet gravity is inversely associated with adverse birth outcomes throughout all the models. Unlike LBW, however, maternal BMI, low income, pre-existing hepatitis B, chronic hypertension, and marijuana, smoking, and alcohol use are unrelated to PTB. The top five risk factors for PTB are previous PTB (OR: 4.271), pre-existing Type 1 diabetes (OR: 2.229), gestational diabetes (OR: 1.983), opioid use during pregnancy (OR: 1.974), and anxiety during pregnancy (OR: 1.537).

4. Discussion

Using data from a large, population-based sample from Southwestern Ontario, we investigated the association between gravity-based accessibility to alcohol outlets and adverse birth outcomes. To our knowledge, there are no other Canadian studies examining this relationship. Contrary to our hypothesis, we found that, although alcohol outlet gravity increased alcohol consumption among pregnant women, it did not increase the likelihood of a low birth weight (LBW) or preterm birth (PTB).

In our study, the top five predictors of LBW were previous PTB, pre-existing hepatitis B, marijuana use during pregnancy, chronic hypertension,

Table 2
Logistic regression assessing the relative effects of alcohol outlets, socioeconomic status, clinical history of medical problems, and behavioral risk factors on mothers having a low birth weight infant

	Model 1		Model 2		Model 3		Model 4		Model 5	
	b	OR	b	OR	b	OR	b	OR	b	OR
Alcohol outlet gravity	–0.051***	0.950	–0.054***	0.947	–0.060***	0.942	–0.045***	0.956	–0.041**	0.959
Maternal age			–0.008	0.992	0.000	1.000	–0.016*	0.984	–0.003	0.997
Body mass index			–0.015***	0.985	–0.018**	0.982	–0.028***	0.973	–0.029***	0.971
% low income					0.010**	1.010	0.009*	1.009	0.008*	1.008
Distance to nearest grocery store					0.010	1.010	0.009	1.009	0.005	1.005
% ≤high school diploma					0.006	1.006	0.004	1.004	0.003	1.003
Population density					0.029	1.029	0.017	1.018	0.020	1.020
% recent immigrants (2006–2010)					–0.023	0.977	–0.024	0.977	–0.025	0.975
% visible minorities					0.002	1.002	0.004	1.004	0.005	1.005
% aboriginal					–0.004	0.996	–0.002	0.998	–0.002	0.998
% lone-parent families					0.001	1.001	–0.002	0.998	–0.005	0.995
Previous preterm birth							1.224***	3.401	1.178***	3.247
# of previous abortions							0.066*	1.068	0.037	1.038
Anxiety this pregnancy							0.089	1.093	0.182	1.200
# of previous cesarean sections							–0.103*	0.902	–0.068	0.935
Pre-pregnancy asthma							0.314*	1.369	0.306*	1.358
Pre-existing heart disease							0.233	1.263	0.330	1.391
Pre-existing hepatitis B							1.272**	3.567	1.086*	2.962
Pre-existing lupus							0.570	1.769	0.675	1.964
Pre-existing thyroid disease							0.308	1.360	0.287	1.332
Depression this pregnancy							0.264	1.302	0.136	1.146
Pre-existing Type 1 diabetes							–0.088	0.916	–0.261	0.770
Chronic hypertension							0.870***	2.387	0.931***	2.537
Female infant							–0.099	0.906	–0.133	0.876
Gestational diabetes							0.452**	1.572	0.516**	1.675
No antenatal care provider							0.324	1.383	–0.105	0.901
Smoked during pregnancy									0.461***	1.585
Opioid use during pregnancy									0.430	1.537
Narcotic use during pregnancy									0.709	2.032
Marijuana use during pregnancy									0.967***	2.629
Herbal medicine use									–0.265	0.767
Intention to breastfeed									–0.063	0.939
Alcohol use during pregnancy									–0.681*	0.506
Constant	–2.322		–1.824		–2.289		–1.902		–2.251	
Adjusted R^2	0.006		0.008		0.014		0.049		0.061	

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

and gestational diabetes; the top predictors of PTB were previous PTB, pre-existing Type 1 diabetes, gestational diabetes, opioid use during pregnancy, and anxiety during pregnancy. Additionally, although the effect size was small, pregnant women living in low-income neighborhoods were more likely to have a LBW infant after adjusting for individual-level risk factors, and this is consistent with other research assessing neighborhood disadvantage and LBW [7, 10, 11].

The strong association between marijuana use and LBW is important. Women who reported marijuana use during pregnancy (2.3%) were 2.6 times more likely to have a LBW infant than women who did not use marijuana. This runs contrary to a new study by Mark et al. [24] which found no effect of marijuana use on the incidence of LBW and PTB; that study was limited, however, to only 170 birth outcomes. However, our findings are in keeping with a large Australian study [25] which showed that marijuana use during pregnancy increased the odds of a LBW baby (OR: 1.7; 95% CI: 1.3, 2.2) and PTB infant (OR: 1.5; 95% CI: 1.1, 1.9). Moreover, the percentage of women reporting marijuana use during pregnancy was almost identical to the percentage in our study (2.6% vs. 2.3%, respectively), and the large sample sizes in both studies ($n = 24{,}874$ vs. $n = 25{,}734$, respectively) give confidence to our conclusion that marijuana use during pregnancy is associated with a higher probability of poor birth outcomes. Clearly, this has important policy implications in Canada considering recent suggestions to legalize its use.

To explore determinants of marijuana use during pregnancy further, we also examined its association with socioeconomic status. Although the associations were weak, women were more likely to use marijuana

Table 3
Logistic regression assessing the relative effects of alcohol outlets, socioeconomic status, clinical history of medical problems, and behavioral risk factors on mothers having a preterm infant

	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	OR	b	OR	b	OR	b	OR	b	OR
Alcohol outlet gravity	–0.056	0.946***	–0.055***	0.946	–0.053***	0.949	–0.038**	0.963	–0.030*	0.971
Maternal age			0.008	1.008	0.012	1.012	–0.004	0.996	–0.002	0.998
Body mass index			0.005	1.005	0.004	1.004	–0.005	0.995	–0.005	0.995
% low income					0.007*	1.007	0.005	1.005	0.004	1.005
Distance to nearest grocery store					0.008	1.008	0.007	1.007	0.004	1.004
% ≤high school diploma					0.001	1.001	–0.002	0.998	–0.001	0.999
Population density					0.039	1.040	0.026	1.027	0.025	1.025
% recent immigrants (2006–2010)					–0.021	0.979	–0.021	0.979	–0.020	0.980
% visible minorities					–0.006	0.995	–0.005	0.995	–0.006	0.994
% aboriginal					–0.003	0.997	–0.002	0.998	–0.002	0.998
% lone-parent families					0.000	1.000	–0.001	0.999	–0.002	0.998
Previous preterm birth							1.432***	4.186	1.452***	4.271
# of previous abortions							0.029	1.029	0.028	1.029
Anxiety this pregnancy							0.341**	1.406	0.430**	1.537
# of previous cesarean sections							–0.073	0.930	–0.078	0.925
Pre-pregnancy asthma							0.258*	1.294	0.272*	1.313
Pre-existing heart disease							0.059	1.061	0.147	1.159
Pre-existing hepatitis B							0.700	2.015	0.502	1.652
Pre-existing lupus							–0.864	0.422	–0.783	0.457
Pre-existing thyroid disease							0.302*	1.353	0.284*	1.328
Depression this pregnancy							0.245*	1.278	0.167	1.181
Pre-existing Type 1 diabetes							0.815**	2.259	0.802**	2.229
Chronic hypertension							0.168	1.183	0.159	1.173
Female infant							0.203**	1.225	0.187**	1.205
Gestational diabetes							0.653***	1.921	0.685***	1.983
No antenatal care provider							0.016	1.016	–0.144	0.866
Smoked during pregnancy									–0.151	0.860
Opioid use during pregnancy									0.680**	1.974
Narcotic use during pregnancy									0.749	2.116
Marijuana use during pregnancy									0.421	1.523
Herbal medicine use									–0.247	0.781
Intention to breastfeed									–0.139	0.871
Alcohol use during pregnancy									–0.254	0.776
Constant	–1.988		–2.477		–2.723		–2.523		–2.522	
Adjusted R^2	0.008		0.008		0.012		0.065		0.068	

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

during pregnancy if they lived below the low-income cut-off (OR: 1.02; 95% CI: 1.02, 1.03), had a high school diploma or less (OR: 1.02; 95% CI: 1.01, 1.03), and who were single mothers (OR: 1.02; 95% CI: 1.01, 1.03).

This study is not without limitations. First, it has been suggested that PTB is the most important measure of perinatal health, whereas LBW is unimportant [26]. Since many LBW babies are born preterm, many risk factors for LBW and PTB will overlap. However, our study examined the extent to which that is the case, and interestingly, we found some important differences based on the outcome under investigation. For example, maternal BMI had a consistent inverse relationship with LBW, but was unrelated to PTB. Similarly, chronic hypertension and smoking increased the odds of a LBW baby, but had no effect on PTB. Second, the impact of alcohol outlet gravity was limited to a narrow timeframe across the lifecycle, particularly the perinatal period. It is possible that alcohol outlet gravity is associated with maternal and child health outcomes over time, but not during or immediately after pregnancy. Third, our data were limited to maternal self-report and data collected from chart records. Thus, several variables, particularly those pertaining to risk-taking behavior (e.g., alcohol, tobacco, and marijuana use) must be interpreted with caution since they are likely to be under-reported.

5. Conclusions

Our large study from Southwestern Ontario is an important contribution to the literature because it demonstrates that high accessibility to alcohol outlets do not negatively affect birth outcomes. In addition, we found that, apart from the small but statistically significant association between mothers living below the low-income cut-off and low birth weight, adverse birth outcomes appear largely unrelated to socioeconomic status. Perhaps our most novel finding is that marijuana use during pregnancy is strongly associated with low birth weight. As maternal use of marijuana is a modifiable risk factor, it is prudent that women who are considering pregnancy, or who are already pregnant, be advised about its associated risks.

Acknowledgments

This work was supported by a Brescia University College research grant.

Disclosure

The authors have no conflicts of interest to declare.

References

[1] Campbell EE, Seabrook JA. The influence of socioeconomic status on adverse birth outcomes. CJMRP. 2016;15(2): 10-20.

[2] Barker DJ. Developmental origins of chronic disease. Public Health. 2012;126(3):185-9.

[3] Gluckman PD, Hanson M, Cooper C, Thornburg KL. Effect of in utero and early-life conditions on adult health and disease. N Engl J Med. 2008;359(1):61-73.

[4] Monk C, Georgieff M, Osterholm E. Research review: Maternal prenatal distress and poor nutrition—mutually influencing risk factors affecting infant neurocognitive development. J Child Psychol Psychiatry. 2013;54(2): 115-30.

[5] Winett LB, Wulf AB, Wallack L. Framing strategies to avoid mother-blame in communicating the origins of chronic disease. Am J Public Health. 2016;106(8):1369-73.

[6] Seabrook JA, Avison WR. Socioeconomic status and cumulative disadvantage processes across the life course: Implications for health outcomes. Can Rev Sociol. 2012;49(1):50-68.

[7] Farley TA, Mason K, Rice J, Halbel JD, Scribner R, Cohen DA. The relationship between the neighbourhood environment and adverse birth outcomes. Paediatr Perinat Epidemiol. 2006;20(3):188-200.

[8] Campbell EE, Dworatzek PD, Penava D, de Vrijer B, Gilliland J, Matthews JI, et al. Factors that influence excessive gestational weight gain: Moving beyond assessment and counselling. J Matern Fetal Neonatal Med. 2016;29(21):3527-31.

[9] Campbell EE, Gilliland J, Dworatzek PD, de Vrijer B, Penava D, Seabrook JA. Socioeconomic status and adverse birth outcomes: A population-based Canadian sample. J Biosoc Sci. 2018;50(1):102-13.

[10] Pearl M, Braveman P, Abrams B. The relationship of neighborhood socioeconomic characteristics to birth weight among 5 ethnic groups in California. Am J Public Health. 2001;91(11):1808-14.

[11] Rauh VA, Andrews HF, Garfinkel RS. The contribution of maternal age to racial disparities in birth weight: A multilevel perspective. Am J Public Health. 2001;91(11):1815-24.

[12] Roche A, Kostadinov V, Fischer J, et al. Addressing inequities in alcohol consumption and related harms. Health Promot Int. 2015;30(Suppl. 2):ii20-ii35.

[13] Brenner AB, Diez Roux AV, Barrientos-Gutierrez T, Borrell LN. Associations of alcohol availability and neighborhood socioeconomic characteristics with drinking: Cross-sectional results from the Multi-Ethnic Study of Atherosclerosis (MESA). Subst Use Misuse. 2015;50(12):1606-17.

[14] Matheson FI, Creatore MI, Gozdyra P, Park AL, Ray JG. A population-based study of premature mortality in relation to neighbourhood density of alcohol sales and cheque cashing outlets in Toronto, Canada. BMJ Open. 2014;4(12):e006032.

[15] O'Leary CM, Nassar N, Kurinczuk JJ, Bower C. The effect of maternal alcohol consumption on fetal growth and preterm birth. BJOG. 2009;116(3):390-400.

[16] Patra J, Bakker R, Irving H, Jaddoe VW, Malini S, Rehm J. Dose-response relationship between alcohol consumption before and during pregnancy and the risks of low birth weight, preterm birth and small for gestational age (SGA)—a systematic review and meta-analyses. BJOG. 2011;118(12):1411-21.

[17] Bakker R, Pluimgraaff LE, Steegers EA, et al. Associations of light and moderate maternal alcohol consumption with fetal growth characteristics in different periods of pregnancy: The Generation R Study. Int J Epidemiol. 2010;39(3):777-89.

[18] Alvik A, Haldorsen T, Groholt B, Lindemann R. Alcohol consumption before and during pregnancy comparing concurrent and retrospective reports. Alcohol Clin Exp Res. 2006;30(3):510-5.

[19] Henderson J, Gray R, Brocklehurst P. Systematic review of effects of low-moderate prenatal alcohol exposure on pregnancy outcome. BJOG. 2007;114(3):243-52.

[20] Alcohol use and pregnancy consensus guidelines. Chapter 3: Why alcohol use is a problem and why guidelines are required. J Obstet Gynaecol Can. 2010;32(Suppl. 3):S9-S11.

[21] Jacobson JL, Jacobson SW. Drinking moderately and pregnancy: Effects on child development. Alcohol Res Health. 1999;23(1):25-30.

[22] Hansen WG. How accessibility shapes land use. J Amer Inst Plann. 1959;25(2):73-6.

[23] Scott D, Horner M. Examining the role of urban form in shaping people's accessibility to opportunities: An exploratory spatial data analysis. J Transp Land Use. 2008;1(2):89-119.

[24] Mark K, Desai A, Terplan M. Marijuana use and pregnancy: Prevalence, associated characteristics, and birth outcomes. Arch Womens Ment Health. 2016;19(1):105-11.

[25] Hayatbakhsh MR, Flenady VJ, Gibbons KS, et al. Birth outcomes associated with cannabis use before and during pregnancy. Pediatr Res. 2011;71(2):215-9.

[26] Wilcox AJ. On the importance – and the unimportance – of birth weight. Int J Epidemiol. 2001;30(6):1233-41.