Examining the association between traditional and mainstream medicine and the prevalence of arthritis in the urban Indigenous population living in Toronto

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A Thesis submitted to the Faculty of Graduate Studies in Partial Fulfillment of the requirements for the degree of Masters of Science

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Toronto, Canada

December 2019

Abstract

Background: In the Indigenous community, the prevalence of arthritis is 1.3 to 1.6 times higher than their non-Indigenous counterparts. Moreover, minimal population health information on urban Indigenous peoples is available.

Objective: To explore the relationship between the use of traditional and mainstream medicine and the prevalence of arthritis in the Indigenous population living in Toronto.

Methods: The Our Health Counts Toronto study surveyed 918 self-identified Indigenous adults using Respondent-Driven Sampling. Survey logistic regression and generalized linear mixed models were used to investigate the multivariable relationships between medication use and arthritis, including adjustments for known confounders.

Results: Compared to using neither types of medicine, use of both mainstream and traditional medicines (OR: 8.69, 95% CI: 4.06-18.59), mainstream medicine use only (6.08 2.41-15.36) and traditional medicine use only (3.86 2.63-5.67) are associated with arthritis.

Conclusion: Indigenous community members with arthritis are likely to use both traditional and mainstream medicine to manage this condition.

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TRC	Truth and Reconciliation Commission
OHC	Our Health Counts
SGMT	Seventh Generation Midwives Toronto
WLH	Well Living House
RDS	Respondent Driven Sampling
NHS	National Household Survey
OHCT	Our Health Counts Toronto
OCAP	Ownership, Control, Access and Possession
SAS	Statistical Analysis System
OR	Odds Ratio

1. Introduction

The disparity between the health of the Indigenous[1] and non-Indigenous populations has been recognized around the world (Martens, Martin, O'Neil, & MacKinnon, 2007). Research indicates that risk factors associated with chronic diseases, such as daily smoking and low SES are commonly outcomes that have impacted over generations through the mechanics of colonisation which has eroded power, social structures and Indigenous community resources. As a result, such risk factors are generally more prevalent in the Indigenous population than their non-Indigenous counterparts (Bruce, Riediger, & Lix, 2014; Ministry of Health, 2006; Truth and Reconciliation Commision of Canada, 2015a; Williams, 1999). These risk factors translate into disease and impairment. For example, studies show that the prevalence of arthritis, a chronic debilitating disease characterized by chronic joint pain, inflammation, and loss of range of motion and joint function, for on and off-reserve, Inuit and Métis was 19%, 18%, 13% and 21%, respectively (O'Donnell, Lagacé, McRae, & Bancej, 2011). These arthritis prevalences are 1.3 to 1.6 times higher in Indigenous adults when compared to the age-adjusted national estimate for the adult Canadian population (O'Donnell *et al*., 2011). Furthermore, it was reported that approximately 76% of the Indigenous population live in urban settings (Place, 2012). Although the majority of the Indigenous peoples live in urban settings, there is limited research on Indigenous health in urban settings (Smylie & Firestone, 2015).

Canada's assimilation policies have actively targeted Indigenous peoples, with a deep history of Indigenous peoples being subject to mistreatments, such as residential schools and

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[1] Indigenous peoples represent a diversity of cultures, perspectives and experiences that brings tremendous vibrancy to our world. Within this diversity, many Indigenous peoples share a common history of colonisation that continues today. The author/I humbly acknowledge and respect that Indigenous people are diverse and constitute many nations, language groups and cultures. For the purposes of this thesis, Indigenous peoples include self-identified First Nations (Status and non-Status), Inuit and Métis peoples unless specified otherwise.

evictions from their homelands (Truth and Reconciliation Commision of Canada, 2015a, 2015b). It is crucial to acknowledge, understand and address this context and these inequalities (Truth and Reconciliation Commision of Canada, 2015a, 2015b). Generations of Indigenous people have experienced annexations and exploitations, government policies that actively aimed to eliminate traditional Indigenous governments, their livelihood and culture. These colonization processes which have fundamentally mistreated Indigenous populations, including the implementation of assimilation policies and perpetuating intergenerational trauma have substantially impacted Indigenous health and wellbeing, including compromising Indigenous languages and cultural expression. Despite this, Indigenous people continue to be a strong and resilient community. To create a historical account of residential schools, help people heal and encourage reconciliation between Indigenous and non-Indigenous Canadians, the Truth and Reconciliation Commission of Canada (TRC) was created. The TRC issued a report that documented the abuse that Indigenous peoples suffered in what has been described as "cultural genocide" and put forward calls to action to redress the legacy of residential schools and further the reconciliation process (Truth and Reconciliation Commision of Canada, 2015a, 2015b). As part of the 94 calls to action outlined in the TRC final report, the TRC aimed to improve the health of Indigenous peoples by: identifying and closing the gaps in health outcomes between Indigenous and non-Indigenous communities; addressing the distinct health needs of First Nations, Métis, and Inuit peoples; recognizing the value of Indigenous healing practices and using them where requested; and by providing sustainable funding for existing and new Indigenous healing centres and cultural competency training for all health-care professionals (Truth and Reconciliation Commision of Canada, 2015b, 2015a). Given this context and in implementing the TRC calls to action (Truth and Reconciliation Commision of Canada, 2015b,

2015a) and aligning with the United Nations Declaration of the Right of Indigenous Peoples (United Nations, 2007), more quantitative investigation into the factors associated with chronic diseases are necessary to better inform more effective and culturally sensitive programs and policies for Indigenous peoples.

In the global burden of disease study, arthritis is one of the fastest growing chronic conditions in high income countries (Murray *et al*., 2013). The prevalence of arthritis is projected to increase in conjunction with the increasing size of the aging population and the rise of obesity around the world. Osteoarthritis is estimated to affect approximately 7 million individuals aged 15 years and older in Canada by 2031 (March & Bachmeier, 1997; Mobasheri & Batt, 2016). The burden of this chronic disease is evident on the global scale, and disproportionally affects Indigenous peoples. In a related study, the Indigenous population in the urban area of Hamilton, Ontario was reported to have 31% prevalence of arthritis, compared to 20% prevalence among their non-Indigenous counterparts (Smylie et al., 2011a). This is nearly double the estimated prevalence of arthritis among all Canadians of 16% found by Barnabe *et al*. (2015) and O'Donnell *et al*. (2011). Stress associated with social determinants of health, the mistreatment of the Indigenous community and other adverse experiences likely contribute to the systemic outcome of arthritis. As a result of impaired communication between the immune and endocrine systems, chronic stress is linked to a multitude of health conditions, metabolic illnesses, immune disorders, dysregulation, chronic fatigue and depression (American Psychological Association, 2019). Studies have reported increased inflammatory characteristics and immune abnormalities connected to adverse childhood experiences (Danese et al., 2009; McEwen, 2017; Miller & Chen, 2010). As a result, the intergenerational trauma and historical events experienced by the

Indigenous community in conjunction with other social determinants of health makes them more susceptible to many chronic disorders like arthritis.

Arthritis is a disease of synovial joints, impacting quality of life and causing significant health and economic burden ("Arthritis: An overview," 2007; O'Donnell et al., 2011). The most common forms of arthritis are osteoarthritis, a degenerative joint disease that involves the breakdown of joint cartilage and underlying bone tissue, and rheumatoid arthritis, an autoimmune disorder that primarily targets joints, with osteoarthritis being much more common than rheumatoid arthritis (Cross et al., 2014; Mobasheri & Batt, 2016). Osteoarthritis is characterized by progressive deterioration of the articular cartilage, ligaments, meniscus (in the knee) and other structures in the entire joint (Buckwalter & Mankin, 1998). Risk factors for osteoarthritis include age, gender, obesity, joint trauma, certain occupations, bone deformities, endocrine disorders and having metabolic or rheumatic diseases (Mobasheri & Batt, 2016). Rheumatoid arthritis is characterized by immune mediated joint destruction. Genetic factors are important risk factors for rheumatoid arthritis, but do not sufficiently explain the triggering of the immune response; other factors are less understood and remain unknown (Morović-Vergles, 2003). Both forms of arthritis are marked by chronic joint pain, inflammation, limitations, and structural/functional changes in the joint. Arthritis is also associated with pain and dysfunction that can lead to disruptions in circadian clocks and rhythms, sleep disturbances, depression and other inflammatory conditions (Lepetsos & Papavassiliou, 2016; Parmelee, Tighe, & Dautovich, 2015). Based on a review of the diagnosis and treatment of arthritis, managing arthritis requires treatment that entails management and individualized care, such as therapy, medication and/or surgery (Alshami, 2014; Mobasheri & Batt, 2016).

Traditional Indigenous medicine can employ the use of herbal treatments, sweat baths, poultices and other therapeutic methods (Obomsawin, 2007). The healing practices of traditional Indigenous medicine often combine mental, social, spiritual, physical and ecological dimensions of health and well-being and aims to balance the individual within and the individual, society and the natural world (Gall *et al*., 2018; Oliver, 2013; Shahid & Thompson, 2009). Traditional medicines have demonstrated efficacy in numerous areas, including disease prevention, mental health and wellbeing, as well as quality of life improvements for people living with chronic diseases (Obomsawin, 2007; World Health Organization, 2001). In terms of treating and managing arthritis, some studies have found the use of different herbal extracts and oils that have been shown to reduce pain, stiffness and improve tenderness in joints (Whitehouse, Turner, Davis, & Roberts, 1998).

Despite these different approaches, the Indigenous population in Alberta were less likely to obtain specialized care for arthritis than their non-Indigenous counterparts (Barnabe *et al*., 2017). The disparity is likely due to racism and feeling unsafe or uncomfortable which is reinforced by the differential treatment Indigenous people experience when receiving healthcare as outline in the TRC Report (Truth and Reconciliation Commision of Canada, 2015a). A related Our Health Counts (OHC) study found evidence linking discrimination in healthcare settings to disparities in healthcare access (Kitching et al., 2019). This disparity may also be the result of incongruence between world views, including the specialized care approach and Indigenous perceptions of health which often means not just the physical well-being of an individual, but refers to the social, emotional and cultural well-being of the whole Community in which each individual is able to achieve their full potential as a human being thereby bringing about the total well-being of their Community (Obomsawin, 2007). Further, multiple studies have referenced

the rationale that Indigenous people who believe in the teachings and traditions of their people heal best through traditional healing and medicine (Gall *et al*., 2018; Hill & Coady, 2003) Indigenous people often distrust the western world because they have been subject to ongoing colonization and active assimilation processes, which includes mistreatment, historical medical experimentation, ignorance and racism. This is a persistent problem which has significant potential for changes that could improve Indigenous people's access to education and access to health care services. The social determinants of health, including colonization, contribute to the disproportionate rate of illness experienced by the Indigenous community (*An Overview of Aboriginal Health in Canada*, 2013; Greenwood & De Leeuw, 2012).

The OHC Urban Aboriginal Health Database Project aims to address the overall lack of Indigenous health data in urban settings. The paucity in Indigenous health data is predominantly due to Indigenous peoples being commonly and systematically excluded, unidentifiable, under-represented as a result of poor sampling frames and mistrust in health information systems (Rotondi et al., 2017; Smylie & Firestone, 2015; Taylor, 2011). Surveys, such as the Canadian Census systematically under sampled urban Indigenous peoples (Rotondi et al., 2017), and traditional methods like snowball sampling are subject to bias. Indigenous community distrust in the government is a major contributor as to why Indigenous people do not actively participate in the Canadian Census, in addition to sampling frames that inadequately sample the Indigenous population, meaning that Indigenous peoples are frequently unidentifiable and under-represented in health information systems. The goal is to improve urban Indigenous health data by documenting many aspects of people's health and wellbeing. Our Health Counts uses an inclusive Indigenous led approach and method to build and apply a comprehensive Indigenous health info-systems as directed by local Indigenous communities. This approach successfully

used Respondent Driven Sampling (RDS) and assisted to ensure the data collection system was relevant, effective and efficient. The OHC projects have collected Indigenous health data to better understand Indigenous health and health service needs in six cities, including Ottawa, Hamilton, Toronto, London, Kenora, and Thunder Bay.

Under the leadership of Seventh Generation Midwives Toronto (SGMT) and the Well Living House (WLH) at St. Michael's Hospital, Our Health Counts Toronto (OHCT) is a partnership with Indigenous and allied health service providers and stakeholders, aiming to conduct research to ultimately improve the health and wellbeing of the Indigenous community in Toronto. Developed and headed by the Indigenous community, the OHC studies use RDS, a unique sampling technique designed to reach hard to reach populations through social networks and dual-incentives (1 - incentive to participate, and 2- incentive to recruit participants), in order to obtain representative samples of the Indigenous population. The use of RDS to build on social network, kinship relations as well as the active involvement, leadership and ownership of the study and the data, by the Indigenous community assists to addresses a number of significant limitations involved in collecting Indigenous health data via other methods, such as the Canadian Census or the National Household Survey (NHS). In addition, this approach also meets Indigenous community standards of accountability, ownership and ethics, such as the OCAP® principles ("OCAP® | FNIGC," 2019).

Our Health Counts Inuit Ottawa found that Statistics Canada under-estimated the Inuit population living in Ottawa by a factor greater than four (Smylie & Firestone, 2017). This significant finding reflects that the Indigenous population is vastly under-represented in the Canadian Census. The inaccurate Indigenous population count provide a significant barrier, formed by the gap in Indigenous health information that resulted from under-representation, for

Indigenous leaders, communities as well as policy makers and practitioners from accurately informing and evaluating evidence based health and wellbeing interventions, such as vaccinations and healthy lifestyle programming. (Smylie & Firestone, 2015). Other work in the OHC studies has found that First Nations people living in Hamilton experience striking levels of poverty, disproportionate burdens of chronic disease and disability, substantial barriers to health care and have higher rates of emergency rate admissions than the general Hamilton and Ontario population among other findings (Smylie et al., 2011b). These findings provide useful information to help inform program and policies, including reinforcing evidence that there are significant Indigenous population undercounts and health inequities. Further, the OHC First Nations Hamilton found that the Indigenous population living in Hamilton were more likely to have diabetes if they felt that the health services they received were not culturally appropriate as compared to those who felt the health services they received were culturally appropriate (Beckett, Firestone, McKnight, Smylie, & Rotondi, 2018). With more accurate data and evidence regarding Indigenous population health and wellbeing, policy makers should be better informed to help improve Indigenous health and wellbeing, addressing health disparities.

Similar to other OHC finding mentioned above, OHCT calculated a conservative population estimate of approximately 45 000 Indigenous adults living in Toronto using RDS, more than twice the estimated Indigenous population found in the NHS, 15 650 Indigenous adults living in Toronto, derived from the long-form census (Rotondi et al., 2017). Further, accurate population estimates are critical as funding and the availability of health and social services are typically based on population size. In addition to these findings, ongoing methodological improvements in multivariable regression methods for RDS has the potential to

make improvements in the standard methods for enumerating hidden populations, and consequently make significant impacts on health and wellbeing.

The virtual absence of urban Indigenous health data and the innovative use of RDS has provided leaders, communities and researchers with a unique opportunity to address community priorities. As more research is completed, other systemic health and social disparities found in urban Indigenous communities will be addressed, helping improve Indigenous health and wellbeing.

Seventh Generation Midwives Toronto and the project reference group identified exploring the use of Indigenous traditional medicines and healing practices as a priority, including examining associations with chronic diseases, such as arthritis. To our knowledge, there is a paucity in research examining the relationship between Indigenous medicines and healing practices and the prevalence of arthritis in an urban setting. The primary objective of this study is to explore the relationship between the use of traditional and mainstream healthcare and the prevalence of arthritis in the Indigenous population living in Toronto. The secondary objective of this study is to analyze the relationship between the use of traditional medicine and the prevalence of pain in Indigenous peoples with arthritis Toronto.

2. Manuscript

Contributor Roles and Responsibilities

Julio Chen is the lead author of this study and was responsible for the project, including data cleaning, coding, analyses and writing the initial draft of the manuscript. The manuscript was circulated to his supervisor, Michael Rotondi, committee members, Chris Ardern and Raglan Maddox, and co-leaders of the OHC study Janet Smylie, Sara Wolfe and Cheryllee Bourgeois for their feedback, assistance with contextualisation and interpretation, and approvals. 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 and question development, data analyses, and sharing of the results to facilitate careful consideration of underlying local Indigenous community processes and protocols. Permission to access this database was granted by the data custodians, Sara Wolfe and Cheryllee Bourgeois from SGMT in accordance with our community-based framework. The OHC processes aligned with the ethical guidelines used for the research conducted by the Royal Commission on Aboriginal Peoples (RCAP) and the principles of OCAP®, which assisted to ensure Indigenous control over Indigenous research data. Ethical approval was provided by the Well Living House Counsel of Grandparents and SGMT. The research was also approved by the Research Ethics Board of St. Michael's Hospital (REB no: 14-083). As this work had received prior ethics approval, was minimal risk, and no further data collection was taking place, further ethics review at York University was not required. However, this manuscript was written with constant input from our community partners to ensure the highest ethical standards. 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.

2.1 Background

The Indigenous population is strong and resilient, despite enduring Canada's assimilation policies including residential schools and cultural genocide as outlined in the final report of the TRC (Truth and Reconciliation Commision of Canada, 2015a). Acknowledging Canada's assimilation policies that actively target Indigenous peoples as well as the research indicating the disproportionate experience of poor housing, low socioeconomic status, and employment rates, we can begin to better understand why there is such large disparities between Indigenous health and non-Indigenous health. In addition, as people continue to age, they become more susceptible to age related chronic conditions. Arthritis, a chronic disorder that affects joints, is one of the fastest growing chronic conditions largely because individuals are getting older and increasingly living into higher risk age groups (Arden *et al*., 2011; Murray *et al*., 2013). In Canada, arthritis is one of the most common chronic health conditions (O'Donnell *et al*., 2011). Evidence indicates that the Indigenous population living in the provinces of Canada had a prevalence of arthritis of 26% compared to 17% of their non-Indigenous counterparts (Lix, Bruce, Sarkar, & Young, 2009; Tjepkema, 2002).

Despite 76% of the Indigenous population now lives in urban settings and the well-known disparities between the health outcomes of Indigenous and non-Indigenous people, research on Indigenous population health in urban areas is sparse (Martens *et al*., 2007; Place, 2012). Gaps in population health data are unfathomable, yet they exist predominantly due to underrepresentation, exclusion and mistrust (Smylie & Firestone, 2015). These gaps are being addressed by inclusive initiatives like OHC that capture relevant Indigenous health data. Moreover, traditional medicine and mainstream medicine are often available in urban settings. This is a unique strength of the Indigenous community as traditional medicine can be a

substantial part of Indigenous culture, health and wellbeing (First Nations Health Authority, 2014; Obomsawin, 2007; Tang, Program, & Jardine, 2016). A study has shown anti-inflammatory effects of Emu oils and other pain relieving effects to combat pain associated with various musculoskeletal disorders (Whitehouse et al., 1998). Another study examining traditional herbal medicine of the Pikuni-Blackfeet used to treat symptoms of Parkinson's disorder has shown neuroprotective properties (de Rus Jacquet et al., 2017a). Both instances point to the effectiveness of traditional Indigenous medicine in treating and managing chronic illnesses. Under the leadership of our Indigenous community partners, arthritis was recognised as a priority chronic condition with the potential to improve Indigenous health and wellbeing. As a result, the findings of this research can assist to address some of the TRC calls to action, recognizing traditional medicines and identifying areas for improvement in Indigenous health and wellbeing outcomes.

The primary objective of this study is to examine the relationship between the use of different types of medicine and the prevalence of arthritis in the urban Indigenous population living in Toronto. The secondary objective of this study is to examine the relationship between the prevalence of pain in the Indigenous population with arthritis and the use of traditional medicine in the urban Indigenous population living in Toronto.

2.2 Methods

2.2.1 The Our Health Counts Toronto Study

The goal of OHCT was to develop a comprehensive health status and health care utilization database for urban Indigenous individuals, families and community health and wellbeing. This included documenting unmet health service needs, tracking emergency room

presentations, and determining population-based estimates for key health outcomes, including arthritis. This study was developed, conducted and designed, under the leadership of Seventh Generation Midwives Toronto (SGMT) and Well Living House (WLH), and in partnership with Indigenous and allied health service providers and stakeholders. This approach assisted to ensure the Indigenous communities' ownership, control, access and possession of research processes and data and consistent with OCAP® principles (OCAP® | FNIGC, 2019). All aspects of study design, data collection, participant recruitment, analyses and interpretation of data were done under Indigenous community leadership. With Indigenous community guidance and support, the survey incorporated questions to address and explore community priorities. Formal ethics approval for the OHCT study was provided by the Research Ethics Board (REB) at St. Michael's Hospital (REB #14-083) in Toronto, while further ethics review at York University was not required as the study had received prior ethics approval, was minimal risk, and no further data collection was taking place.

2.2.2 Respondent Driven Sampling

This study used an innovative sampling technique, respondent driven sampling (RDS) developed by Heckathorn (1997). RDS was used to sample the hidden and hard to reach Indigenous population living in Toronto. This sampling method uses social networks, including kinship networks to generate asymptotically unbiased estimates of population proportions despite its non-random initial selection of participants (seeds) (Salganik & Heckathorn, 2004; Schonlau & Liebau, 2010). RDS uses respondents' self-reported peer network sizes to calculate sampling weights in order to reduce differential recruitment bias resulting from some groups recruiting more than other groups (Heckathorn, 2007). These unique aspects of RDS are what separates

RDS from traditional snowball sampling techniques. In addition, RDS includes a structured system of dual incentives. This approach reduces over-volunteerism bias by rewarding participants for completing the survey and successfully recruiting others to complete the survey.

Ten individuals were selected as seeds for the study and survey completers were given three coupons to recruit participants. Financial incentive of $20.00 was provided to participants who completed the survey and $10.00 for each successfully recruited participant. The seeds were selected in consultation with Indigenous health and social service organizations to ensure they capture the diversity of the Indigenous community and sufficiently large social networks among the seeds, so that the chain referral would get past the initial waves and expand. To increase recruitment speed, 10 more seeds were added and the number of coupons per participant was increased from three to five. At this point, 65 participants had completed the survey prior to this increase and were contacted and given the opportunity to recruit two additional people. Of the 65 participants contacted, 41 participants received two additional coupons (five coupons in total). Potential duplicates were reduced through a preliminary screener and identified by examining survey questionnaires and matching provincial health insurance numbers that were voluntarily provided by 97% of study participants. The RDS recruitment tree for OHC Toronto can be seen in the Appendix under Figure 1. The OHCT study consisted of 918 Indigenous adults 18 years old or older living in Toronto.

2.2.3 Data Analysis

Based on the study design and lack of standardized method for multivariable analysis of data derived from RDS, two approaches, were used to examine the relationship between the use of traditional Indigenous medicine and mainstream medicine, and the prevalence of arthritis. The first approach is a weighted logistic regression using the function PROC SURVEYLOGISTIC in

SAS version 9.4. This approach accounts for the difference in recruitment tendencies by weighing participants inversely proportionate to their self-reported network sizes. The second approach is a weighted generalized linear mixed model using the function PROC GLIMMIX in SAS version 9.4. Similarly to the first approach, this method accounts for participant weights as derived from network sizes. In addition, the weighted generalized linear mixed model can account for both fixed effects of study covariates and random effects for correlation between shared recruiters and along recruitment trees.

2.2.3.1 Primary analysis: Different types of medicine and the prevalence of arthritis

For the primary analysis, the outcome variable, the prevalence of arthritis, was coded as a binary variable. Participants who reported having been diagnosed by a health care practitioner, where diagnosis indicates participants have and are expected to have arthritis for six months or more, met the criteria for having arthritis as a chronic health condition on the OHCT survey. Participants were grouped into four groups based on the primary explanatory variable, use of traditional and mainstream medicines. Use of traditional medicines was elicited via the binary (yes, no) question 21.3 "Do you use traditional Indigenous medicines or practices to maintain wellbeing?" Use of mainstream medicine was determine by question 12.3 "When did you last see a doctor or nurse practitioner?" on the OHCT survey under the access and relationship to health care services section. Participant responses were coded such that participants who selected "Less than 1 year ago" were considered to currently use mainstream medicine and all other responses were considered to not currently using mainstream medicines. This was consistent with the other questions regarding chronic health conditions and to ensure that those who were categorized as users of mainstream medicine have used it recently and not just once before. Income indicators were collapsed into three groups using $20,000 increments starting from $0-

$20,000 and ending with more than $40,000. The gender categories "Trans" and "Other" were collapsed due to low cell counts in an inclusive approach and helping capture the unique experiences of gender non-conforming communities. All other chronic health conditions excluding arthritis were grouped together into a generic "Other Chronic Health Conditions" variable and used in the adjusted analyses to mark the prevalence of chronic health conditions other than arthritis. The prevalence of this aggregate variable amongst the sample is presented in Table 1. This helped to ensure that the analyses were specific to the objectives of the study, specifically participants who were using medicine for arthritis and not other chronic health conditions. All other variable coding was derived directly from the survey results without manipulation, such as smoking, age, etc. The demographic characteristics of the Indigenous population living in Toronto and the distribution of participants are detailed in Table 1.

2.2.3.2 Secondary analysis: Traditional medicine and pain

The outcome variable for the secondary analysis, joint pain within the arthritis group, was coded as a binary variable derived from question 5.1b1. Participants who answered "Yes" to question 5.1b "Have you ever been told by a health care provider that you have arthritis?" and met the criteria as described above, were asked the following "Yes" or "No" question 5.1b1 which read "In the past 12 months, did you ever have pain in your joints (i.e. hips, knees, hands) that limited the amount or type of activity that you were able to do?"

The explanatory variable for the secondary analysis was the use of traditional medicine determined by question 21.3 on the OHCT survey. Due to small cell counts and to ensure anonymity of the participants, analysis was reduced for specific subpopulation criteria (those with arthritis). As a result, we were unable to categorize the data into four groups: (1) using both traditional and mainstream medicines, (2) using mainstream medicine only, (3) using traditional

medicine only and (4) using neither types of medicine. As a result, we simplified the analysis to examine and focus on the use of traditional medicine only.

Weighted unadjusted analyses were completed for each statistical model and objective, followed by models for the primary and secondary analysis that adjusted for known confounders including, how many days during the week do they participate in physical activity, smoking status, other chronic illnesses and annual household income. Estimated odds ratios (OR) and their 95% confidence intervals (OR, 95% CIs) were reported for each model. Cases of missing data and incomplete surveys were handled via case deletion.

2.3 Results

The OHCT Indigenous health study consisted of 918 Indigenous adults older than 18 years of age. Of the 918 participants, 896 met the inclusion criteria and 760 individuals remained after case deletions for incomplete data. Table 1 outlines basic demographic characteristics of Indigenous adults who participated in the OHCT survey. From this information, we note that the estimated proportion of urban Indigenous adults living in Toronto with arthritis (21.0 %, 16.3-25.6) was slightly higher than that of their non-indigenous counterparts living in Ontario (19.2%), but not statistically significantly different (Statistics Canada, 2017). Almost half the urban Indigenous population used traditional medicines and practices for maintaining wellbeing and 80.5% (75.7-85.3) had seen a doctor or nurse practitioner less than a year ago. Approximately 66.2% (60.9-71.5) were living at or below the poverty line (under $20,000 per year), while 62.6% (56.8-68.3) of the urban Indigenous population smoked and 50.3% (42.7-58.0) exercised 6-7 days in a week.

Table 2 includes RDS-adjusted tabulations of the proportions of individuals who have arthritis and their medication use, respectively. An unadjusted analysis of the relationship between the prevalence of arthritis and the use of different types of medicine is shown in Table 3 along side the adjusted analyses. The weighted survey logistic regression analysis indicated a significant association between the prevalence of arthritis and mainstream and traditional medicine users (10.09, 3.38-30.12) and mainstream medicine users only (10.04, 3.24-31.14) as compared to non-medicine users. The unadjusted weighted generalized linear mixed model analysis indicated significant differences in the prevalence of arthritis in traditional medicine users only (3.54, 1.81-6.94), as well as both mainstream and traditional medicine users (9.78, 5.22-18.29) and mainstream medicine users only (9.98, 5.40-18.42) as compared to non-

	Point Estimate (%)	95% CI
Table 1: Demographic characteristics of the Indigenous population living in Toronto (Maddox, R., *et al.,* 2018).		
Arthritis		
Yes	21.0%	16.3-25.6
No	78.9%	74.2-83.6
Do you use Traditional Medicines and Practices for maintaining wellbeing		
Yes	49.2%	43.5-54.9
No	50.5%	44.8-56.2
When did you last see a doctor or nurse practitioner		
Less than 1 year ago	80.5%	75.7-85.3
1 year to less than 2 years ago	8.0%	4.8-11.3
2 years to less than 3 years ago	2.7%	0.7-4.6
3 years to less than 4 years ago	2.2%	0.6-3.8
4 years to less than 5 years ago	1.2%	0.4-2.1
5 years or more ago	4.4%	1.6-7.2
Never	0.9%	0.0-2.3
Income		
Less than $20,000	66.2%	60.9-71.5
$20,000 to less than $40,000	22.0%	15.8-28.1
More than $40,000	10.5%	2.8-19.5
Gender		
Female (a woman)	48.3%	42.6-54.0
Male (a man)	50.2%	44.5-55.9
Other/You do not have a category that applies to me (Please specify/Comment)	0.5%	0.0-1.5
Trans (e.g. Transgender, Transsexual, Gender Queer)	1.0%	0.3-1.7
Exercise Frequency		
0 - 2 Days / Week	17.3%	14.4-20.2
3 - 5 Days / Week	31.6%	27.7-35.5
6 - 7 Days / Week	51.1%	47.0-55.1
Do you smoke		
Yes	62.6%	56.8-68.3
No	36.5%	30.8-42.3
Heart Disease		
Yes	6.8%	3.8-9.9
No	93.0%	90.0-96.1

Stroke		
Yes	3.7%	1.8-5.6
No	95.8%	93.8-97.9
Liver Disease		
Yes	7.4%	4.9-10.0
No	92.5%	89.9-95.0
High Blood Pressure		
Yes	23.5%	18.4-28.6
No	75.8%	70.7-80.9
Hepatitis B		
Yes	2.0%	0.6-3.4
No	97.6%	96.1-99.1
Hepatitis C		
Yes	10.9%	7.9-14.0
No	88.3%	85.1-91.5
Allergies		
Yes	38.0%	32.5-43.6
No	61.6%	56.0-67.2
Chronic Bronchitis		
Yes	8.7%	5.9-11.6
No	90.5%	87.4-93.6
Cancer		
Yes	7.1%	4.5-9.6
No	92.1%	89.4-94.8
Diabetes		
Yes	14.5%	10.4-18.5
No	83.1%	79.0-87.3
Other Chronic Illnesses [1]		
Yes	69.5%	62.4-76.6
No	30.5%	23.4-37.6

[1]The aggregate of all chronic illnesses besides arthritis.

Table 2: Prevalence of arthritis, by type of medicine used and by joint pain in the Indigenous population living in Toronto.

	Arthritis % (95% CI)	
Use of medicine	**Yes**	**No**
Both traditional and mainstream medicine	10.1 (6.8-13.5)	31.2 (24.2-38.2)
Mainstream medicine	9.6 (5.9-13.3)	29.7 (22.0-37.4)
Traditional medicine	0.9 (0.0-1.9)	6.9 (3.5-10.4)
Neither	0.4 (0.1-0.7)	11.3 (4.9-17.7)
	Joint Pain % (95% CI)	
Use of Traditional Medicine (within those who have arthritis)	**Yes**	**No**
Yes	48.6 (36.4-60.8)	3.9 (0.5-7.2)
No	36.8 (24.7-48.9)	10.8 (2.5-19.1)

medicine users.

From Table 3, the adjusted survey-weighted logistic regression showed those who used both traditional and mainstream medicine (9.86, 2.78-35.00) and mainstream medicine only (6.57, 1.77-24.38) had a higher prevalence of arthritis as compared to those who use neither type of medicine. While not statistically significant, this analysis showed an odds ratio of 4.26 (0.75-24.10) for arthritis in Indigenous adults who use traditional medicine only as compared to Indigenous adults who used neither traditional nor mainstream medicine.

From the adjusted weighted generalized linear mixed model analysis column in Table 3, it is evident that there is a significant difference in the prevalence of arthritis between the different groups of medicine users and the group of individuals who use neither type of medicine listed. Indigenous adults who used both traditional and mainstream medicines (9.45, 4.14-21.56), mainstream medicine only (6.64, 2.59-17.01) and traditional medicines (4.09, 2.63-6.35) only had higher odds of arthritis suggesting that those who had arthritis were actively using these medicines to manage their conditions.

Table 3: Models of Arthritis prevalence by type of medicine used in the Indigenous population living in Toronto.

	Survey-Logistic Regression	Generalized Linear Mixed Model
Unadjusted		
Types of Medicine Used		
	Odds ratio (95% CI)	Odds ratio (95% CI)
Both Traditional and Mainstream Medicine vs Neither	10.09 (3.38-30.16)*	9.78 (5.22-18.29)*
Mainstream Medicine vs Neither	10.04 (3.23-31.19)*	9.98 (5.40-18.42)*
Traditional Medicine vs Neither	3.85 (0.75-19.84)	3.54 (1.81-6.94)*
Adjusted		
Type of Medicine Used	Survey-Logistic Regression	Generalized Linear Mixed Model
	Odds ratio (95% CI)	Odds ratio (95% CI)
Both Traditional and Mainstream Medicine vs Neither	9.86 (2.78-35.00)*	9.45 (4.14-21.56)*
Mainstream Medicine vs Neither	6.57 (1.77-24.38)*	6.64 (2.59-17.01)*
Traditional Medicine vs Neither	4.26 (0.75-24.10)	4.09 (2.63-6.35)*

* Denotes an estimate that is statistically significant at the p<.05 level

Table 4: Prevalence of joint pain by Traditional medicine use in the Indigenous population living in Toronto.

	Logistic Regression	Generalized Linear Mixed Model
Unadjusted		
Use of Traditional Medicine		
	Odds ratio (95% CI)	Odds ratio (95% CI)
Yes vs No	3.68 (0.99-13.79)	4.66 (2.18-9.96)*
Adjusted		
Use of Traditional Medicine	Logistic Regression	Generalized Linear Mixed Model
	Odds ratio (95% CI)	Odds ratio (95% CI)
Yes vs No	6.55 (1.54-27.87)*	6.71 (4.77-9.44)*

* Denotes an estimate that is statistically significant at the p<.05 level

Table 4 presents the unadjusted survey-weighted logistic regression analysis and the weighted generalized linear mixed model analysis of the relationship between the use of traditional medicine and the prevalence of joint pain in the Indigenous community living in Toronto with arthritis. The survey-weighted logistic regression analysis showed an odds ratio of

3.68 (0.99-13.79) for having joint pain associated with arthritis in those who used traditional medicine as compared to those who did not use traditional medicine. The weighted generalized linear mixed model analysis showed an odds ratio of 4.66 (2.18-9.96) for having joint pain associated with arthritis in those who used traditional medicine as compared to those who did not use traditional medicine. The latter analysis was statistically significant at the level of $p<0.05$. Table 4 also presents the adjusted weighted logistic regression analysis and the weighted generalized linear mixed model analysis of the relationship between the use of traditional medicine and the prevalence of pain in the Indigenous community living in Toronto with arthritis. The survey-weighted logistic regression analysis showed an odds ratio of 6.55 (1.54-27.87) for having joint pain associated with arthritis in those who used traditional medicine as compared to those who did not use traditional medicine. Similarly, the weighted generalized linear mixed model analysis showed an odds ratio of 6.71 (4.77-9.44) for having joint pain associated with arthritis in those who used traditional medicine as compared to those who did not use traditional medicine. Both adjusted models showed statistically significant associations suggesting a strong relationship between participants with joint pain and use of traditional medicines.

2.4 Discussion

2.4.1 Primary analysis: Different types of medicine and the prevalence of arthritis

The results of this study indicated a significant association between the use of both traditional and mainstream medicine and the prevalence of arthritis in the Indigenous community aged 18 years and older living in Toronto. The data suggests that while participants who have arthritis are consistently using mainstream medicine, many individuals also use traditional medicine. This evidence supports the idea that there is efficacy in traditional medicine (Obomsawin, 2007; World Health Organization, 2001). This also supports the TRC calls for action that aims to recognize the value of Indigenous healing practices (Truth and Reconciliation Commision of Canada, 2015b). The results from the adjusted analyses, that controlled for other variables associated with arthritis, further emphasized the significance of the association between the use of different types of medicine and the prevalence of arthritis. This indicates the Indigenous population in Toronto requires access to primary healthcare amongst nurses and general practitioners. Addressing unmet health needs, promoting culturally safety training, and addressing discrimination from healthcare providers will help the Indigenous population to access primary healthcare (Kitching et al., 2019; Truth and Reconciliation Commision of Canada, 2015b). This inference supports the finding that the Indigenous community are more likely to seek primary care physicians for arthritis, which was reported in a study on the prevalence of arthritis and health services use in the First Nations population in Alberta (Barnabe *et al*., 2017). In the same study, First Nations people were less likely to seek specialized care for arthritis which suggests barriers to seeking specialized care for the Indigenous population are more prevalent than the barriers for seeking primary care. Specialized health care visit data was not available in the OHCT dataset. However, further research in this area could examine

differences and similarities in specialized health care use, identifying and addressing barriers in accessing specialized health care for Indigenous populations living in urban areas.

2.4.2 Secondary analysis: Traditional medicine and pain

The secondary analysis of this study revealed a significant relationship between the prevalence of joint pain in individuals with arthritis and the use of traditional medicine. In other words, those who have joint pain associated with their arthritis are more likely to use traditional medicine than not using traditional medicine. This implies that the Indigenous population living in Toronto with arthritis use traditional Indigenous healing alone or in combination with other types medicine. Given the effectiveness of traditional remedies in treating symptoms of arthritis, such as Whitehouse's study on the non-toxic, transdermal, anti-inflammatory effects of Emu oils (1998) and Soeken's systematic review of herbal medicines used to treat arthritis (2003), it is reasonable to assume that the Indigenous population use traditional medicine for its ability to treat joint pain. Furthermore, other research looking at traditional medicine and healing have shown positive results in treating other chronic diseases, such as Parkinson's disease (de Rus Jacquet et al., 2017b). This suggests that the incorporation of traditional medicine could improve the effectiveness of mainstream health treatments and supports the TRC calls to action to use Indigenous medicine where requested (Truth and Reconciliation Commision of Canada, 2015b).

Limitations and strengths

One limitation of this paper is that the data collected in this study is both self-reported and cross-sectional in nature, thus causality cannot be established. The lack of a standardized method for modeling regression data collected through RDS is another limitation. Preliminary statistical simulations showed a similar type I error rate for both weighted logistic regression models and weighted generalized linear mixed models. However, more research is needed to

determine the best standardized method for analyzing RDS collected data. In addition, the low prevalence rates shown in Table 1 of chronic diseases, like heart disease, are interesting to note. These lower prevalence rates (as compared to the national average of 8.5%) may be attributed to limited primary care access and consequently being under diagnosed (*Heart Disease in Canada highlights from the canadian chronic disease surveillance system*, 2017). Moreover, as shown in Table 2, a large majority of Indigenous adults living in Toronto use both mainstream and traditional medicine for reasons other than arthritis. As a result, other chronic conditions or confounding factors that were not identified through the OHCT survey may not have been adequately adjusted in this analysis. However, there are many strengths to this study, including the use of RDS to recruit Indigenous people living in in Toronto, thus allowing for a more representative sample of this population with less bias than traditional snowball sampling techniques. More Indigenous community driven research focusing on Indigenous health care use would help create a more detailed and holistic profile of the Indigenous community living in urban areas, assisting to better inform programs and policies.

Finally, this study revealed the importance of traditional medicine in the Indigenous community living in Toronto. Almost half of the Indigenous population living in Toronto used traditional medicine and practices to maintain wellbeing which speaks to its efficacy and importance to the community. This suggests the need for improved access to traditional medicine and the necessity of mainstream practitioners to better understand the importance and validity of traditional medicine. This may help improve the health and wellbeing of Indigenous peoples, fostering a safer environment to address the health and wellbeing needs of Indigenous peoples, and better recognizing the value of Indigenous healing practices.

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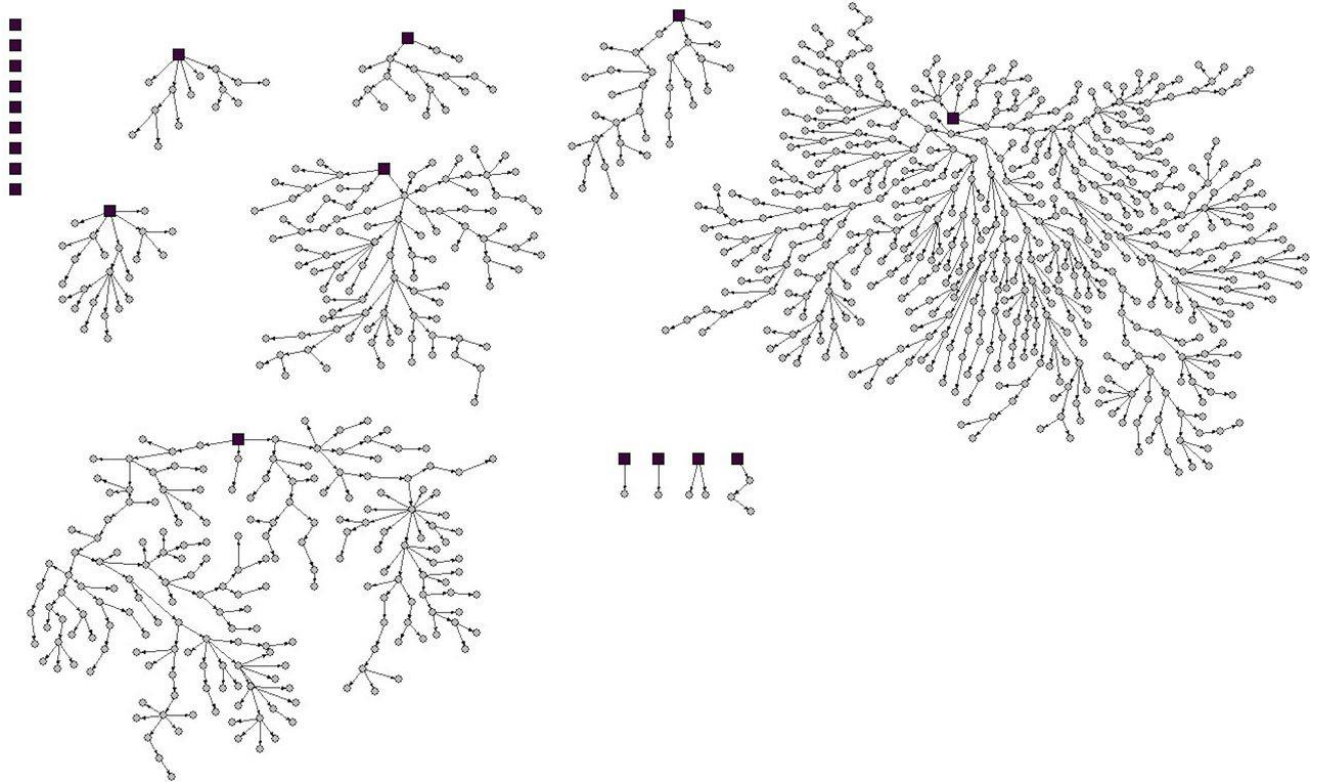
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2.6 Appendix A: Figures

Figure 1: Our Health Counts Toronto Indigenous adult recruitment diagram. The seeds are represented as squares and the participants recruited are represented as circles.

2.6 Appendix B: Tables

Table A: Survey questions from the OHCT adult survey.

Q1.12 - What is your date of birth? (e.g. 12-Aug-1985):	
Q2.6 - What is your gender?	o Female o Male o Trans (e.g. Transgender, Transgender, Gender Queer) o Other/You do not have a category that applies to me.
Q4.4 - On average, how many days per week do you do 30 minutes or more of moderate or hard physical activity? This activity can be part of work, transportation, or recreation, and does not need to occur all at once. Moderate activity includes brisk walking, and hard activity that makes you work up a sweat. Based on this definition, how many days per week do you do at least 30 minutes of moderate or hard activity?	o 0 Days o 1 Day/Week o 2 Days/Week o 3 Days/Week o 4 Days/Week o 5 Days/ Week o 6 Days/Week o 7 Days/Week
SECTION 5: CHRONIC HEALTH CONDITIONS	
I would now like to ask you about certain chronic health conditions that you may have. We are interested in "long-term conditions" which are expected to last or have lasted 6 months or more and that have been diagnosed by a health care provider.	
Have you ever been told by a health care provider that you have any of the following chronic health conditions?	
Condition	Told that you have or been diagnosed with:
Q5.1a - Asthma	o Y o N
Q5.1b - Arthritis	o Y o N
Q5.1b1 - In the past 12 months, did you ever have pain in your joints (i.e. hips, knees, hands) that limited the amount or type of activity that you were able to do?	o Y o N

Q5.1c - Heart disease	o Y o N
Q5.1d - Stroke	o Y o N
Q5.1e - Liver disease	o Y o N
Q5.1f - High Blood Pressure	o Y o N
Q5.1g - Hepatitis B	o Y o N
Q5.1h - Hepatitis C	o Y o N
Q5.1i - Allergies	o Y o N
Q5.1j - Chronic bronchitis. Emphysema, or COPD (Chronic Obstructive Pulmonary Disease)	o Y o N
Q5.1k- Attention Deficit Disorder/ Attention Deficit Hyperactivity Disorder (ADD/ADHD)	o Y o N
Q5.1l - Learning Disability	o Y o N
Q5.1m - Cancer	o Y o N
Q5.1n – Other: Please specify	o Y o N
Q12.3 - When did you last see a doctor or nurse practitioner	o Less than 1 year ago o 1 year to less than 2 years ago o 2 years to less than 3 years ago o 3 years to less than 4 years ago o 4 years to less than 5 years ago o 5 years or more ago o Never
Q19.1 - At the present time, do you smoke cigarettes?	o Y o N
Q21.3 - Do you use traditional Indigenous medicines or practices to maintain wellbeing?	o Y o N

Q23.2 - Can you estimate in which of the following groups your household income falls – what was the total household income from all sources…	o Less than $20,000 o $20,000 to less than $30,000 o $30,000 to less than $40,000 o $40,000 to less than $50,000 * Start asking ranges from here o $50,000 to less than $60,000 o $60,000 to less than $70,000 o $70,000 to less than $80,000 o $80,000 to less than $90,000 o $90,000 to less than $100,000 o More than $100,000