The cedar project: using indigenous-specific determinants of health to predict substance use among young pregnant-involved aboriginal women

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Abstract

Background: Indigenous women in Canada have been hyper-visible in research, policy and intervention related to substance use during pregnancy; however, little is known about how the social determinants of health and substance use prior to, during, and after pregnancy intersect. The objectives of this study were to describe the social contexts of pregnant-involved young Indigenous women who use substances and to explore if an Indigenous-Specific Determinants of Health Model can predict substance use among this population.

Methods: Using descriptive statistics and hierarchical logistic regression guided by mediation analysis, the social contexts of pregnant-involved young Indigenous women who use illicit drugs' lives were explored and the Integrated Life Course and Social Determinants Model of Aboriginal Health's ability to predict heavy versus light substance use in this group was tested (N = 291).

Results: Important distal determinants of substance use were identified including residential school histories, as well as protective factors, such as sex abuse reporting and empirical evidence for including Indigenous-specific determinants of health as important considerations in understanding young Indigenous women's experiences with pregnancy and substance use was provided.

Conclusions: This analysis provided important insight into the social contexts of women who have experiences with pregnancy as well as drug and/or alcohol use and highlighted the need to include Indigenous-specific determinants of health when examining young Indigenous women's social, political and historical contexts in relation to their experiences with pregnancy and substance use.

Keywords: Canada, Aboriginal health, Women's Health, Substance use, Addictions, Pregnancy, Maternal health, Social determinants of health

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Background
In Canada, Aboriginal mothers have been hyper-visible in research, policy and intervention related to alcohol and drug use during pregnancy, while the social contexts underlying Aboriginal women's substance use have often been ignored [17, 22] particularly as they relate to experiences with pregnancy. Due to imposed legislative and social conditions, beginning with colonization, many young Aboriginal mothers are located at the intersections of multiple dimensions of social inequality that shape their experiences with substance use and parenting in complex ways. However, there is a dearth of epidemiological data that explores these contextual factors related to substance use before, during and after pregnancy, and quantitative data which necessarily and explicitly attends to understanding these broader determinants of substance use is needed [22]. To understand these determinants across women's lives in a more nuanced and contextualized way, the typical research focus on substance use only during pregnancy must be broadened to include pregnant-involved women's life experiences with alcohol and drug use before, during and after pregnancy. For the purposes of this research project, pregnant-involved was defined as having ever experienced a pregnancy, regardless of pregnancy outcome or subsequent mothering role.

The social determinants of substance use
Heavy and frequent substance use by women typically peaks among women aged 18 to 24 years old, and is highest among women with lower incomes and/or lower levels of education [1]. Women who use alcohol or drugs problematically are also often living in high risk environments characterized by poverty, unstable housing, food insecurity and unemployment, and often have histories of abuse and psychological issues [17].

Aboriginal women who use substances often face triple discrimination and marginalization as women, Aboriginal people, and people who use substances [7]. When compared to the rest of Canada, the comparatively young population of Aboriginal peoples bear a disproportionate burden of illness, poor health and violent life experiences [6, 14], while also experiencing higher unemployment rates, and lower formal education attainment and incomes (with Aboriginal women having lower incomes than Aboriginal men) [5, 4, 18]. While Aboriginal young women have higher rates of problematic substance use in Canada than non-Aboriginal young women [17], the contexts of use are explicitly linked to these downstream manifestations of the colonial process (including social and cultural disruption, and historical and intergenerational trauma) that continues to impact Aboriginal peoples lives today [14, 15].

The integrated life course and social determinants of aboriginal health (ILCSD) model
In 2009, the National Collaborating Centre for Aboriginal Health commissioned a report on the health inequalities experienced by Indigenous peoples in Canada, which also introduced The Integrated Life Course and Social Determinants Model of Aboriginal Health (ILCSD) “as a promising conceptual framework for understanding the relationships between social determinants and various health dimensions, as well as examining potential trajectories of health across the life course” (p.6, [19]). Importantly, the ILCSD locates Indigenous health outcomes within the socio-political context of being Indigenous in Canada and in relation to the nested influences of distal (i.e. social, political and historical contexts), intermediate (i.e. health, education and community infrastructure and systems, environmental stewardship and cultural continuity) and proximal (i.e. physical, mental, emotional or spiritual health impacts) determinants, across the life course. The ILCSD model provides an opportunity to explore social determinants not previously examined in the epidemiological literature focusing on pregnant-involved Aboriginal women [22].

A better understanding of the social determinants underlying pregnant-involved Aboriginal women's substance use is needed to inform policies and programs. The research questions guiding this study were:

This research study aimed to answer the following questions:

1. What are the social contexts of the lives of pregnant-involved young Aboriginal women who use alcohol and drugs in British Columbia, Canada?
2. Can the ILCSD Model’s social determinants of health within distal, intermediate and proximal domains predict heavy alcohol use, drug use (smoked) and drug use (injected) in the previous six months among pregnant-involved young Aboriginal women?

Hypothesis #1: The influence of distal determinants on each dependent variable (alcohol use, drug use (smoked) and drug use (injected), will be mediated by intermediate and proximal determinants.

Hypothesis #2: The influence of intermediate determinants on each dependent variable (alcohol use, drug use (smoked) and drug use (injected), will be mediated by proximal determinants.

Methods
A secondary data analysis was conducted using data from a baseline questionnaire that was administered in a larger project, the Cedar Project, to all participants at enrollment [25]. A descriptive quantitative design was used, in addition to hierarchical logistic regression
guided by mediation analysis principles, to test the 
ILCSD Model’s ability to predict heavy substance use 
among pregnant-involved female participants.

Data and study setting
A secondary data analysis using survey data from a larger 
research study, The Cedar Project, was conducted. The 
Cedar Project is an ongoing prospective cohort study of 
young Aboriginal men and women who use drugs in three 
centres in British Columbia, Canada [25] (Table 2). The 
Cedar Project’s purpose is to explore HIV- and HCV- 
related vulnerabilities among male and female Aboriginal 
youth who use drugs. Recruitment for the project began 
in October 2003 and is ongoing. Participants are recruited 
through health care providers, street outreach workers, 
and word of mouth. Eligibility criteria for the Cedar pro-
ject included self-identification as Aboriginal, being be-
tween the ages of 14–30 years of age, and having smoked 
illicit drugs in the last week, or injected illicit drugs in the 
last month, including crystal methamphetamine, crack-
cocaine, heroin or cocaine, prior to enrolment. Saliva 
screens were used to confirm drug use. Table 1 shows a 
comparison of the three study sites for several relevant 
factors related to the lives of pregnant-involved young 
Aboriginal women who live there.

Data collection procedures for the Cedar Project have 
been detailed elsewhere [25]. This analysis is based on 
the baseline questionnaire that is administered at enroll-
ment to all Cedar Project participants to elicit socio-
demographic characteristics, patterns of drug use, sexual 
vulnerability, use of services and to assess the risk fac-
tors associated with Aboriginal youth’s elevated risk and 
transmission of HIV and HCV.

Cohort definition
In order to understand women’s life contexts and experi-
ences with alcohol and drug use before, during and after 
pregnancy, this secondary analysis was restricted to “pregnant-involved women” defined as women who have 
ever been pregnant before the age of 30. Not restricting 
the sample to women who were currently pregnant, or 
any defined outcome of pregnancy, was a purposeful 
decision to explore women’s life experiences with sub-
stances and pregnancy more fully, while rejecting the 
notion that women’s health is only of import if it relates 
to the health of a foetus or child.

For this analysis, the cohort was defined as all female 
participants under the age of 30 years who completed a 
baseline questionnaire between October 2003–July 2013 
and responded ‘yes’ to the question ‘Have you ever been 
pregnant?’ The resulting study sample was 291. Anon-
ymized data that included the following measures was 
available for analysis.

Measures
Based on the ILCSD Model, indicators were selected that 
were deemed most relevant in measuring the proximal, 
intermediate or distal social determinants of health. 
Variables available for this analysis included measures of 
socio-demographic factors, pregnancy characteristics, 
survival sex3 involvement, sexual abuse histories, cul-
tural continuity, the use of health care services, alcohol 
and/or drug treatment services, the use of any services 
general, and measures of colonialism and historical or 
cultural trauma. Table 2 shows a summary of all in-
cluded variables, as well as their definitions for further 
clarification.

Dependent variables
Three dependent variables were used that measured the 
participants’ pattern of alcohol use, drug use (smoked) 
and drug use (injected) over the previous 6 months, re-
spectively. Based on previous studies of people who use 
illicit drugs [9], heavy drug smoking or injecting was de-
fined as those who reported smoking or injecting once 
or more per day and light drug use was defined as using 
less than daily (heavy vs. light use). Alcohol use over the 
previous 6 months was defined as heavy for participants 
who reported having 6 or more drinks on one occasion 
on more than a monthly basis, and light for participants 
having 6 or more drinks on one occasion once a month or 
less, based on the low risk drinking guidelines from the 
Canadian Centre on Substance Abuse and the information

| Table 1 | Comparison of study site characteristics |
|---------|-----------------------------------------|
| Characteristic | Vancouver (Site A) | Prince George (Site B) | Interior (Site C) |
| Urban/Rural Mix | Large Urban Centre | Small Urban Centre | Urban-Rural Mix |
| Harm Reduction vs. Abstinence Service Models | Primarily Harm Reduction | Harm Reduction | Primarily Abstinence-Based |
| Aboriginal Population* | 40,310 (2% of total) | 8855 (11% of total) | 7050 (7.7% of total) |
| On or Off- Reserve Living | Primarily off-reserve | Primarily off-reserve | Mixture |
| Service Density | Dense in downtown eastside | Dense in downtown core | Dense in Kamloops, Sparse everywhere else |

Based on 2006 Statistics Canada Census Data for Greater Vancouver, Prince George, and Kamloops
| Variable names | Variable definitions |
|----------------|----------------------|
| **Proximal Determinants** | |
| **Socioeconomic Status (SES)** | Current relationship status. |
| Relationship Status | Highest level of education completed. |
| Highest Education | Monthly income from all sources (gov't, work, and illegal sources). |
| Income | Has the participant ever done survival sex work? |
| Survival Sex, ever | Age of participant the first time she did survival sex work. |
| IF YES, | Has the participant done survival sex work in the previous 6 months? |
| Age of 1st Survival Sex | |
| Survival Sex, last 6 Months | |
| **Physical Environments** | |
| Housing Stability | Considered unstable if lived anywhere other than house or apartment in previous 6 months (i.e. hotel, hostel, shelter, crack shack etc.). |
| Homelessness | Has the participant ever been on the street with no place to sleep for more than three nights? |
| Age First Left Home | Age the participant first left home to live on her own. |
| **Health Behaviours** | |
| Number of Pregnancies | Number of times the participant has ever been pregnant (including abortions/miscarriages). |
| Age of First Pregnancy | Age of participant the first time she was pregnant. |
| **Trauma** | |
| Sexual Abuse, ever | Has the participant ever been sexually abused? (Any type of forced sexual activity including childhood sexual abuse, molestation, rape, and sexual assault) |
| IF YES, | |
| Age of 1st Sexual Abuse | Age of participant the first time she was sexually abused. |
| Sexual Abuse, reported | Has the participant ever reported the sexual abuse to anyone? |
| Sexual Abuse, repeated | Has the participant been sexually abused again, since the first time? |
| Sexual Abuse, last 6 Months | Has the participant been sexually abused in the previous 6 months? |
| **Mothering Experiences** | |
| Child Apprehended, ever | Has the participant ever had any of her children apprehended by child and family services? |
| **Intermediate Determinants** | |
| **Cultural Continuity** | |
| Taken from Parents, ever | Has the participant ever been taken from her biological parents by child and family services? |
| IF YES, | |
| Age 1st Taken from Parents | Age of participant the first time she was taken from her biological parents. |
| Language | Does the participant speak her native or traditional language? |
| Reserve, ever | Has the participant ever been to a reserve? |
| Cultural Substance Treatment | Is the participant interested in more culturally specific substance use treatment? |
| **Services Used within the previous 6 months** | |
| Emergency Room Visit | Has the participant received health care from the emergency room (ER) in the previous 6 months? |
| Admitted to Hospital | Has the participant been admitted overnight to a hospital in the previous 6 months? |
| Ambulance | Has the participant received health care from an ambulance in the previous 6 months? |
| Counselling Services | Has the participant accessed a counsellor in the previous 6 months? |
| Food Services | Has the participant accessed food services in the previous 6 months? |
| Visit with a Health Care Provider Visit | Has the participant accessed a health care provider in the previous 6 months? |
| Housing Services | Has the participant accessed housing services in the previous 6 months? |
| Needle Exchange Services | Has the participant accessed a needle exchange in the previous 6 months? |
available in the survey about alcohol use patterns [8] (heavy vs. light use).

Given that all the participants were women who used drugs at enrollment, creating outcome variables to distinguish between light and heavy use allowed for an exploration of the relationships between social determinants of health and substance use. This was also particularly relevant given that pregnant-involved women who have a history of heavy drug and/or alcohol use are more likely to use alcohol and/or drugs during pregnancy, and also, heavy use of substances during pregnancy specifically, is associated with greater harms for both the mother and the foetus [15, 21]. While this variable measures level of use within the past 6 months and, therefore, is not measuring use during a pregnancy necessarily, it is nonetheless an important and relevant measure to examine the impact of the social determinants of health on substance use among pregnant-involved young Aboriginal women. Figure 1 depicts the hypothesized relationship between the distal, intermediate and proximal determinants of health, and the three dependent variables.

**Data analysis**

Descriptive statistics were used to describe the sample. Categorical variables were compared across the three study locations of the project using Pearson’s $\chi^2$ test. No expected cell values were less than 5. Continuous variables were analyzed using the Kruskal-Wallis one-way analysis of variance for non-parametric data. All reported $p$-values are two-sided and significant associations were determined at the 0.05 cut-off point. Continuous variables were inspected for outliers, and outliers were replaced with the value of two times the variable’s standard deviation. Multicollinearity and linearity of the logit was also inspected before conducting logistic regressions.

Univariate logistic regression was conducted to identify the determinants of health that were independently associated with each of the outcome measures. In the

![Fig. 1 Hypothesized relationship between variables based on the Integrated Life Course and Social Determinants Model of Aboriginal Health](image-url)
adjusted Model I for each dependent variable, significant variables at the $p < 0.05$ cut-off in univariate analysis were entered into multivariable logistic regression analysis using the Enter method in SPSS. All models were adjusted for age.

In the adjusted Model II for each dependent variable, variables that remained significant in Model I were entered as blocks according to their hypothesized relationship based on the ILCSD Model to test for any mediated effects to support the model. The most common method for testing mediation involves four steps: First, there is shown to be a significant relationship between a predictor and outcome; second, there is shown to be a significant relationship between the mediator and the predictor; third, there is shown to be a significant relationship between the mediator and the outcome; and, fourth, there is shown to be a significant reduction in the strength of the relationship between the predictor and the outcome when the mediator is added to the model [3, 13]. In this analysis, there were no significant relationships between any predictor variables and hypothesized mediator variables (step two of mediation analysis), so further mediation analysis was not possible beyond showing the results of the full models in Model II. Both unadjusted and adjusted odds ratios and 95% confidence intervals were obtained using logistic regression.

Results
The sample for this secondary analysis included 291 pregnant-involved young Aboriginal women: 154 (52.9%) completed their baseline questionnaires in Vancouver, 111 (38.1%) completed their baseline questionnaires in Prince George, and 26 (9%) completed their baseline questionnaires in the Interior region of British Columbia. The median age of participants was 24 years old, and the majority of participants were single (64.4%), had not completed high school (79.5%), and were living in unstable housing situations (66.2%). Also, the majority of women had ever been homeless (65.9%), while 67.7% of women had ever been sexually abused and the median age of first sexual abuse was six years old (range 1–20 years old).

Descriptive results
Table 3 shows comparisons of all the included social determinants of health based on location of the participant, and addresses the first research question of this study. Participants in Vancouver were older and more likely to have ever been homeless, while participants in both Vancouver and Prince George were more likely than Interior participants to have been taken from their biological parents, to have participated in survival sex ever or in the last six months, to have lower monthly incomes, to be interested in culturally specific treatment options, and to have accessed a needle exchange or a social welfare worker in the last six months. Vancouver and Prince George participants were less likely than Interior participants to speak a traditional language, to have visited the emergency room or have been treated by an ambulance in the past six months, and to have accessed a counsellor in the last six months. Participants in Prince George left home for the first time at a younger age, and were more likely to state that they had needed any social or health service or had accessed housing services in the previous 6 months.

Testing the ILCSD model for predicting heavy versus light substance use
In order to address the second research question, the ILCSD Model’s ability to predict heavy versus light substance use was assessed for each dependent variable. If variables remained significant even after block entry according to the ILCSD model, then there was no evidence of mediation occurring.

Heavy versus light alcohol use
Table 4 shows the results from the univariate and multivariate logistic regression analyses conducted with pattern of alcohol use as the dependent variable. In univariate analyses, participants who lived in Vancouver and Prince George were significantly less likely to have more than six drinks in one occasion more than once a month than participants who lived in the Interior (OR 0.33, 95% CI 0.13, 0.82; OR 0.35, 95% CI 0.14, 0.88 respectively). Participants who had reported their sexual abuse to somebody, were also less likely to have more than six drinks in one occasion more than once a month (OR 0.40, 95% CI 0.22, 0.73). In Model 1, multivariate logistic regression was conducted, where both interview location and sexual abuse reporting were entered as covariates in the model. Vancouver participants were significantly less likely than participants in the Interior to use alcohol more than monthly (OR 0.30, 95% CI 0.12, 0.77) and having reported sexual abuse was also protective (OR 0.38, 95% CI 0.21, 0.71). Model II tested the ILCSD Model using the block entry shown in Fig. 1. Since both determinants remained statistically significant, their direct effects seem to override any mediation expected according to the ILCSD model.

Heavy versus light smoked drug use
Table 5 shows the results from the univariate and multivariate logistic regression analyses conducted with pattern of smoked drug use as the dependent variable. In univariate analyses, daily or more use of smoked drugs was independently associated with living in Vancouver, being single, having unstable housing, having more
Table 3  Comparison of Proximal, Intermediate and Distal Determinants between Participants in Vancouver, Prince George and the Interior

| Characteristic                                      | Vancouver (n = 154) | Prince George (n = 111) | Interior (n = 26) | p-value (N = 291) |
|-----------------------------------------------------|---------------------|-------------------------|------------------|------------------|
| **Proximal Determinants**                           |                     |                         |                  |                  |
| Median age at enrollment, years (range)             | 24 (16–30)          | 23 (15–30)              | 23 (16–30)       | 0.024            |
| Single                                              | 107 (69.9)          | 67 (60.4)               | 12 (48)          | 0.280            |
| Did not complete high-school                        | 121 (79.1)          | 84 (77.1)               | 24 (92.3)        | 0.220            |
| Median monthly income, dollars (range)              | 558 (80–13,000)     | 850 (40–10,100)         | 1035 (100–5000)  | 0.023            |
| Survival sex, ever                                 | 116 (76.8)          | 77 (72)                 | 10 (38.5)        | <0.001           |
| IF YES, (n = 203)                                   |                     |                         |                  |                  |
| Median age of first survival sex, years (range)     | 16 (11–28)          | 16 (9–27)               | 17 (12–23)       | 0.303            |
| Survival sex, last 6 months                         | 89 (57.8)           | 65 (58.6)               | 5 (19.2)         | 0.001            |
| Unstable Housing (last 6 months)                    | 109 (71.2)          | 70 (63.1)               | 13 (50)          | 0.071            |
| Ever lived on the streets (>3 nights)               | 116 (75.3)          | 62 (56.4)               | 13 (50)          | 0.001            |
| Median age first left home, years (range)           | 16 (8–22)           | 14 (8–19)               | 16 (12–21)       | 0.001            |
| Median number of pregnancies (range)                | 2 (1–5)             | 2 (1–5)                 | 2 (1–5)          | 0.238            |
| Median age of first pregnancy, years (range)        | 17 (12–25)          | 17 (10–24)              | 18.16 (13–24)    | 0.068            |
| Ever sexually abused                                | 102 (66.2)          | 80 (72.1)               | 15 (57.7)        | 0.315            |
| IF YES, (n = 197)                                   |                     |                         |                  |                  |
| Median age first sexually abused (years)            | 6 (1–18)            | 8 (2–19)                | 9 (3–20)         | 0.057            |
| Child apprehended, ever                            | 72 (49.7)           | 47 (44.3)               | 8 (36.4)         | 0.430            |
| **Intermediate Determinants**                       |                     |                         |                  |                  |
| Ever taken from biological parent                   | 104 (67.5)          | 75 (67.6)               | 11 (42.3)        | 0.036            |
| IF YES, (n = 190)                                   |                     |                         |                  |                  |
| Median age first taken from biological parents (range)| 4 (1–17)         | 5 (0–14)                | 6 (1–13)         | 0.666            |
| Speak traditional language                          | 21 (13.6)           | 22 (20)                 | 12 (46.2)        | <0.001           |
| Ever been to a reserve                              | 121 (81.2)          | 98 (89.1)               | 25 (96.2)        | 0.056            |
| Interested in more culturally specific treatment    | 77 (50)             | 72 (64.9)               | 8 (32)           | 0.004            |
| Substance Use Treatment, Ever                       | 110 (71.4)          | 92 (82.9)               | 22 (84.6)        | 0.057            |
| Services used within the previous 6 months          |                     |                         |                  |                  |
| Emergency Room Visit                                | 49 (31.8)           | 53 (47.7)               | 15 (57.7)        | 0.005            |
| Admitted to Hospital                                | 32 (21.1)           | 22 (19.8)               | 9 (34.6)         | 0.245            |
| Ambulance                                           | 37 (24)             | 20 (18)                 | 12 (46.2)        | 0.010            |
| Counselling Services                                | 25 (16.2)           | 39 (35.1)               | 13 (50)          | <0.001           |
| Food Services                                       | 85 (55.2)           | 58 (52.3)               | 12 (46.2)        | 0.669            |
| Visit with a Health Care Provider Visit             | 77 (50)             | 58 (52.3)               | 13 (50)          | 0.933            |
| Housing Services                                    | 35 (22.7)           | 48 (43.2)               | 7 (26.9)         | 0.002            |
| Needle Exchange Services                            | 73 (47.4)           | 85 (76.6)               | 4 (15.4)         | <0.001           |
| Support Group Services                              | 9 (5.8)             | 11 (9.9)                | 4 (15.4)         | 0.189            |
| Social Worker                                       | 68 (44.2)           | 69 (62.2)               | 6 (23.1)         | <0.001           |
| Denied housing due to drug use                      | 45 (29.4)           | 24 (21.6)               | 7 (26.9)         | 0.363            |
| Denied service due to drug use                      | 37 (24)             | 18 (16.2)               | 6 (23.1)         | 0.294            |
| Have barriers to accessing services                 | 13 (8.5)            | 7 (6.3)                 | 4 (15.4)         | 0.315            |
| Needed a service, last 6 months                     | 100 (65.8)          | 93 (83.8)               | 18 (69.2)        | 0.005            |
pregnancies, having your first pregnancy at a younger age, having participated in survival sex ever or in the last six months, having been denied a service due to drug use in the last six months, and have had either parent attend residential school. In Model I, all variables that were statistically significant at the 0.05 cut-off were entered into the logistic regression as covariates. In this model daily or more use of smoked drugs was independently associated with being single (OR 2.36, 95% CI 1.09, 5.08), having unstable housing (OR 2.17, 95% CI 1.03, 4.58), and having had either parent attend residential school (OR 4.10, 95% CI 1.17, 14). In Model II, statistically significant variables from Model I were entered in blocks as shown in Fig. 1 to test the ILCSD Model. All variables remained significantly associated, suggesting no evidence of mediation.

Heavy versus light injected drug use
Table 6 shows the results from the univariate and multivariate logistic regression analyses conducted with pattern of injection drug use as the dependent variable. In univariate analyses, daily or more use of injection drugs was independently associated with a higher number of pregnancies, survival sex in the last six months, and having ever received treatment. Having received sexual abuse counselling, attending support groups in the last six months, and having experienced barriers to services in the last six months were all protective. In Model I, all variables that were statistically significant at the 0.05 cut-off were entered into the logistic regression as covariates. In Model I, having ever received substance use treatment and number of pregnancies were no longer significantly associated with daily or more injection drug use. In Model II, statistically significant variables from Model I were entered in blocks as shown in Fig. 1 to test the ILCSD Model. All variables remained significantly associated, suggesting no evidence of mediation.

Discussion
This study reports on empirical support for the importance of integrating socio-historical contexts into models of determinants of substance use and supports a counter-narrative to the current pathologizing discourse in Canada, where “Aboriginal Status” is often cited as a determinant of health on its own [16]. Instead, by using an Aboriginal-specific model, it was possible to explore how determinants that uniquely impact Aboriginal health in Canada (including residential school histories, racism, and intergenerational trauma) have differentially impacted the health status and experiences of Aboriginal women, in an appropriately nuanced and fluid manner. This is one of the first studies to evaluate an Aboriginal-specific social

Table 3 Comparison of Proximal, Intermediate and Distal Determinants between Participants in Vancouver, Prince George and the Interior (Continued)

| Distal Determinants | Vancouver | Prince George | Interior | Overall P-value |
|---------------------|-----------|---------------|----------|-----------------|
| At least one parent attended Residential School | 73 (47.4) | 49 (45) | 9 (34.6) | 0.478 | 131 (45.3) |
| Residential School Family History | 104 (68) | 81 (73) | 22 (84.6) | 0.198 | 207 (71.1) |
| Median number of family members in Residential School (range) | 4 (1–19) | 3.5 (0–36) | 5 (0–29) | 0.648 | 3 (0–36) |
| At least one caregiver with drug or alcohol addiction | 124 (81) | 87 (78.4) | 30 (76.9) | 0.813 | 231 (79.7) |
| Family history of survival sex | 50 (43.1) | 39 (52) | 5 (50) | 0.474 | 94 (46.8) |

For continuous variables, range is reported instead of percentage

Table 4 Univariate and Multivariate Modeling for Alcohol Use among Participants (N = 210)

| Location | Monthly or less (N = 144) | More than monthly (N = 66) | Unadjusted OR (95% CI) | Adjusted OR Model I (95% CI) | Adjusted OR Model II (95% CI) |
|----------|---------------------------|---------------------------|------------------------|-----------------------------|-------------------------------|
| Interior | 11 (7.6)                  | 13 (19.9)                 | Reference              | Reference                    | Reference                     |
| Prince George | 61 (42.4)              | 25 (37.8)                 | 0.35* (0.14, 0.88)     | 0.38 (0.14, 1.01)           | 0.38 (0.14, 1.01)             |
| Vancouver | 72 (50)                   | 28 (42.4)                 | 0.33* (0.13, 0.82)     | 0.30* (0.11, 0.78)          | 0.30* (0.11, 0.78)            |
| Sex Abuse Reported | | | | | |
| No | 55 (38.2) | 40 (60.6) | Reference | Reference | Reference |
| Yes | 89 (61.8) | 26 (39.3) | 0.40** (0.22, 0.73) | 0.40** (0.21, 0.74) | 0.40** (0.21, 0.74) |

Overall Percentage Correct for Adjusted Models 70.5 70.2

*p < .05,**p < .01
determinants model to identify predictors of substance use among pregnant-involved Aboriginal women. The inclusion of variables that measured the lifelong and future impacts of colonialism and cultural continuity provide a more complete picture of the social determinants of substance use, from an Aboriginal-specific perspective. Given the lack of previous research in this area that includes and explicitly acknowledges the important contexts of substance use among young pregnant-involved Indigenous women [22], this study is a timely and important contribution to the research landscape.

In testing the ILCSD Model, important independent risk and protective factors for heavy substance use were identified. Among participants who had ever been sexually abused, having reported sexual abuse to anyone was found to be associated with lower alcohol use. In their study, Draucker et al. [10] also found that disclosing abuse was the main way participants were able to make sense of their experiences and to heal.

Women's substance use is often positively correlated to their partner's use [20]. However, being in a relationship was associated with lower smoked drug use. Having spoken anecdotally with community workers and women who use injection drugs, they suggested that for many women, their partners initiate their first use of injection drugs, as well as continue to inject for them, and so there is the possibility that single women have higher use of smoked drugs because they have not progressed to

| Table 5 | Univariate & Multivariate Modeling for Drug Use (Smoked) among Participants (N = 285) |
|---------|-----------------------------------------------|
|         | < Daily (n = 49) | ≥ Daily (n = 236) | Unadjusted OR (95% CI) | Adjusted OR Model I | Adjusted OR Model II |
| Location |                  |                   |                       |                     |                      |
| Interior | 9 (18.4)         | 16 (6.8)          | Reference             | Reference           | –                     |
| Prince George | 24 (49)         | 86 (36.4)         | 2.01 (0.79, 5.13)     | 1.11 (0.33, 3.71)   | –                     |
| Vancouver | 16 (32.7)        | 134 (56.8)        | 4.71** (1.79, 12.29)  | 3.45 (1.00, 12.00)  | –                     |
| Relationship Status |                  |                   |                       |                     |                      |
| Legally Married | 24 (49)         | 66 (28.1)         | Reference             | Reference           | Reference             |
| Common Law | 3 (6.1)          | 2 (0.9)           | 0.24 (0.04, 1.54)     | 0.15 (0.01, 2.00)   | 0.26 (0.03, 1.93)    |
| Widowed/Separated/Divorced | 2 (4.1)      | 3 (1.3)           | 0.55 (0.09, 3.47)     | 0.93 (0.06, 12.47)  | 0.53 (0.08, 3.58)    |
| Single | 20 (40.8)         | 164 (69.8)        | 2.98** (1.54, 5.76)   | 2.40* (1.11, 5.20)  | 3.08** (1.58, 6.02)  |
| Housing Stability, last 6 months |                  |                   |                       |                     |                      |
| Stable | 25 (51)           | 71 (30.2)         | Reference             | Reference           | –                     |
| Unstable | 24 (49)          | 164 (69.8)        | 2.41** (1.29, 4.5)    | 2.02 (0.95, 4.31)   | –                     |
| Median Number of Pregnancies |                  |                   |                       |                     |                      |
| Number (SD) | 2 (1.3)          | 2 (1.4)           | 1.29* (1.02, 1.63)    | 1.46 (1.00, 2.13)   | –                     |
| Median Age of First Pregnancy |                  |                   |                       |                     |                      |
| Years (SD) | 18 (2.6)         | 17 (2.6)          | 0.89* (0.77, 0.98)    | 0.92 (0.78, 1.09)   | –                     |
| Sex Work, Ever |                  |                   |                       |                     |                      |
| No | 22 (45.8)         | 58 (25)           | Reference             | Reference           | –                     |
| Yes | 26 (54.2)         | 174 (75)          | 2.54** (1.34, 4.82)   | 1.54 (0.54, 4.42)   | –                     |
| Sex Work, last 6 months |                  |                   |                       |                     |                      |
| No | 32 (65.3)         | 96 (40.7)         | Reference             | Reference           | –                     |
| Yes | 17 (34.7)         | 140 (59.3)        | 2.75** (1.44, 5.22)   | 1.77 (0.61, 5.13)   | –                     |
| Service Denied due to Drug Use, last 6 mos |                  |                   |                       |                     |                      |
| No | 45 (91.8)         | 181 (76.7)        | Reference             | Reference           | –                     |
| Yes | 4 (8.2)           | 55 (23.3)         | 3.42* (1.18, 9.93)    | 3.04 (0.97, 9.54)   | –                     |
| Residential School, Parents |                  |                   |                       |                     |                      |
| No | 31 (63.3)         | 125 (53.4)        | Reference             | Reference           | Reference             |
| Yes, one | 4 (8.2)          | 53 (22.6)         | 3.29* (1.11, 9.77)    | 4.12* (1.20, 14.20) | 3.67* (1.21, 11.45)  |
| Yes, both | 14 (28.6)        | 56 (23.9)         | 0.99 (0.49, 2.01)     | 1.00 (0.42, 2.36)   | 0.99 (0.47, 2.08)    |
| Overall Percentage Correct For Adjusted Models | 87.0 | 83.2 |

*p < .05, **p < .01
injection drug use. Further research on this topic would be beneficial. The association between parental residential school attendance and increased use of smoked drugs is an indicator of the importance for understanding inter-generational trauma and the perpetuation of harms among young Aboriginal women as well as the impacts of foster care involvement, which is understood as directly linked with residential school histories.

Having participated in survival sex in the last 6 months was associated with daily or more injection drug use. This relationship could be bi-directional because women may be participating in survival sex to support their heavier use, or they may be using drugs more heavily to cope with survival sex. Also, having a higher number of pregnancies, having received sex abuse counselling and attending a support group in the last six months, were all protective against more than daily use of injection drugs. These results again suggest that attending to sexual abuse trauma can be protective, and that peer support is also a promising strategy for some women. The results also suggest that pregnancies can be protective, possibly because women reduce drug use for the pregnancies, and/or because of increased supports during pregnancy. Finally, having experienced barriers to any services (health and supportive) was also associated with lower injection drug use. This may be because those who are heavier users are less aware of or connected to services to perceive any barriers. Similarly, if those women are not accessing services as much as women who use less, then they would not have had an opportunity to encounter any barriers to services.

Women who participate in sex work in BC have reported that histories of injection drug use further compounded risks in women’s lives and added to barriers to parenting, while limited access to appropriate non-judgmental services to support their needs as women who participated in survival sex work and who used drug mitigated access to environments or services that support them as pregnant women/parents [11]. Survival sex work may therefore be confounding or contributing to the other associations with injection drug use.

Table 6 Univariate and Multivariate For Drug Use (Injected) among Participants (N = 184)

|                           | < Daily (n = 76) N (%) | ≥ Daily (n = 108) N (%) | Unadjusted OR (95% CI) | Adjusted OR Model 1 | Adjusted OR Model 2 |
|---------------------------|------------------------|------------------------|-----------------------|---------------------|---------------------|
| Median Number of Pregnancies (SD) | 3 (1.46) | 2 (1.37) | 0.77* (0.63, 0.95) | 0.80 (0.62, 1.02) | –                   |
| Survival Sex, last 6 months |                        |                        |                       |                     |                     |
| No | 37 (48.7) | 32 (29.6) | Reference | Reference | Reference |
| Yes | 39 (51.3) | 76 (70.4) | 2.25** (1.22, 4.15) | 2.75** (1.13, 4.74) | 2.71** (1.40, 5.23) |
| Sex Abuse Counselling |                        |                        |                       |                     |                     |
| No | 48 (63.2) | 88 (81.5) | Reference | Reference | Reference |
| Yes | 28 (36.8) | 20 (18.5) | 0.39** (0.2, 0.76) | 0.42* (0.20, 0.87) | 0.35** (0.17, 0.71) |
| Substance Use Treatment, Ever |                        |                        |                       |                     |                     |
| No | 12 (15.8) | 31 (28.7) | Reference | Reference | –                   |
| Yes | 64 (84.2) | 77 (71.3) | 2.15* (1.02, 4.52) | 1.73 (0.77, 3.91) | –                   |
| Support Group, last 6 months |                        |                        |                       |                     |                     |
| No | 66 (86.8) | 104 (96.3) | Reference | Reference | Reference |
| Yes | 10 (13.2) | 4 (3.7) | 0.25* (0.08, 0.84) | 0.22* (0.06, 0.79) | 0.20* (0.06, 0.70) |
| Service Barriers, last 6 months |                        |                        |                       |                     |                     |
| No | 65 (85.5) | 103 (96.3) | Reference | Reference | Reference |
| Yes | 11 (14.5) | 4 (3.7) | 0.23* (0.07, 0.75) | 0.20* (0.06, 0.72) | 0.21* (0.06, 0.73) |
| Overall Percentage Correct for Adjusted Models | 72.5 | 69.4 |

For continuous variables, standard deviation is reported instead of percentage
*p < .05, **p < .01

Understanding Indigenous health in Canada within the context of colonial practices both past and present [12]
is needed. Poverty, homelessness, housing instability, lack of education, involvement in the child welfare system, visits to the emergency room, survival sex work, and sexual abuse were all important predictors of substance use in the study sample. Given the relationship of all of these factors with historical and contemporary colonization practices (and that over 70% of the sample had a family history of residential school attendance and addiction), the intergenerational impacts of residential schooling, addiction, survival sex and trauma must foreground any deeper understanding of substance use among young Aboriginal women. Explicit attention to these factors has been decidedly absent from the literature examining substance use among Indigenous women [19], while a lack of meaningful data that captures the distinct sociopolitical, historical and geographical contexts of Indigenous women’s lives has limited discussions on these topics [2, 12].

Multiple perspectives and models, in addition to the ILCSD Model, including for example The Indigenist Stress-Coping Model (on which The Cedar Project is based) [26], will likely be needed to capture the complexity of young Indigenous women’s experiences with both pregnancy and substance use. As evidenced by this study, these contextual factors are paramount to creating a fuller understanding of substance use and pregnancy. Further, highlighting the structural and social determinants of substance use provides actionable targets for interventions that can support women and their children. Importantly, by including the variables in this analysis related to women’s socio-political-historical contexts, we were able to present a fuller depiction of women’s actual lives, in keeping with previous qualitative findings from work with this same population [23, 24]. Indeed, a common criticism of quantitative research is its inability to produce rich and contextualized data. By developing methods for capturing and measuring Indigenous-specific determinants of health, such as intergenerational trauma, foster care and racism experiences, it will be possible to provide richer and more useful empirical data to support and develop understandings in this area of research. Racism, while playing an important role in the health and well-being of Indigenous peoples in Canada [2], for example, can be particularly challenging for groups that have experienced marginalization throughout their lives (like women in this study) to even identify, let alone quantify. As more research stresses the importance of understanding the role of Indigenous-specific social determinants in the health and well-being of Indigenous people in Canada [12], however, this work is important, timely and necessary.

Strengths and limitations
This study had several strengths. The Cedar Project’s criterion for defining Aboriginal Status was any individual who self-identified as Metis, Aboriginal, First Nations, Inuit, and status and non-status Indians. This type of self-identification, therefore, was more inclusive and was also in keeping with post-colonialism approaches in research. This data set included variables surrounding foster care involvement, residential schooling histories, and sexual abuse questions which allowed for more culturally appropriate and nuanced analyses. The Cedar Project Partnership actively maintains the quality of their data and try to minimize any reporting bias through the extensive training of their Aboriginal interviewers, assurances of confidentiality and availability of support services.

This study also had several limitations. Analysis was limited to previously collected data based on self-report that was cross-sectional, limiting conclusions about causation. Recruitment was non-random and there was no way to determine non-response bias. The limited focus of the study population means that generalizations to the general population of young Aboriginal women could not be made. Finally, it is unclear if women in the study used drugs and/or alcohol during their pregnancies.

Conclusion
This analysis provided insight into the social contexts of women who have experiences with pregnancy as well as drug and/or alcohol use and highlighted the need to include Indigenous-specific determinants of health when examining young Aboriginal women’s social, political and historical contexts in relation to their experiences with pregnancy and substance use.

Endnotes
1Collectively refers to the original people of North America, including the three distinct groups of First Nations (historically referred to as Indian), Metis and Inuit peoples (Constitution Act, 1867). Over 1.4 million individuals in Canada identify themselves as an Aboriginal person (Statistics Canada, 2011).
2The terms Aboriginal, First Nations, Indigenous, Status Indian and Indian are used in accordance with the term used by the cited authors. Otherwise, the authors use the term Indigenous to acknowledge Indigenous peoples of Canada’s international legal rights under the UN Declaration of the Rights of Indigenous Peoples.
3The practice of people who are homeless or otherwise socially disadvantaged in society, trading sex for food, a place to sleep, or other basic needs, including drugs.

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Availability of data and materials
The datasets generated and/or analysed during the current study are not publicly available due to the possibility of compromising individual privacy, but are available from the corresponding author on reasonable request.

Authors’ contributions
S.Z.S led the conceptualization of this study, and conducted the data analysis and major preparation of this manuscript. JLB contributed to the conceptualization of the study, the data analysis plan, and major elements of the preparation of this manuscript. NDO and LD provided guidance and insight to the data analysis and interpretation of findings and provided feedback and edits for the final version of this manuscript. VT (Research Coordinator, The Cedar Project) and PMS (PI, The Cedar Project) were integral to the data collection for the data set used, establishing ethical protocols, guiding the data retrieval and analysis plan, and interpretation and dissemination of the results. The Cedar Project Partnership oversees all research conducted with Cedar Project participants and were integral to all parts of this research study. All authors reviewed and approved the final manuscript.

Ethics approval and consent to participate
The Behavioural Research Ethics Board at the University of British Columbia and the Cedar Project Partnership Ethics Review committee, that oversees research conducted with Cedar Project participants, approved this research protocol. The Cedar Project Partnership also oversaw the analysis plan and helped with the interpretation of the results. All participants provided informed consent.

Consent for publication
N/A

Competing interests
The authors declare that they have no competing interests.

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