

Identification of risk and protective factors: A study of major depressive disorder among  
Indigenous adults in Toronto

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## Abstract

**Background:** Major depressive disorder (MDD) prevalence in Indigenous communities is higher than in the general population.

**Objective:** To determine the risk and protective factors associated with MDD among Indigenous peoples living in Toronto.

**Database:** Our Health Counts Toronto (OHCT) database, the largest urban Indigenous health study of 897 Indigenous adult participants, was accessed for analysis.

**Methods:** Performed analyses using weighted generalized linear mixed modelling approaches.

**Results:** Factors protecting against MDD include having a strong connection to Indigenous identity, smoking, and hallucinogen use. Risk factors for MDD include only completing a high school education and use of cannabis, crack, and amphetamine.

**Conclusion:** The findings in this study suggest potential areas for preemptive measures against MDD, including establishing programs to help support a strong sense of cultural identity.

*Keywords:* Respondent-driven sampling; Generalized linear mixed model; Major depressive disorder; Urban Indigenous communities; Indigenous adults in Toronto

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## List of Acronyms

**CI** confidence interval

**DSM-5** Diagnostic and Statistical Manual of Mental Disorders, fifth edition

**GLMM** generalized linear mixed models

**MDD** major depressive disorder

**MDMA** methylenedioxy-methamphetamine

**MEIM** Multigroup Ethnic Identity Measure

**OCAP** Ownership, Control, Access and Possession

**OHC** Our Health Counts

**OHCT** Our Health Counts Toronto

**OR** odds ratio

**PAP** psychedelic-assisted psychotherapy

**RCAP** Royal Commission on Aboriginal Peoples

**RDS** respondent-driven sampling

**REB** Research Ethics Board

**SES** socioeconomic status



**SGMT** Seventh Generation Midwives Toronto

**SUDs** substance use disorders

**TRC** Truth and Reconciliation Commission of Canada

## **1 Introduction**

The Truth and Reconciliation Commission of Canada (TRC) details the goals and impacts of Canada's Indigenous policies over time, which have disrupted families and communities through processes of assimilation (Seventh Generation Midwives Toronto, 2018a). While attempts at assimilation have been unsuccessful, there have been negative influences on structural determinants of health, such as housing, income, employment and land ties. Language, cultural expression, and family systems have been undermined. As a result, there is a continued impact on the health of Indigenous peoples, including mental health and well-being. An approach that addresses structural risks, social determinants, and the restoration of balanced family and community relationships is key to improving mental health and addressing mental illness for Indigenous peoples, fostering an environment for Indigenous populations in Canada to thrive (Seventh Generation Midwives Toronto, 2018a).

The Indigenous population living in Canada has many strengths and experiences many challenges and everyday stressors, one of which is mental health and well-being. Indigenous adults in Toronto have a higher prevalence of mental health challenges than the overall adult population, including major depressive disorder (MDD) (Seventh Generation Midwives Toronto, 2018a). MDD is a common but serious mood disorder that causes symptoms that can severely affect emotions, thoughts, and performance of daily activities. According to the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), there are nine criterion symptoms for MDD (American Psychiatric Association, 2013). The first is a depressed mood most of the day, which is indicated by either a subjective report or observations made by others. The second is significantly decreased interest or pleasure in all or almost all activities most

of the day. The third is significant weight change and increase or decrease in appetite. Other symptoms include (4) sleep disturbances, (5) psychomotor agitation or impairment, (6) fatigue, (7) feelings of worthlessness and/or excessive or inappropriate guilt, (8) diminished ability to think or concentrate or indecisiveness, and (9) recurrent thoughts of death, suicidal ideation without a plan, or a suicide attempt/specific plan for committing suicide. These symptoms must be experienced nearly every day to be considered present, except for weight change and suicidal ideation.

Within the Indigenous population in North America, there are significant associations between psychological distress and culturally-meaningful stressors (Walls & Whitbeck, 2011). While psychological distress has a strong positive directional association with mental illness in the general population, Indigenous populations experience higher rates of psychological distress than their non-Indigenous counterparts (Bellamy & Hardy, 2015; Payton, 2009). In 2000 and 2001, 13.2% of the off-reserve Indigenous population in Canada experienced a major depressive episode in the past year, which is 1.8 times higher than the non-Indigenous population (Tjepkema, 2002). This is concerning as the presence of mood disorders increases the chance of suicidal thoughts approximately three-fold (Nock et al., 2008) and the 2012 Aboriginal Peoples Survey reported that suicide is a major cause of death among Indigenous peoples (Statistics Canada, 2016). In fact, the suicide rates among Indigenous peoples are several times higher than rates among non-Indigenous peoples while nearly a quarter of Indigenous peoples living off-reserve and one in five Métis people reported having suicidal thoughts (Statistics Canada, 2016).

Various psychological studies have identified potential MDD risk and protective factors (e.g. Brown, Lewinsohn, Seeley, & Wagner, 1996; Muris, Schmidt, Lambrichs, & Meesters, 2001). However, these studies are not specific to the Indigenous population. That is, most of them use Caucasian participants and exclude racialized population groups. Furthermore, MDD is often

underdiagnosed in minority groups due to various disparities, including socioeconomic status (SES), cultural beliefs, help-seeking patterns, and access to culturally and linguistically appropriate care (Shao, Richie, & Bailey, 2016).

The aim of this study is to investigate the protective and risk factors associated with MDD in the Indigenous community living in Toronto. This is based on the following six domains of the OHCT study:

- i) Age and gender/sex
- ii) Relationship to self, connection to identity and culture, and relationships to culture and cultural resources
- iii) Social determinants of health and income
- iv) General health status and exercise
- v) Relationship to family and social support
- vi) Substance use

Within these six domains, potential explanatory variables for MDD were selected following consultation with the literature and our Indigenous community partners. Included explanatory variables that were identified for investigation are summarized below:

- i) Age, gender/sex
- ii) Connection to Indigenous identity and culture
- iii) Education level, SES, type of employment

- iv) Physical and spiritual health and well-being, amount of exercise
- v) Amount of familial and social support
- vi) Smoking, alcohol consumption, and nine other substances (including cannabis, opiates, and hallucinogens)

Determining which factors are both associated with and protect from MDD is an important preliminary step to understanding MDD, including assisting to promote good mental health and well-being. Based on our consultation with community partners, factors such as connection to Indigenous identity and culture, and family and social support are expected to protect from MDD (Grav, Hellzèn, Romild, & Stordal, 2012; King, Smith, & Gracey, 2009). With the support of our Indigenous community partners, understanding which factors are associated with MDD in Indigenous adults living in Toronto may allow preliminary identification of culturally relevant and appropriate areas for intervention and reduce the risk of experiencing MDD.

## 2 Manuscript

### 2.1 Contributor Roles and Responsibilities

Octavia Wong is the lead author of this study examining MDD and was responsible for the project, including data cleaning, coding, analyses and writing the initial draft of the manuscript. The manuscript was circulated to her supervisor, Michael Rotondi, and committee members, Alison Macpherson and Nancy Laliberté. In alignment with ethical practice (OCAP<sup>®</sup>), our Indigenous community partners provided assistance with interpretations, feedback, and approval. Permission to access this database was granted by the data custodians, Sara Wolfe and Cherylee Bourgeois of Seventh Generation Midwives Toronto (SGMT) in accordance with our community-based framework (Seventh Generation Midwives Toronto, 2018b). A project reference group comprised of over 20 local and regional Indigenous and allied health and social service organizations met quarterly to guide the research process. These rightsholders were involved throughout the study process, including survey design, question development, and data analyses to facilitate careful consideration of underlying local Indigenous community processes and protocols. For example, the reference group identified priority areas which included mental health and well-being. As a result, Sara Wolfe and Cherylee Bourgeois supported examining MDD as a community priority and supported identification of appropriate variables and interpretation in the Indigenous health context. The OHCT engagement processes aligned with the ethical guidelines used for the research conducted by the Royal Commission on Aboriginal Peoples (RCAP) and the principles of OCAP<sup>®</sup>, which assisted to ensure Indigenous control over Indigenous research data. Ethics approval was provided by the Well Living House Counsel of Grandparents and Seventh Generation Midwives Toronto (SGMT). The research has also been reviewed and approved by the

Research Ethics Board of St. Michael's Hospital (REB #14-083). As it was a planned analysis of this database, no further ethics approval was required from York University. Although this thesis has been vetted by SGMT, the opinions in this thesis do not necessarily reflect those of SGMT and SGMT reserves the right to their own interpretations of this work and analyses.

## **2.2 Background**

A high burden of mental illness has been documented in Indigenous communities in Canada (Tjepkema, 2002). Specifically, epidemiological studies show a greater burden of mental health morbidity in many Indigenous communities across Canada, with prevalence rates of mental health conditions up to two times as high as those of neighbouring non-Indigenous communities (Kirmayer, Brass, & Tait, 2000). This illustrates the significant potential for improving the mental health and well-being for this community. The majority of Indigenous peoples in Canada now live in cities and despite the increasing rate of urbanization among Indigenous populations in Canada, there is little data on Indigenous peoples living in urban areas. Moreover, data that does exist often unreliable due to misclassification errors, limited sample sizes, often not being up-to-date, and failure to adequately reflect mobility between rural and urban locations (Place, 2012; Smylie & Firestone, 2015).

The main objective of this study is to determine which factors, both risk and protective, are associated with MDD among the adult Indigenous population in Toronto using advanced multivariable modelling approaches. There is a paucity in Indigenous-specific studies regarding MDD. However, various psychological studies have identified potential MDD risk and protective factors. Determining which risk and protective factors are associated with the diagnosis of MDD within Indigenous populations will be beneficial in many ways, including but not limited to

assisting early detection and identifying culturally appropriate upstream treatment that addresses underlying determinants. This is particularly important as the early detection of signs and subsequent treatment is important before symptoms such as suicidal ideation manifest. According to Statistics Canada (2017b), suicide was the ninth leading cause of death in Canada in 2013. In fact, suicide is the second leading cause of death amongst Canadians aged 15 to 24, with people aged 15 to 44 making up 73% of hospital admissions for attempted suicide (Statistics Canada, 2017b). Early detection of MDD can help in reducing the number of suicide attempts and, thus, suicide deaths. Moreover, addressing underlying determinants early on may improve overall quality of life for the communities and create opportunities for Indigenous peoples to thrive.

In partnership with our community stakeholders, we hope to develop a culturally relevant and responsible understanding of risk and protective factors and improve the lives of the many Indigenous peoples living in urban areas who are experiencing or are at risk of experiencing MDD.

## **2.3 Methods**

**2.3.1 Respondent-Driven Sampling (RDS).** RDS is a data collection technique that uses network sampling to gain access to hard-to-reach or hidden populations (Gile & Handcock, 2010; Heckathorn, 1997). Sampling strategies for hidden populations, such as targeted sampling or snowball sampling, are affected by various biases due to limitations like recruitment strategies, location, and choice of seed participants (Heckathorn, 2002). RDS is able to reduce some of these biases but is particularly effective in reducing selection bias. As recruitment chains lengthen and sample size increases, the sample composition eventually becomes representative of the target population, negating bias from seed participant selection (Salganik & Heckathorn, 2004). Thus, RDS provides asymptotically unbiased estimates when the recruitment chains are long enough.

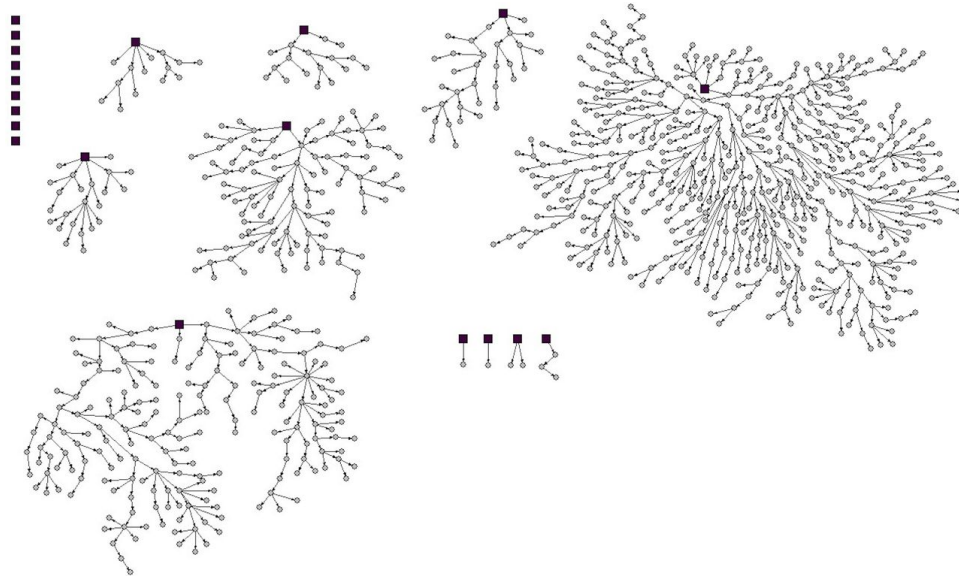


It is an effective sampling method for Indigenous populations living in urban areas because it leverages existing social networks to sample community members (Firestone, Smylie, Maracle, Spiller, & O'Campo, 2014).

**2.3.2 Our Health Counts Study (OHC).** The focus of the Our Health Counts (OHC) project is to develop a culturally relevant baseline population health database for Indigenous peoples living in urban areas in Ontario (Smylie et al., 2011). Six cities are involved in the project: Ottawa, Hamilton, Toronto, London, Kenora, and Thunder Bay. The OHC survey was designed as a respectful health assessment rather than a rapid health assessment (Smylie et al., 2011). The survey incorporates indicators specific to Indigenous health based on local and cultural understandings of health and well-being as well as health and social issues prioritized by Indigenous stakeholders and community members through concept mapping (Smylie et al., 2011).

All data for this study were collected from one of the first inclusive community-driven health survey for Indigenous peoples in Toronto. The OHCT includes a sample of 918 urban Indigenous peoples 15 years of age and older. The data were collected for a year from March 2015 to March 2016 at three health and social services locations across the city of Toronto using RDS (Rotondi et al., 2017). Participants of the OHCT study were asked to complete a 60 to 90 minute comprehensive survey administered by a trained Indigenous community interviewer. This approach was undertaken to assist participants in feeling as comfortable as possible, striving to foster a culturally safe environment. Participants who completed the survey received \$20 for completing the survey and \$10 for every eligible participant they recruited into the study. The OHCT study initially started off with 10 seeds and each of these 10 seeds were given three coupons to recruit others. The respondents would then give their coupon to the researchers before participating in the study. Later on, 10 more seeds were added to increase recruitment speed and

the number of coupons was increased to five per participant. These coupons allowed for network referral patterns to be mapped out as recruitment trees (see Figure 1 below).



*Figure 1.* Our Health Counts Toronto respondent-driven sampling recruitment diagram. Squares represent seeds and circles represent recruits.

**2.3.3 Community Partnerships and Data Ownership.** This study was completed in partnership with our Indigenous community partner, Seventh Generation Midwives Toronto (SGMT), a midwifery clinic in Toronto that provides maternity care for women and their families, including Indigenous women. SGMT is working in partnership with the Well Living House in the Centre of Urban Health Solutions at St. Michael’s Hospital for all aspects of the OHCT study (Seventh Generation Midwives Toronto, 2018a). Our project’s community-based research, publication, and data governance protocols ensure Indigenous community leadership in all aspects of study design, data collection, recruitment, analyses, and data interpretation. Our Indigenous community partners recognized mental health as a priority. Examining mental health will assist in improving the health and well-being of the adult Indigenous community by providing a greater understanding of the risk and protective factors associated with mental well-being. SGMT retains

full ownership and control over all data in accordance with the project's academic-community partnership agreements and in accordance with OCAP<sup>®</sup> principles (First Nations Information Governance Center, 2018). As outlined above, the OHCT engagement processes aligned with the ethical guidelines approval was provided by the Well Living House Counsel of Grandparents, SGMT and the Research Ethics Board (REB) at St. Michael's Hospital (REB #14-083) in Toronto. Ethics review at York University was not required as the study had received ethics approval, was minimal risk, and no further data collection was taking place.

**2.3.4 Analysis.** Weighted generalized linear mixed models (GLMM) were applied using PROC GLIMMIX in SAS version 9.4 for multivariable logistic analysis of RDS data. This approach accounts for participant weights and both the fixed effects of study covariates and random effects of correlation (SAS Institute, 2008). Identifying the proper covariance structure that best describes the level of correlation between data points is crucial for analysis when using GLMM (Barnett, Koper, Dobson, Schmiegelow, & Manseau, 2010). A model of the covariance structure among participants in the OHC study is shown in Figure 2 below (Rotondi, 2013).

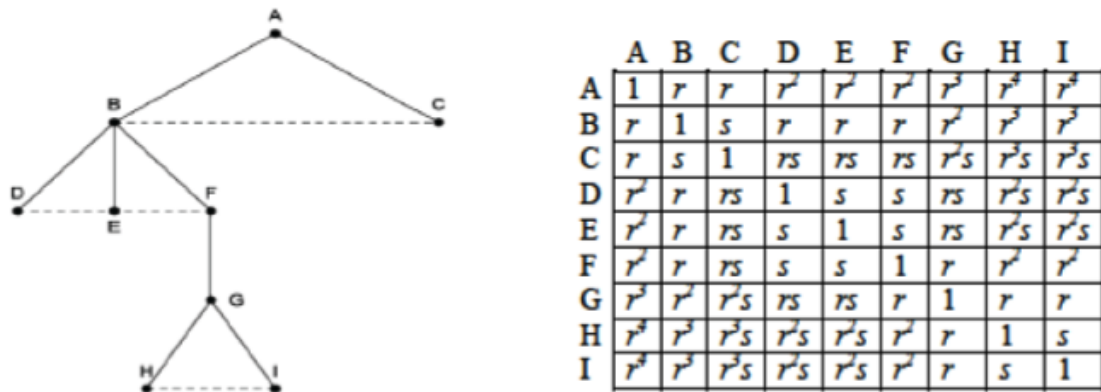


Figure 2. Proposed covariance structure for a single tree in RDS.

In the model, ( $r$ ) denotes the correlation of individuals recruited by the same respondent and ( $s$ ) denotes the correlation within the same cluster. The structure assumes the magnitude of correlation decreases exponentially as the distance between observations increases (Verbeke & Molenberghs, 2000). In all models, participants were weighted using RDS-II weights for the outcome where participants with larger social networks had lower weight (Volz & Heckathorn, 2009). Any missing data were removed using case deletion. Odds ratio (OR) were reported as greater than one for risk factors and less than one for protective factors. Although there is no universally accepted approach for regression modelling of RDS data, this approach was selected based on preliminary simulations as it protects the nominal type I error rate and reduces the risk of spurious declaration of statistical significance.

### 2.3.5 Outcome variable.

**2.3.5.1 MDD in Indigenous populations.** MDD is a serious mood disorder causing symptoms that can have a severe effect on emotions, thoughts, and performance of daily activities.

There are nine criterion symptoms for MDD in the DSM-5, which must be experienced nearly every day to be considered present, except for weight change and suicidal ideation (American Psychiatric Association, 2013).

Since the outcome variable is mental health and well-being (specifically MDD), MDD was based on the responses to two questions in the survey. The respondents to the OHCT Adult survey were considered as having MDD if they responded in the following manner: “Yes” to “Have you ever been told by a healthcare worker that you have a psychological or mental health disorder(s)?” and responded “Major depression” to “If yes, which psychological and/or mental health disorders have you been told that you have?” (see Table 1 below for response categories).

Table 1  
*Major depressive disorder outcome coding in the Our Health Counts Toronto study.*

Question	Categories
Have you ever been told by a healthcare worker that you have a psychological or mental health disorder(s)?	1. Yes 2. No
If yes, which psychological and/or mental health disorders have you been told that you have?	1. Anxiety disorder 2. Major depression 3. Bipolar disorders 4. Schizophrenia 5. Personality disorders 6. Eating disorders 7. Suicidal behaviour 8. Post-traumatic stress disorder 9. Other

Those who answered “No” to the first question were grouped with those who did not respond “Major depression” to the second question and they were all considered as not having MDD to obtain the overall proportion of MDD. A valid scale measuring MDD was not included in the OHC survey as a diagnostic tool, thus the OHCT relies on self-report.

**2.3.6 Explanatory variables.** Explanatory variables are organized into six domains: (1) age and gender/sex; (2) relationship to self, connecting to identity and culture, and relationships to culture and cultural resources; (3) social determinants of health and income; (4) general health status and exercise; (5) relationship to family and social support; and (6) substance use.

**2.3.6.1 Age and gender/sex.** The association between age and MDD is an often-researched topic. Median age-of-onset is about thirty years of age for mood disorders, with half of all lifetime cases starting at 14 years of age and three quarters of all lifetime cases starting at 24 years of age (Kessler et al., 2005). While most research on age-of-onset and lifetime prevalence of MDD has examined both adolescent and adult Caucasian participants, there has been limited research focused on Indigenous peoples, especially adults.

Both Zisook et al. (2007) and Park et al. (2014) found a similar frequency distribution of ages-of-onset of the first major depressive episode with ages 18 to 44 having the highest frequency of age-of-onset and 60 years of age and older being the lowest frequency of age-of-onset. As RDS analyses require categorical outcomes, age was categorized based on the age-of-onset subgroups used by Park et al. (2014) to enhance clinical interpretability and ensure accurate estimation. However, in the context of multivariable analyses, age was considered as a continuous measure (years) to increase power.

Based on community consultations and the literature, age was grouped into four categories:

1. Younger than 18 years
2. 18 years to 44 years
3. 45 years to 59 years
4. 60 years and older

Gender and sex differences are frequently studied for both physical and mental illnesses. Studies and meta-analyses have shown that twice as many women are affected by MDD as men, with both symptoms and diagnoses appearing as early as the age of twelve (Kessler et al., 2005; Kornstein et al., 1995; Salk, Hyde, & Abramson, 2017). Both symptom and illness severity are greater for women than men, however there is little research looking into gender differences in Indigenous populations. Studies have also shown that there is a high prevalence of MDD in transgender communities (Rotondi, Bauer, Scanlon, et al., 2012; Rotondi, Bauer, Travers, et al., 2012), however, research examining gender differences and mental health issues that considers transgender or genderqueer identities is still quite sparse. Transgender individuals often experience discrimination, stigma, lack of acceptance, and abuse on a regular basis, which is understood to be the underlying cause of their higher rates of mental illness as compared to cisgender individuals (Robles et al., 2016). Genderqueer individuals (i.e., those who do not see themselves as fitting in the traditional "male" or "female" gender categories) encounter similar issues to those of transgender individuals wherein they experience discrimination, stigma, and the psychological costs of possibly trying to conceal their identities (Hayes-Skelton & Pantalone, 2018). As such, there is a clear need for more research that is specific to transgender or genderqueer individuals as their experiences are unique. Respondents were asked their gender/sex and their responses were grouped into four categories:

1. Female (a woman)
2. Male (a man)
3. Transgender or genderqueer
4. Other/You don't have a category that applies for me

**2.3.6.2 Relationship to self, connection to identity and culture, and relationships to culture and cultural resources.** In this paper, we examined cultural identity and gender/sex from the Relationship to Self component of the OHCT adult survey. While there are many shared or similar factors that influence mental health and well-being among Indigenous and non-Indigenous peoples, there are some factors that are Indigenous-specific. For example, the impact of colonization and associated factors, such as loss of language and connection to land (King et al., 2009). Colonization continues contemporaneously at both country and global levels wherein Indigenous knowledge, values, behaviours and protocols have been suppressed by colonization processes that are implemented by institutions such as governments and churches (Waa et al., 2019). Isolation from a cultural identity is widely understood to negatively affect Indigenous health. However, the specific association between cultural identity and MDD, as opposed to mental health more broadly, requires further investigation. Increasing mental health service providers' understanding of Indigenous values regarding health and wellness may increase Indigenous peoples' willingness to use mental health services and/or the success of the treatment these services provide.

The twelve-item Multigroup Ethnic Identity Measure (MEIM) (which has been pilot tested and adjusted for face validity among the population of interest) was used to measure connection to identity and culture. It is a questionnaire based on elements of ethnic identity to assess the strength of affiliation to one's ethnic group (Roberts et al., 1999). Items are rated on a four-point scale ranging from 1 to 4, with "strongly agree" being 1 and "strongly disagree" being 4. A mean item score is calculated to measure the strength of the respondent's connection to Indigenous identity. Relationships to culture and cultural resources were measured based on the responses to a series of questions in the survey. The respondents were considered as having a strong relationship to culture and cultural resources if they respond "Yes" to Q21.1 and "No" to Q21.2 (see Table 2 below). A



subset of the questions and possible responses in the OHCT survey analyzed across this domain are contained in Table 2 for illustration below.

Two-Spirit is a term that encompasses a wide range of sexual and gender identities, and it may refer to someone who identifies as having two spirits (i.e., there is the presence of both a masculine and a feminine spirit within that person) (Hunt, 2016; Seventh Generation Midwives Toronto, 2018d). Two-Spirit individuals are more likely to experience higher rates of personal trauma, such as substance abuse, addiction, and suicidal thoughts, as compared to their non-Two-Spirit counterparts (Laing, 2016). Some other issues and challenges experienced include discrimination, isolation, poverty, and inappropriate care due to the lack of understanding of Two-Spirit identity at healthcare centers (Laing, 2016). There is a lack of research that is specific to Two-Spirit individuals as well as overall understanding of their experiences, which are key to improving their health and well-being. To identify Two-Spirit individuals, respondents to the OHCT survey were asked “Do you identify as a Two-Spirit person” and the response categories were (1) yes and (2) no.

Table 2  
*Survey questions and categories for relationship to self, connection to identity and culture, and relationships to culture and cultural resources.*

Variable	Question	Categories
Connection to identity and culture	I have spent time trying to find out more about Aboriginal traditions and customs.*	1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree
	I feel good about my Aboriginal background.*	1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree
	Mean MEIM item score	1. Strong 2. Moderately strong

		3. Moderately weak 4. Weak
Relationship to culture and cultural resources	Do you participate in traditional Indigenous ceremony (i.e., smudge, sweat lodge, fast, healing Qulliq or Kudlik lamp lighting ceremony)?	1. Yes 2. No
	Have you experienced any challenges in trying to access traditional ceremonies?	1. Yes 2. No
	Strength of relationship to culture and cultural resources? (composite)	1. Not strong <sup>†</sup> 2. Strong <sup>‡</sup>

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\* Sample MEIM items - see Table A1 in Appendix A for full questionnaire

<sup>†</sup> If “Do you participate in traditional Indigenous ceremony?” = “No” or if “Do you participate in traditional Indigenous ceremony?” = “Yes” and “Have you experienced any challenges in trying to access traditional ceremonies?” = “Yes”.

<sup>‡</sup> If “Do you participate in traditional Indigenous ceremony?” = “Yes” and “Have you experienced any challenges in trying to access traditional ceremonies?” = “No”.

**2.3.6.3 Social determinants of health and income.** Social determinants of health include education, employment, and SES. There are high rates of high school dropouts among First Nations children, which results in reduced literacy, lower employment rates later in life, and a reduced level of overall SES (Firestone et al., 2014; Reading & Wien, 2009). In 2012, 56% of Indigenous adults living on reserve completed a high school education compared to 60% of Indigenous peoples living off-reserve and 76% of the general Canadian population (Raphael, 2016). Indigenous peoples attending school off-reserve have access to up-to-date textbooks and technology as well as a sufficient nutrition programs that on-reserve schools do not have (Morin, 2017). The schools on reserve are under-funded and under-equipped, with many of them in need of repair and with insufficient funding for nutrition programs for children so that they are motivated to learn rather than sitting in classrooms hungry (Morin, 2017). While there is a clear need for increasing K-12 funding on reserve in order to raise the high school graduation rates for the Indigenous peoples

living on reserve, Indigenous peoples who have moved to urban spaces only have a slight increase in high school graduation rates. Moreover, in 2011, 48.4% of Indigenous peoples aged 25 to 64 (as compared to 64.7% of the non-Indigenous population) had a postsecondary qualification, with 9.8% of the Indigenous population and 26.5% of their non-Indigenous counterparts having a university degree (Statistics Canada, 2018). In fact, 28.9% of the Indigenous population in Canada had no certificate, diploma or degree as compared to 12.1% of the non-Indigenous population (Statistics Canada, 2018). Access to education is certainly an issue whether it is due to discrimination off-reserve or lack of funding both on- and off-reserve. Another issue is the learning environment that may be contributing to poorer educational outcomes for Indigenous students. Factors that may be exacerbating low academic achievement for Indigenous students include overt or subconscious racism and discrimination within schools as well as teachers and support staff who may not understand the challenges Indigenous students face (National Collaborating Centre for Aboriginal Health, 2017). Students may feel alienated and disconnected from their learning, thus underperforming and/or dropping out.

According to Raphael (2016), the unemployment rate of Indigenous peoples living in Canada was 14% compared to the 8% for non-Indigenous Canadians in 2009. In fact, over 25% of Indigenous households have an income that is below the low-income cut-off in 2011 compared to 15% of non-Indigenous households (Raphael, 2016). The unemployment rate for Indigenous individuals who do not complete high school is more than 25% greater than for those who do, and income significantly increases with higher levels of education (National Collaborating Centre for Aboriginal Health, 2017). There is a clear connection between education, employment and SES wherein the higher the level of education, the greater the probability of employment and job security, and the greater the SES (Berger & Parkin, 2009). Lower education amplifies the

effect that unemployment has on MDD (Dooley, Prause, & Ham-Rowbottom, 2000). Moreover, unemployment and inadequate employment may result in low SES, which is associated with a higher prevalence of MDD (Freeman et al., 2016).

It is clear that improving graduation rates for Indigenous peoples is one of the first steps to improving employment rates and SES. Educating teachers and support staff in urban schools about Indigenous histories, worldviews, languages and cultures may help in fostering a safe and comfortable learning environment, developing Indigenous students' sense of self-worth and belonging. If students feel empowered in the classroom and are able to develop trust-based relationships with their teachers and peers, there may be an increase in graduation rates. Two of the main reasons why Indigenous graduation rates have begun to increase in British Columbia, Canada, are increased Indigenous content approved by the Indigenous communities in school curriculums (i.e., TRC Call to Action 10) as well as the presence of Indigenous social workers at schools that teachers and administrators encourage students to talk to (Hyslop, 2019). Implementation of these Calls to Action in Toronto could thus be beneficial for the graduation rates of the Indigenous community living in the city. With increased graduation rates come increases in employment and SES, which then lead to improved quality of life and subsequent physical and mental well-being (National Collaborating Centre for Aboriginal Health, 2017). A subset of the questions and response categories in the OHCT survey analyzed across this domain are contained in Table 3 for illustration below.

Table 3

*Survey questions and categories for social determinants of health and income.*

Variable	Question	Categories
Education	What is the highest level of schooling you have ever completed?	1. More than high school 2. High school 3. Less than high school
Employment	Which of the following best describes your current employment status?	1. Part-time 2. Full-time 3. Seasonal 4. Self-employed 5. Homemaker 6. Any other informal paid work (e.g. babysitting, housekeeping) 7. Student 8. Retired 9. Unemployed 10. Other
SES	What was the total household income from all sources?	1. \$40,000 and more 2. \$20,000 to less than \$40,000 3. Less than \$20,000

**2.3.6.4 General health status and exercise.** General health includes holistic well-being as well as physical health. Spiritual well-being is included in the realm of holistic well-being. Indigenous spirituality is widely viewed as an essential part of any healing process (Adelson, 2001). Healing and Indigenous spirituality are often tightly linked because healing implies an adherence to the Indigenous beliefs and practices of spirituality (Adelson, 2001). Thus, healing involves the re-awakening or renewal of Indigenous spirituality through the inclusion of, for example, sweat lodges in mental health and well-being programmes (Adelson, 2001). Regarding the healing of mental illnesses, an improvement in spiritual well-being is significantly correlated with a reduction in MDD (Hawkins, Siang-Yang, & Turk, 1999). In Coleman's (2009) study of HIV-infected African Americans, religious and existential well-being explained 32% of the variance in MDD. Integrating clients' spiritual and religious beliefs in therapy has been found to

be as effective, if not more effective, in reducing MDD than not integrating these beliefs (Pearce et al., 2014). However, there is little empirical evidence as to whether the effectiveness is significant. Treatment approaches integrating religious or spiritual beliefs have generally considered five religions (Christianity, Judaism, Islam, Buddhism, and Hinduism), but Indigenous worldviews and spirituality (including their connection to healing) is diverse and can differ from such religions. Thus, MDD should be examined in the local context, considering Indigenous worldviews and spirituality.

Exercise is moderately protective against MDD as it is correlated to a reduction in symptoms of MDD, though only with a small effect size (Cooney, Dwan, & Mead, 2014; Dunn, Trivedi, & O’Neal, 2001). Sports participation, in particular, has an inverse association with the odds of suffering from MDD when age and race/ethnicity are controlled for in the model (Babiss & Gangwisch, 2009). However, these studies have not considered Indigenous peoples when controlling for race/ethnicity. Thus, the relative strengths of the association between physical activity and MDD is still unclear in the Indigenous population in Canada. A subset of the questions and response categories in the OHCT survey analyzed across this domain are contained in Table 4 for illustration below.

Table 4  
*Survey questions and categories for general health status and exercise.*

Variable	Question	Categories
General health	Please rate your health. Compared to other people your age, would you say your health is:	1. Excellent 2. Very good 3. Good 4. Fair 5. Poor
	How often do you feel that you are in balance in the four aspects (e.g., physical, emotional, mental, spiritual) of your life?	1. All of the time 2. Most of the time 3. Some of the time

		4. A little of the time 5. None of the time
	How often do you feel strong in your relationship to the land/Mother Earth?	1. All of the time 2. Most of the time 3. Some of the time 4. A little of the time 5. None of the time
	General health (composite) <sup>†</sup>	1. Excellent 2. Very good 3. Good 4. Fair 5. Poor
Exercise	On average, how many days per week do you do at least 30 minutes of moderate (e.g., brisk walking) or hard activity (any activity that makes you work up a sweat)? <sup>‡</sup>	1. Very active (6-7 days/week) 2. Moderately active (3-5 days/week) 3. Infrequently active (0-2 days/week)

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<sup>†</sup>Calculated from the scores of the previous three questions for a mean score. The lower the mean score, the better the respondent's general health.

**2.3.6.5 Relationship to family and social support.** Strong family and social support are associated with good mental health and well-being. In contrast, deficits in parental support, but not peer support, are predictive factors of increases in depressive symptoms as well as the onset of MDD (Stice, Ragan, & Randall, 2004). However, social support may act as a buffer against major stressors that provoke MDD. Studies have found that people who are less likely to experience MDD are individuals who have some social support (Grav et al., 2012). Richmond, Ross, and Egeland (2007) examined the data collected from Métis, Inuit, and First Nation people who participated in Canada's 2001 Aboriginal Peoples Survey and found that Indigenous adults in Canada with high levels of social support are significantly more likely to report positive well-being and health than those with low levels of social support. Relationship to family and social support are measured based on how many close friends and close relatives they have that they feel at ease with and talk

to about what is on their minds.

The OHCT respondents were asked “About how many close friends and close relatives do you have, that is, people you feel at ease with and can talk to about what is on your mind?” and their responses were grouped into two categories of (1) no social support and (2) social support.

**2.3.6.6 Substance use.** Substance use disorders (SUDs) and MDD are often comorbid (Swendensen & Merikangas, 2000). Nearly one-third of clinical patients with MDD also have SUDs, and this comorbidity leads to higher risk of suicide, greater social impairment, and other psychiatric conditions (Davis, Uezato, Newell, & Frazier, 2008). However, there is a lack of unidirectional and consistent association patterns for SUDs and MDD within the general population, indicating that multiple mechanisms of comorbidity are likely to be active in the general population. While SUDs are often portrayed to be prevalent in Indigenous communities as a negative stereotype, substance use is often a method of self-medication among populations with unmet healthcare needs. Implementing the TRC Call to Action 19 (i.e., establish measurable goals to identify and close gaps in health outcomes between Indigenous and non-Indigenous communities such as addictions and mental health, in consultation with Indigenous peoples) and the TRC Call to Action 21 (i.e., providing sustainable funding for existing and new Indigenous healing centers to address physical, mental, emotional, and spiritual harms) would help in reducing the prevalence of both SUDs and MDD in Indigenous communities (Seventh Generation Midwives Toronto, 2018c).

Smoking, alcohol consumption, and nine other substances are examined within this domain. There is still sparse evidence regarding the mechanisms involved in the association between smoking and MDD (Dierker, Avenevoli, Stolar, & Merikangas, 2002). Murphy et al. (2003) examined trends over time from the Stirling County Study and found that smoking did not predict



the onset of MDD, but people who became depressed were more likely to start or continue smoking and were also less likely to quit compared to those who never had MDD. They also found that the odds that a smoker would be depressed were three times that of a nonsmoker. Due to differing results depending on the year they examined, Murphy et al. (2003) summed up their results by stating that the relationships between smoking and MDD are multiple and complex.

Smoking status was assessed in the OHCT survey when respondents were asked "At the present time, do you smoke cigarettes" and the response categories were (1) yes and (2) no.

Alcohol abuse or dependence is associated with worse outcomes in MDD, including increased suicide risk, decreased social functioning, and it is more common in those with MDD than in the general population (Sullivan, Fiellin, & O'Connor, 2005). Alcohol consumption was measured based on the responses to the question "During the past 12 months, how often have you had 5 or more drinks on one occasion?". The responses were grouped into two categories for ease of interpretation. In accordance with Martens et al.'s (2010) grouping, which examined alcohol consumption levels in their health status and healthcare utilization study focusing on Métis in Manitoba, the two categories were: (1) less than once per month and (2) at least once per month. The original seven categories were (1) never, (2) less than once per month, (3) once per month, (4) 2-3 times per month, (5) once per week, (6) more than once per week, and (7) every day.

The nine other substances aside from cigarettes and alcohol examined in this domain are:

1. Cannabis/marijuana (weed, grass hash...)
2. Crack/cocaine (rock, snow, freebase...)
3. Sedatives/sleeping pills (Valium, Xanax, Nembutal, Ambien, etc.)
4. Heroin

5. Prescription opiates (codeine, morphine, percodan, Tylenol 3, fentanyl, talwin, etc.)
6. Hallucinogens (acid, LSD, ecstasy, magic mushrooms, speed, PCP, etc.)
7. Amphetamines (Adderall, Ritalin, methamphetamine, crystal meth, etc.)
8. Inhalants/solvents (glue, gas paint, lighter fluid, cleaners, etc.)
9. Other

The OHCT respondents were given a list of these substances and asked to respond (1) yes or (2) no to the use of each of these substances in the last 12 months. Regarding use of any drugs that were prescribed, the question is specifically referring to use without a prescription or out of keeping with how they were prescribed.

**2.3.7 Confounding variables.** Fully-adjusted analyses were completed for each variable where analyses were adjusted for factors that can influence the risk of MDD. While we are interested in the main effects of age, gender, income, exercise, smoking, and alcohol consumption on MDD, we also adjusted for them as confounders in the fully-adjusted analyses of the associations between the other explanatory variables and MDD. The crude associations as well as the age and gender-controlled associations are reported as supplementary material in Appendix C.

## **2.4 Results**

Demographic characteristics and prevalence of outcome (MDD) along with their associated RDS-adjusted proportions and 95% confidence intervals (CIs) are presented in Table B1 of Appendix B. Prevalence of the explanatory variables and their respective RDS-adjusted proportions and 95% CIs are presented in Table 5 below.

Table 5

*RDS-adjusted estimates of explanatory variables in Indigenous adults living in Toronto.*

Explanatory variable	Category	<i>n</i>	Estimated population proportion (%) (95% CI)
Connection to identity and culture	Strong/Moderately strong <sup>†</sup>	56	12.7 (9.3-16.3)
	Moderately weak	431	53.2 (47.6-58.9)
	Weak	397	30.9 (25.7-36.1)
	Missing	30	-
Two-Spirit	Yes	147	17.6 (13.6-21.6)
	No	739	81.6 (77.4-85.7)
	Missing	10	-
Relationship to culture and cultural resources	Not strong	417	58.9 (53.3-64.5)
	Strong	475	40.8 (33.6-48.0)
	Missing	4	-
Education	More than high school	347	32.5 (27.3-37.7)
	High school	167	17.9 (13.2-22.7)
	Less than high school	380	49.2 (43.5-54.9)
	Missing	2	-
Employment	Part-time	75	6.0 (3.4-8.7)
	Full-time	100	5.0 (2.3-7.8)
	Seasonal	20	1.6 (0.2-3.1)
	Self-employed	29	2.1 (0.2-4.1)
	Homemaker	38	2.1 (0.7-3.5)
	Any other informal paid work (e.g. babysitting, housekeeping)	7	0.6 (-0.2-1.4)
	Student	80	15.0 (11.2-18.8)
	Retired	52	3.2 (0.7-5.9)
	Unemployed	463	61.6 (56.1-67.2)
	Other	32	2.6 (2.0-4.3)
	Missing	0	-
SES	\$40,000 and more	143	10.5 (6.9-14.2)
	\$20,000 to less than \$40,000	186	22.0 (17.4-26.5)
	Less than \$20,000	553	66.2 (60.9-71.5)
	Missing	14	-
General health	Excellent	16	1.7 (-0.3-3.7)
	Very good	125	13.2 (9.6-16.9)
	Good	250	26.7 (21.6-31.8)
	Fair	283	31.8 (26.5-37.2)

	Poor	197	23.6 (18.8-28.5)
	Missing	25	-
Exercise	Very active	479	50.3 (44.6-56.0)
	Moderately active	245	31.7 (26.4-37.0)
	Infrequently active	168	17.8 (13.3-22.3)
	Missing	4	-
Relationship to family and social support	Social support	752	90.9 (87.7 - 94.1)
	No social support	142	9.1 (5.9-12.2)
	Missing	2	-
Smoking	No	285	36.5 (30.8-42.3)
	Yes	605	62.5 (56.8-68.3)
	Missing	6	-
Alcohol consumption	Less than once per month	415	47.0 (41.3-52.8)
	At least once per month	475	52.6 (46.8-58.3)
	Missing	6	-
Use of cannabis/marijuana in the last 12 months	No	375	36.0 (30.5-41.5)
	Yes	517	63.7 (48.1-69.2)
	Missing	4	-
Use of crack/cocaine in the last 12 months	No	685	77.5 (73.7-81.6)
	Yes	205	21.9 (17.9-26.0)
	Missing	6	-
Use of sedatives/sleeping pills in the last 12 months	No	758	82.6 (78.6-86.7)
	Yes	133	17.0 (13.0-21.1)
	Missing	5	-
Use of heroin in the last 12 months	No	856	97.7 (96.3-99.1)
	Yes	35	2.0 (0.7-3.3)
	Missing	5	-
Use of prescription opiates in the last 12 months	No	707	81.5 (77.7-85.3)
	Yes	182	17.9 (14.6-21.6)
	Missing	7	-
Use of hallucinogens in the last 12 months	No	816	90.0 (86.6-93.4)
	Yes	75	9.7 (6.3-13.1)
	Missing	5	-
Use of amphetamines in the last 12 months	No	841	94.2 (91.6-96.8)
	Yes	49	5.3 (2.8-7.8)
	Missing	6	-

Use of inhalants/solvents in the last 12 months	No	881	96.3 (94.5-98.1)
	Yes	7	2.7 (1.0-4.5)
	Missing	8	-
Use of other substances in the last 12 months	No	881	98.6 (97.2-100.0)
	Yes	9	0.9 (-0.5-2.2)
	Missing	5	-

<sup>†</sup>Cell count of zero for “strong” so it was merged with “moderately strong”.

Of the 918 respondents analyzed for MDD, 189 (22.4%, 95% CI: 17.9% to 26.8%) reported the presence of MDD. The number of cases with missing data for each explanatory variable was minimal and ranged from 0 to 30 cases per variable, thus case deletion was used to remove cases with missing data. Furthermore, only 4 respondents identified as “Other/You don’t have a category that applies for me” for their gender/sex, making it unstable, so they were removed from all analyses involving gender/sex. Crude associations as well as associations adjusted for age and gender/sex between the explanatory variables and MDD can be found in Tables C1 through C6 in Appendix C, respectively. The results discussed below are the fully adjusted models as they are the main focus of this study. These results are summarized in Table 6 below.

Table 6

*Protective factors against and risk factors for MDD using GLIMMIX. Results adjusted for age, gender/sex, income, exercise, smoking, and alcohol consumption.*

Variable	Odds ratio (95% CI)
Age (years)	
Younger than 18 ( <i>n</i> = 19) vs. 18 to 44 ( <i>n</i> = 470)	1.32 (0.74-2.37)
45 to 59 ( <i>n</i> = 306) vs. 18 to 44 ( <i>n</i> = 470)	1.35 (0.99-1.84)
60 and older ( <i>n</i> = 101) vs. 18 to 44 ( <i>n</i> = 470)	<b>4.93 (1.18-20.64)</b>
Gender/sex	
Female (a woman) ( <i>n</i> = 464) vs. Male (a man) ( <i>n</i> = 416)	1.62 (0.51-5.18)
Transgender or genderqueer ( <i>n</i> = 12) vs. Male ( <i>n</i> = 416)	1.84 (0.95-3.57)
Mean MEIM item score	
Strong ( <i>n</i> = 56) vs. Moderately weak ( <i>n</i> = 431)	<b>0.40 (0.29-0.54)</b>
Weak ( <i>n</i> = 379) vs. Moderately weak ( <i>n</i> = 431)	1.25 (0.76-2.08)

Two-Spirit	
Yes ( <i>n</i> = 147) vs. No ( <i>n</i> = 739)	1.26 (0.43-3.73)
Strength of relationship to culture and cultural resources	
Strong ( <i>n</i> = 475) vs. Not strong ( <i>n</i> = 417)	0.93 (0.35-2.48)
Education	
High school ( <i>n</i> = 167) vs. More than high school ( <i>n</i> = 347)	<b>4.00 (1.90-8.42)</b>
Less than high school ( <i>n</i> = 380) vs. More than high school ( <i>n</i> = 347)	1.09 (0.42-2.88)
Employment	
Part-time ( <i>n</i> = 75) vs. Unemployed ( <i>n</i> = 463)	<b>6.00 (3.37-10.67)</b>
Full-time ( <i>n</i> = 100) vs. Unemployed ( <i>n</i> = 463)	1.32 (0.47-3.70)
Seasonal ( <i>n</i> = 20) vs. Unemployed ( <i>n</i> = 463)	5.35 (0.36-80.15)
Self-employed ( <i>n</i> = 29) vs. Unemployed ( <i>n</i> = 463)	<b>2.78 (2.02-3.85)</b>
Homemaker ( <i>n</i> = 38) vs. Unemployed ( <i>n</i> = 463)	<b>3.66 (2.04-6.57)</b>
Any other informal paid work ( <i>n</i> = 7) vs. Unemployed ( <i>n</i> = 463)	0.17 (0.03-1.08)
Student ( <i>n</i> = 80) vs. Unemployed ( <i>n</i> = 463)	1.10 (0.58-2.10)
Retired ( <i>n</i> = 52) vs. Unemployed ( <i>n</i> = 463)	3.43 (0.93-12.62)
Other ( <i>n</i> = 32) vs. Unemployed ( <i>n</i> = 463)	<b>2.48 (1.14-5.41)</b>
SES	
\$40,000 and more ( <i>n</i> = 143) vs. Less than \$20,000 ( <i>n</i> = 553)	0.77 (0.47-1.27)
\$20,000 to less than \$40,000 ( <i>n</i> = 186) vs. Less than \$20,000 ( <i>n</i> = 553)	0.49 (0.23-1.05)
General health	
Excellent ( <i>n</i> = 16) vs. Good ( <i>n</i> = 250)	<b>2.02 (1.52-2.69)</b>
Very good ( <i>n</i> = 125) vs. Good ( <i>n</i> = 250)	1.17 (0.70-1.93)
Fair ( <i>n</i> = 283) vs. Good ( <i>n</i> = 250)	1.33 (0.50-3.54)
Poor ( <i>n</i> = 197) vs. Good ( <i>n</i> = 250)	0.33 (0.02-4.68)
Exercise (days per week)	
Very active ( <i>n</i> = 479) vs. Infrequently active ( <i>n</i> = 168)	0.63 (0.25-1.58)
Moderately active ( <i>n</i> = 245) vs. Infrequently active ( <i>n</i> = 168)	2.57 (0.50-13.10)
Amount of social support	
Social support ( <i>n</i> = 752) vs. No social support ( <i>n</i> = 142)	1.76 (0.72-4.31)
Smoking	
Yes ( <i>n</i> = 605) vs. No ( <i>n</i> = 285)	<b>0.74 (0.68-0.81)</b>
Alcohol consumption	
At least once per month ( <i>n</i> = 475) vs. Less than once per month ( <i>n</i> = 415)	0.69 (0.36-1.32)

Cannabis	
Yes ( <i>n</i> = 517) vs. No ( <i>n</i> = 375)	<b>2.03 (1.39-2.97)</b>
Crack	
Yes ( <i>n</i> = 205) vs. No ( <i>n</i> = 685)	<b>2.08 (1.44-3.01)</b>
Sedative	
Yes ( <i>n</i> = 133) vs. No ( <i>n</i> = 758)	1.30 (0.39-4.37)
Heroin	
Yes ( <i>n</i> = 35) vs. No ( <i>n</i> = 856)	1.03 (0.75-1.41)
Opiate	
Yes ( <i>n</i> = 182) vs. No ( <i>n</i> = 707)	<b>1.49 (1.31-1.71)</b>
Hallucinogen	
Yes ( <i>n</i> = 75) vs. No ( <i>n</i> = 816)	<b>0.24 (0.11-0.54)</b>
Amphetamine	
Yes ( <i>n</i> = 49) vs. No ( <i>n</i> = 841)	<b>1.92 (1.05-3.51)</b>
Inhalant	
Yes ( <i>n</i> = 7) vs. No ( <i>n</i> = 881)	4.23 (0.48-37.35)
Other	
Yes ( <i>n</i> = 9) vs. No ( <i>n</i> = 881)	1.63 (0.04-74.42)

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There are a few key results to note from Table 6. Having a strong connection to Indigenous identity was found to be a significant protective factor against MDD (OR = 0.40, 95% CI: 0.29 to 0.54). Due to a cell count of zero for the mean MEIM score of “strong” (see Table B1), the categories for “strong” and “moderately strong” mean MEIM scores were combined into a single category of “strong”. Interestingly, some substances were found to be significant risk factors for MDD such as crack (OR = 2.08, 95% CI: 1.44 to 3.01). However, smoking (OR = 0.74, 95% CI: 0.68 to 0.81) and hallucinogen use (OR = 0.24, 95% CI: 0.11 to 0.54) were found to be significantly protective against MDD. From these results, the complexities of understanding MDD begin to emerge.

## 2.5 Discussion

This study examined social and culturally relevant protective and risk factors associated with MDD in the urban Indigenous community living in Toronto, Canada. Being 60 years of age and older is a significant risk factor for MDD. Note that the OHCT survey asks whether an individual has ever been diagnosed with MDD. As a result, with increased years of life lived, there is an inherent increase in the period for people to “ever” experience MDD. Furthermore, while the literature indicates that the lowest frequency of age-of-onset occurs at 60 years of age and older, it is important to also remember the lifetime prevalence of MDD is 21% (Hasin et al., 2018). It may be the case that older respondents were diagnosed with MDD earlier in their lives. Thus, the results of individuals 60 years of age and older being at a higher risk for MDD may be an artifact of how the survey question was framed and is not associated with age-of-onset directly.

Having a strong connection to Indigenous identity was a significant protective factor against MDD. Raising children, Indigenous or otherwise, with a positive self-identity increases their chances of growing up healthy (Government of Canada, 2013). In addition to this, Indigenous leaders indicated that raising children with a strong sense of cultural identity plays a key role in healthy child development since community and belonging are key parts of their cultures’ belief systems (Government of Canada, 2013). Auger (2016) performed a metasynthesis and found that health and wellness outcomes are linked to cultural continuity for Indigenous peoples. For example, Katl’odeeche First Nation Children’s Centre on the Hay River Dene Reserve in the Northwest Territories interweaves culture and language into every activity for the children. Instilling a strong sense of cultural identity in Indigenous peoples is an integral component in well-being and healing from past traumatic experiences that may help in reducing the risk of MDD



for Indigenous peoples living in Toronto.

Robust evidence has established that education, employment, and SES are connected. Completing high school as the highest level of education increases the risk for MDD as compared to completing more than high school. This may assist in explaining why certain types of employment are also significant risk factors for MDD. Education level is positively correlated to employment rate, potentially influencing the nature of one's employment as well (Statistics Canada, 2009). Employment advantages associated with a higher level of education may include steadier, higher income employment. However, beyond level of education, field of study, and location of work, trends in Canadian economy also play a role in how workers with different educational qualifications are compensated for their work (Statistics Canada, 2017a). This may explain the high number of respondents who stated their income was less than \$20,000 as well as the high number of respondents who are unemployed. Our findings support existing research wherein unemployment, inadequate employment, and low education level are associated with a higher prevalence of MDD, even amplifying each other's effects (Freeman et al., 2016).

With regards to smoking being found to be a significant protective factor against MDD, almost all existing research suggests the opposite in that smoking and MDD are positively associated (Fluharty, Taylor, Grabski, & Munafò, 2017). However, smoking can be regarded as a coping mechanism for MDD rather than a protective factor as smokers tend to report stress relief from smoking cigarettes (Parrott, 1999). Maddox (2015) found commercial tobacco use among Indigenous population was impacted by the social normalisation of tobacco use, tobacco being role modelled, being easy to obtain, and facilitating social interactions through various social structural and psychosocial mechanisms which could provide a coping mechanism for MDD. Furthermore, some Indigenous peoples in North America use tobacco as a sacred medicine to pray to the Creator.

Semi-structured interviews with Indigenous community members and health staff showed that Indigenous peoples living in Australia are more than twice as likely to smoke tobacco than their non-Indigenous counterparts due to familial influence (Johnston & Thomas, 2008). The interviews revealed that these Indigenous peoples regard smoking as a ceremonial act passed down through generations. Furthermore, smoking is seen as a communal and collective activity that nurtures a sense of belonging and social cohesiveness (Johnston & Thomas, 2008). Since sharing a smoke provides an easy opportunity to talk, not smoking may foster a sense of isolation. Individuals who have a strong connection to culture and higher levels of social support have a lower probability of experiencing MDD and smoking facilitates both of these factors. Thus, the social aspects of smoking may contribute to its use as a coping mechanism against MDD.

The use of hallucinogens was found to be a significant protective factor against MDD. Hallucinogens are psychedelic drugs that alter perception of surrounding objects and conditions, thoughts, and feelings, thus causing hallucinations (National Institute on Drug Abuse, 2016). Recently, there has been increasing revival of interest in using hallucinogens to treat treatment-resistant MDD (i.e., psychedelic-assisted psychotherapy (PAP)). When testing for the safety and efficacy of the use of various hallucinogens in PAP, participants in randomized control trials are showing improvements in depressive symptoms and with low rates of side effects (Byock, 2018; dos Santos et al., 2016; Patra, 2016; Reiche et al., 2018; Schenberg, 2018). Thus, there appears to be a physiological for the protective effect of hallucinogens on MDD, which may be explored further.

Cannabis, crack, and amphetamine use were found to be significant risk factors for MDD. Heavy or problematic cannabis use and MDD in cohort studies and cross-sectional studies are shown to be strongly associated (Degenhardt, Hall, & Lynskey, 2003). Frequency of cannabis use is positively

associated with depressive symptoms, with weekly cannabis users having higher MDD scores than that of non-users (Horwood et al., 2012).

Regarding crack use and MDD, patients in recuperation from substance dependency who use crack have an MDD prevalence rate of 32% (Paiva, Ferreira, Bosa, & Narvaez, 2017). In fact, 80% of a cross-sectional study's sample of crack users had more than minimal MDD and 55% had moderate to severe MDD (Falck, Wang, Carlson, Eddy, & Siegal, 2002).

The use of amphetamines, such as methylenedioxy-methamphetamine (MDMA) or ecstasy, increases feelings of elation, agreeableness, energy and mental confusion (Davison & Parrott, 1997). However, coming down from MDMA often leads to temporary feelings such as lethargy, moodiness, insomnia, and depression while long-term cognitive changes from ecstasy use include changes associated with MDD (Davison & Parrott, 1997; Kelly, 2000). Moreover, problematic ecstasy users exhibit significantly elevated scores of MDD compared to non-problematic ecstasy users (Soar, Turner, & Parrott, 2006). Thus, studies suggest that there may, in fact, be positive associations between problematic use of cannabis, crack, amphetamines and MDD.

We have also shown that opiate use is a significant risk factor for MDD. Research has shown that opiate use and MDD are often comorbid. Opiate use causes a sense of euphoria that is especially intoxicating for individuals who have an underlying depressive condition such as MDD (Dackis & Gold, 1983). In another study, almost half of a sample of untreated opiate users in several Canadian urban centres were diagnosed with MDD (Wild et al., 2005). Thus, opiate use being a significant risk factor for MDD is in concurrence with research.

Finally, it is important to note that other factors which were identified as non-significant do not necessarily have no effect on MDD as these findings may be due to factors such as low power or simply random variation.

## 2.6 Strengths and Limitations

Using RDS and improved multivariable models afford a larger and more representative sample than snowball sampling while also reducing selection bias. This allowed for a more valid representation of the Indigenous community living in Toronto. Due to the community-based participatory framework used in developing the OHC study, the Indigenous community led all aspects of study design, analysis and interpretation, assisting to ensure that the study represents their objectives and priorities.

Regarding limitations, the data analyzed were cross-sectional, thus causality cannot be established. As such, it cannot be concluded with certainty whether the risk factors cause MDD or if the underlying presence of MDD has led to these risk factors. Conversely, it cannot be concluded with certainty that whether the protective factors truly protect against MDD or whether the absence of MDD is causing these protective factors' presence. A limitation of respondents self-reporting an MDD diagnosis is the possibility that MDD was underreported due to the stigma related to MDD. There is considerable social stigma associated with MDD (e.g., being viewed as weak) as well as self-stigmatization, which can cause individuals with MDD to become secretive and prevent them from seeking proper treatment (Wolpert, 2001). Moreover, factors such as discrimination and racism may limit participants' willingness to access the healthcare system and thus be diagnosed. Finally, there is a lack of a standardized method for regression modelling using RDS data, so it is unclear as to which type of modelling is best used to analyze the data and it remains a topic of methodological research. However, in recognizing this limitation, we implemented this approach to protect against the nominal type I error rate and reduce the risk of spurious declaration of statistical significance. Overall, OHCT has provided a new gold standard in urban Indigenous

population health and well-being data for the city of Toronto (Rotondi et al., 2017; Smylie & Firestone, 2015).

## **2.7 Conclusions and Implications**

These findings suggest potential risk and protective factors that are associated with MDD in the urban Indigenous community. While being mindful of the historical and ongoing colonial context, these findings may include increases in resources, informing the development of programs to support protective factors such as having a strong connection to culture and Indigenous identity as well as improving education in a culturally respectful way. Interventions and resources could also focus on how to mitigate or limit the risk factors of MDD, such as substance use, through prevention, early detection, and appropriate interventional support. Moreover, increased accessibility to, and funding for, healthcare that takes into consideration Indigenous spiritual beliefs and values is essential. This can be done through the implementation of the TRC Calls to Action, including Call to Action 10 (i.e., increased Indigenous content in school curriculums with full participation and informed consent of Indigenous peoples), Call to Action 19 (i.e., in consultation with Indigenous peoples, establishing measurable goals to identify and close gaps in health outcomes between Indigenous and non-Indigenous communities), and Call to Action 21 (providing sustainable funding for existing and new Indigenous healing centers to address physical, mental, emotional, and spiritual harms) (Truth & Reconciliation Commission of Canada, 2015).

Successful application of RDS in the OHCT study suggests a feasible sampling framework for future research in urban Indigenous communities, including local Indigenous community engagement and the active application of local protocols. Moreover, the use of multivariable techniques illustrates the application of potential regression strategies for RDS data. The results

of this study highlight potential areas where culturally-relevant resources may be allocated to help Indigenous peoples to thrive, while protecting urban Indigenous communities from MDD.

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## Appendix A Multigroup Ethnic Identity Measure (MEIM) Items

Table A1

*Complete MEIM questionnaire used in the Our Health Counts Toronto survey.*

Question	Response
I have spent time trying to find out more about Aboriginal traditions and customs.	1. Strongly agree 2. Agree 3. Disagree 4. Strongly disagree
I have a clear sense of my cultural background as an Aboriginal person and what that means to me.	(see above)
I think a lot about how being Aboriginal influences my life.	(see above)
I am happy that I am an Aboriginal person.	(see above)
I have a strong sense of belonging to an Aboriginal community.	(see above)
I understand pretty well what being Aboriginal means to me.	(see above)
In order to learn more about being an Aboriginal person, I have often talked to other Aboriginal people about being Aboriginal.	(see above)
I have a lot of pride in my Aboriginal identity.	(see above)
I participate in cultural practices, such as pow wows, Aboriginal day events, jigging/dancing, ceremonies, feasts, drumming, singing, etc.	(see above)
I feel a strong attachment towards other Aboriginal people.	(see above)
I feel good about my Aboriginal background.	(see above)

**Appendix B Demographic characteristics and RDS-adjusted estimates of explanatory variables**

Table B1  
*RDS-adjusted estimates of demographic characteristics and major depressive disorder (MDD) in Indigenous adults in the Our Health Counts Toronto survey.*

Demographic variable	Category	<i>n</i>	Estimated population proportion (%) (95% CI)
MDD	No	702	77.1 (72.6-81.6)
	Yes	189	22.3 (17.9-26.8)
	Missing	5	0.5 (0.0-1.2)
Gender/sex	Female (a woman)	464	48.3 (42.7-54.0)
	Male (a man)	416	50.2 (44.5-55.9)
	Transgender or genderqueer	12	1.0 (0.3-1.7)
	Other/You don't have a category that applies for me	4	0.5 (0.0-1.5)
Age (years)	Younger than 18	19	9.1 (6.1-12.0)
	18 to 44	470	53.5 (47.8-59.2)
	45 to 59	306	31.5 (26.3-36.8)
	60 and older	101	5.9 (2.7-9.0)

## Appendix C Detailed associations between explanatory variables and MDD

Table C1

*Analysis of the association between age and MDD.*

Variable	Odds ratio (95% CI)
<b>Crude</b>	
Age (years)	
Younger than 18	1.22 (0.49-3.04)
18 to 44	1
45 to 59	1.55 (0.99-2.44)
60 and older	<b>5.52 (1.56-19.45)</b>
Gender	
Female (a woman)	1.68 (0.54-5.16)
Male (a man)	1
Transgender or genderqueer	<b>1.83 (1.05-3.21)</b>
Other/You don't have a category that applies for me <sup>†</sup>	-
<b>Adjusted for age and gender/sex</b>	
Age (years)	
Younger than 18	1.21 (0.53-2.77)
18 to 44	1
45 to 59	<b>1.46 (1.13-1.90)</b>
60 and older	<b>5.48 (1.63-18.43)</b>
Gender	
Female	1.62 (0.54-4.80)
Male	1
Transgender or genderqueer	<b>1.97 (1.13-3.43)</b>
Other/You don't have a category that applies for me <sup>†</sup>	-

<sup>†</sup>Removed due to low cell count

Table C2  
*Analysis of the association between relationship to self, connection to identity and culture, and relationships to culture and cultural resources, and MDD.*

Variable	Odds ratio (95% CI)
<b>Crude</b>	
Mean MEIM item score	
Strong	<b>0.27 (0.12-0.58)</b>
Moderately weak	1
Weak	1.08 (0.69-1.69)
Two-Spirit	
Yes	1.39 (0.44-4.34)
No	1
Strength of relationship to culture and cultural resources	
Strong	0.90 (0.46-1.74)
Not strong	1
<b>Adjusted for age and gender/sex</b>	
Mean MEIM item score	
Strong	<b>0.28 (0.17-0.47)</b>
Moderately weak	1
Weak	1.03 (0.64-1.64)
Two-Spirit	
Yes	1.23 (0.46-3.26)
No	1
Strength of relationship to culture and cultural resources	
Strong	0.83 (0.43-1.59)
Not strong	1

Table C3

*Analysis of the association between social determinants of health and income and MDD.*

Variable	Odds ratio (95% CI)
<b>Crude</b>	
Education	
More than high school	1
High school	<b>3.15 (2.34-4.24)</b>
Less than high school	1.26 (0.60-2.65)
Employment	
Part-time	<b>6.41 (3.88-10.58)</b>
Full-time	1.02 (0.33-3.13)
Seasonal	5.00 (0.48-52.11)
Self-employed	<b>1.92 (1.57-2.36)</b>
Homemaker	<b>2.23 (1.35-3.68)</b>
Any other informal paid work	<b>0.19 (0.05 - 0.69)</b>
Student	<b>0.64 (0.47-0.88)</b>
Retired	<b>5.61 (1.47-21.45)</b>
Unemployed	1
Other	1.87 (0.56-6.31)
SES	
\$40,000 and more	1.08 (0.53-2.20)
\$20,000 to less than \$40,000	0.55 (0.18-1.69)
Less than \$20,000	1
<b>Adjusted for age and gender/sex</b>	
Education	
More than high school	1
High school	<b>2.83 (2.34-3.43)</b>
Less than high school	1.06 (0.51-2.20)
Employment	
Part-time	<b>6.67 (3.57-12.47)</b>
Full-time	1.11 (0.42-2.92)
Seasonal	4.29 (0.28-66.38)
Self-employed	<b>2.00 (1.63-2.44)</b>
Homemaker	<b>2.73 (1.28-5.81)</b>
Any other informal paid work	<b>0.22 (0.07 - 0.67)</b>
Student	0.91 (0.57-1.45)
Retired	<b>3.75 (1.21-11.64)</b>
Unemployed	1

Other	1.98 (0.51-7.73)
SES	
\$40,000 and more	1.08 (0.53-2.20)
\$20,000 to less than \$40,000	0.55 (0.18-1.69)
Less than \$20,000	1

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Table C4  
*Analysis of the association between general health status and exercise and MDD.*

Variable	Odds ratio (95% CI)
<b>Crude</b>	
General health	
Excellent	<b>2.57 (1.92-3.45)</b>
Very good	1.19 (0.72-1.98)
Good	1
Fair	1.13 (0.55-2.32)
Poor	0.28 (0.02-3.87)
Exercise (days per week)	
Very active	0.53 (0.26-1.11)
Moderately active	2.02 (0.55-7.46)
Infrequently active	1
<b>Adjusted for age and gender/sex</b>	
General health	
Excellent	<b>2.37 (1.52-3.71)</b>
Very good	1.15 (0.66-2.06)
Good	1
Fair	1.18 (0.49-2.86)
Poor	0.35 (0.04-3.42)
Exercise (days per week)	
Very active	0.68 (0.21-2.15)
Moderately active	2.57 (0.47-14.23)
Infrequently active	1



Table C5  
*Analysis of the association between relationship to family and social support and MDD.*

Variable	Odds ratio (95% CI)
<b>Crude</b>	
Amount of social support	
Social support	1.44 (0.53-3.93)
No social support	1
<b>Adjusted for age and gender/sex</b>	
Amount of social support	
Social support	1.73 (0.91-3.27)
No social support	1

Table C6  
*Analysis of the association between substance use and MDD.*

Variable	Odds ratio (95% CI)
<b>Crude</b>	
Smoking	1.05 (0.81-1.35)
Alcohol consumption <sup>†</sup>	0.63 (0.27-1.46)
Cannabis	1.74 (0.96-3.13)
Crack	0.87 (0.68-1.11)
Sedative	1.61 (0.49-5.30)
Heroin	1.07 (0.66-1.72)
Opiate	<b>1.82 (1.48-2.24)</b>
Hallucinogen	<b>0.25 (0.07-0.87)</b>
Amphetamine	<b>1.59 (1.15-2.03)</b>
Inhalant	5.35 (0.50-57.54)
Other	0.92 (0.09-9.47)
<b>Adjusted for age and gender/sex</b>	
Smoking	0.92 (0.75-1.12)
Alcohol consumption <sup>†</sup>	0.70 (0.24-2.04)
Cannabis	<b>2.09 (1.26-3.48)</b>
Crack	0.82 (0.58-1.16)
Sedative	1.66 (0.40-6.89)
Heroin	0.89 (0.66-1.21)
Opiate	<b>1.92 (1.36-2.73)</b>
Hallucinogen	<b>0.26 (0.08-0.84)</b>

Amphetamine	<b>1.71 (1.22-2.41)</b>
Inhalant	3.59 (0.67-19.28)
Other	0.91 (0.09-8.93)

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*Note.* With the exception of alcohol consumption, the reference category for each variable is "No".

† Reference group is "Less than once per month".