Indoor Tanning and Youth –
Compliance, Inspection, and Enforcement of Legislation

by
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ABSTRACT

INDOOR TANNING AND YOUTH – COMPLIANCE, INSPECTION, AND ENFORCEMENT OF LEGISLATION

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Indoor tanning is a common health risk behaviour that exposes users to artificial ultraviolet radiation, which can lead to skin cancer. Evidence of the dangers of indoor tanning and its popularity, including among youth, has led jurisdictions around the world to implement indoor tanning legislations. The objective of this research was to determine compliance, implementation, impact, and enforcement of indoor tanning legislations, as well as access to indoor tanning facilities, and to provide suggestions for legislative amendments and improvements, with a focus on youth access and use. The findings of two systematic reviews indicate that while compliance with most aspects of indoor tanning legislation varies widely, including the all-important age restrictions (range=0–100%; mean=65%; SD=25), the prevalence of youth indoor tanning is significantly lower in jurisdictions with indoor tanning legislation compared to those without (n=4, mean=5% lower, range=1%–18% lower). Variability in compliance suggests indoor tanning legislations may not be as impactful as their fully intended protective purpose. In Ontario, survey research demonstrates that most indoor tanning legislation infractions were uncovered during non-mandatory routine inspections (n=234, 97%) rather than mandatory complaints-driven inspections (n=8, 3%) and have
largely been related to a lack of required warning signs (n=201, 83%), with only one infraction related to youth access (n=1, 0.4%). Furthermore, geospatial analysis reveals 95% (n=655) of indoor tanning facilities in Ontario are located within 3 km of a high school, and 44% (n=300) are located within 3 km of a college or university. In Toronto specifically, the locations of indoor tanning facilities and schools cluster (p=0.004). Together, this suggests youth and young adults have relatively easy access to indoor tanning given the low compliance with indoor tanning legislation restricting youth access, small impact of indoor tanning legislation on youth indoor tanning use, lack of infractions related to youth access in Ontario, and close geographic distances between indoor tanning facilities and schools. Findings highlight the public health importance of indoor tanning legislation and the need for enhanced resource allocation to support inspection and enforcement, policy amendments, and new policy initiatives, including zoning by-laws, especially addressing youth access to indoor tanning facilities.
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STATEMENT OF WORK

Jessica Reimann conducted all data collection, data analysis, data management, and interpretation of results of all chapters included in this thesis, with input from her co-authors. Jessica is the principal author of all chapters.

Dr. Jennifer McWhirter is a co-author who contributed to the research described in Chapters 2, 3, 4, and 5 of this thesis. Dr. McWhirter was involved in study concept and design, as well as co-authoring these chapters, and provided guidance on data collection, analysis, and interpretation of results. Additionally, Dr. McWhirter provided critical feedback and edited Chapters 1 through 6 of this thesis.

Dr. Cate Dewey is a co-author who contributed to the research described in Chapters 2, 3, 4, and 5 of this thesis. Dr. Dewey was involved in study concept and design, as well as co-authoring these chapters, and provided guidance on data collection, analysis, and interpretation of results. Additionally, Dr. Dewey provided critical feedback and edited Chapters 1 through 6 of this thesis.

Dr. Andrew Papadopoulos is a co-author who contributed to study concept and design of Chapter 2, 3, 4 and 5 of this thesis. Dr. Papadopoulos also provided guidance related to health policy concepts and terms throughout all chapters. Dr. Papadopoulos provided critical feedback and edited Chapters 1 through 6 of this thesis.

Dr. Olaf Berke is a co-author who contributed to data analysis of Chapter 5 and aided in editing Chapter 5 of this thesis.
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Together with Dr. Jennifer McWhirter, members of the Ontario Sun Safety Working Group named below developed an initial draft of the survey questions for Chapter 4.

Dr. Kim Bergeron, Susan Flynn, Dr. Loraine Marrett, Dr. Thomas Tenkate, and Dr. Cheryl F. Rosen are co-authors who contributed to the research described in Chapter 4 of this thesis. They were all involved in study concept and design, as well as creating the questions that were included in the survey. Additionally, Dr. Kim Bergeron, Susan Flynn, Dr. Loraine Marrett, Dr. Thomas Tenkate, and Dr. Cheryl F. Rosen aided in editing Chapter 4 of this thesis.
# TABLE OF CONTENTS

Abstract ................................................................................................................................. ii
Acknowledgements ............................................................................................................ iv
Statement of Work ............................................................................................................. vii
Table of Contents .............................................................................................................. ix
List of Tables ..................................................................................................................... xiv
List of Figures ................................................................................................................... xv
List of Abbreviations ........................................................................................................ xvi
List of Appendices ............................................................................................................ xvii

1  CHAPTER 1 | Literature Review and Research Objectives ........................................ 1
   1.1 Introduction ............................................................................................................... 1
   1.2 Skin Cancer ............................................................................................................ 2
      1.2.1 Types of Skin Cancer ....................................................................................... 2
      1.2.2 Incidence and Prevalence .............................................................................. 4
      1.2.3 Risk Factors ..................................................................................................... 7
      1.2.4 Prevention .......................................................................................................... 9
   1.3 Indoor Tanning ......................................................................................................... 10
      1.3.1 Participation in Indoor Tanning ..................................................................... 11
      1.3.2 Indoor Tanning Motivators .......................................................................... 11
      1.3.3 Health Risks of Indoor Tanning .................................................................... 12
      1.3.4 Indoor Tanning in the Media ....................................................................... 13
      1.3.5 Indoor Tanning Industry Marketing Tools ................................................... 14
      1.3.6 Availability and Access to Indoor Tanning .................................................... 16
1.3.7 Prevention of Indoor Tanning ................................................................. 16
1.4 Legislation ........................................................................................................ 19
  1.4.1 Legislation Restricting Health Risk Behaviours ........................................ 19
  1.4.2 Indoor Tanning Legislation .......................................................................... 21
  1.4.3 Key Indoor Tanning Legislative Components ............................................ 23
  1.4.4 Enforcement of Indoor Tanning Legislation .............................................. 27
1.5 Conclusions, Research Gaps, and Objectives ............................................... 28
  1.5.1 Conclusions .................................................................................................. 28
  1.5.2 Research Gaps and Objectives ................................................................... 29
  1.5.3 Thesis Organization .................................................................................... 31
1.6 References ......................................................................................................... 32
2 CHAPTER 2 | A systematic review of compliance with indoor tanning legislation.. 54
  2.1 Abstract ........................................................................................................... 54
  2.2 Background ..................................................................................................... 56
  2.3 Methods ........................................................................................................... 58
    2.3.1 Search Strategy .......................................................................................... 58
    2.3.2 Selection Criteria ....................................................................................... 59
    2.3.3 Data Extraction .......................................................................................... 60
  2.4 Results ............................................................................................................. 60
    2.4.1 Study Characteristics .................................................................................. 60
    2.4.2 Study Outcomes ......................................................................................... 61
  2.5 Discussion ....................................................................................................... 70
    2.5.1 Youth Access ............................................................................................. 71
    2.5.2 Risk Communication ................................................................................ 74
LIST OF TABLES

Table 2.1 - Compliance with Indoor Tanning Legislation Outcomes of Interest ............... 92
Table 2.2 - Relevant Legislations Examined in the Included Studies ............................ 98
Table 2.3 - Ranges and Means of Compliance for Key Outcomes of Interest ............... 102
Table 3.1 - Overview of Studies .................................................................................. 129
Table 3.2 - Summary and Impact of Legislation on Prevalence of Youth Indoor Tanning by Comparison Type ......................................................................................... 132
Table 4.1 - Skin Cancer Prevention Act (SCPA) Sections and Descriptions .............. 161
Table 4.2 - Complaints Related to the SCPA by Year Reported by Seven Ontario PHUs ......................................................................................................................... 162
Table 4.3 - Compliance: SCPA Infractions Reported by Ten Ontario PHUs (2014-2017) .......................................................................................................................... 163
Table 4.4 - Enforcement: Responses to SCPA Infractions by Ten Ontario PHUs (2014-2017) ......................................................................................................................... 164
Table 5.1 - Community Type based on Population Size and Population Density ...... 199
Table 5.2 - Indoor Tanning Facility Type and School Type by Population Type ......... 200
Table 5.3 - Number and percent of tanning facilities within 1.5, 2.0, or 3.0 km to the nearest school, by tanning facility type ................................................................. 201
Table 5.4 - Number and percent of schools within 1.5, 2.0, or 3.0 km to the nearest tanning salon and gym with tanning, by school type ................................................. 202
Table 5.5 - Mean distance between Tanning Facilities and Schools .......................... 203
LIST OF FIGURES

Figure 2.1 - Flow Chart for search and selection of studies of compliance with indoor tanning policy .......................................................... 91

Figure 3.1 - Flow Chart for the Search and Selection of Studies ...................... 128

Figure 5.1 - High Schools and Colleges/Universities Across Ontario .................. 190

Figure 5.2 - High Schools and Colleges/Universities in Central, Eastern, and Southern Ontario ........................................................................................................... 191

Figure 5.3 - Indoor Tanning Facilities Across Ontario ........................................ 192

Figure 5.4 - Indoor Tanning Facilities in Central, Eastern, and Southern Ontario .... 193

Figure 5.5 - Schools and Indoor Tanning Facilities Across Ontario ..................... 194

Figure 5.6 - Schools and Indoor Tanning Facilities in Central, Eastern, and Southern Ontario ........................................................................................................... 195

Figure 5.7 - Population Density Across Ontario .................................................. 196

Figure 5.8 - Population Density in Central and Southern Ontario ....................... 197

Figure 5.9 - Point map of school and salon location within the Toronto Public Health Unit area. (axis scales in km) ............................................................. 198
LIST OF ABBREVIATIONS

AL- Alabama; AR- Arkansas; AZ- Arizona; BCC- basal cell carcinoma; CA- California;
CO- Colorado; CRAYS- Cancer Risk Assessment in Youth; CSR- complete spatial
randomness; CT- Connecticut; DC- District of Columbia; DE- Delaware; FDA- Food and
Drug Administration; FL- Florida; FTC- Federal Trade Commission; GA- Georgia;
HPPA- Ontario Health Protection and Promotion Act; HI- Hawaii; IARC- International
Agency for Research on Cancer; ID- Idaho; IL- Illinois; IN- Indiana; IT- Indoor Tanning;
KY- Kentucky; LA- Louisiana; MA- Massachusetts; MD- Maryland; ME- Maine; MI-
Michigan; MN- Minnesota; MS- Mississippi; NA- not applicable; NB- Nebraska; NC-
North Carolina; ND- North Dakota; NH- New Hampshire; NJ- New Jersey; NMSC- non-
melanoma skin cancer; NR- not reported; NV- Nevada; NY- New York; MOH- Medical
Officer of Health; OH- Ohio; OR- Oregon; OSSWG- Ontario Sun Safety Working Group;
PA- Pennsylvania; PHU- Public Health Unit; RI- Rhode Island; SC- South Carolina;
SCC- squamous cell carcinoma; SCPA- Skin Cancer Prevention Act (Tanning Beds);
SD- standard deviation; TN- Tennessee; TX- Texas; UV- ultraviolet; US- United States;
UT- Utah; VA- Virginia; VT- Vermont; WA- Washington; WHO- World Health
Organization; WI- Wisconsin; WV- West Virginia; WY- Wyoming
LIST OF APPENDICES

Appendix 1: PRISMA Checklists (Chapters 2 and 3) ............................................................... 223
Appendix 2: Information for Critical Appraisals (Chapters 2 and 3) ................................. 229
Appendix 3: Survey Questions ............................................................................................... 234
1 CHAPTER 1 | Literature Review and Research Objectives

1.1 Introduction

Indoor tanning is the deliberate exposure of skin to artificial ultraviolet (UV) radiation from radiation emitting devices for the purpose of getting a tan (International Agency for Research on Cancer 2005). Despite well documented health risks, indoor tanning is common in North American and European countries, especially among female young adults and adolescents (The World Health Organization 2017a). Artificial UV exposure has many negative health impacts, including to the skin (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2017). Exposure to artificial UV radiation causes DNA damage and mutation of skin cells, which can ultimately result in skin cancer (El Ghissassi et al. 2009). Indoor tanning significantly increases the lifetime risk of melanoma, and there is evidence of a dose–response relationship between indoor tanning and cutaneous melanoma (Boniol et al. 2012; El Ghissassi et al. 2009; The International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer 2006; Veierød et al. 2010), with the highest risk associated with indoor tanning at a young age (Boniol et al. 2012; Whiteman et al. 2001). In 2003, the World Health Organization recommended governments around the world implement legislation, with a focus on banning indoor tanning by youth under 18 years of age (The World Health Organization 2003). Since 2009, UV radiation from indoor tanning beds has been classified as a known cancer-causing agent in humans (El Ghissassi et al. 2009). Indoor tanning is a health risk behaviour requiring legislative efforts to curb its use and prevent disease.
The purpose of this literature review is to provide a background and an overview of the key scientific literature related to indoor tanning. Specific areas covered include skin cancer types and risk factors; skin cancer epidemiology; methods of skin cancer prevention; motivators for indoor tanning; health risks associated with indoor tanning; and indoor tanning prevention, including legislation regulating the indoor tanning industry, as well as other risky health behaviours; key legislative components; and, enforcement of indoor tanning legislations. This chapter provides an introduction and overview to the research addressed in this doctoral thesis.

1.2 Skin Cancer

1.2.1 Types of Skin Cancer

Melanoma is the most dangerous type of skin cancer because of its tendency to spread to other parts of the body, especially when not diagnosed early (Canadian Dermatology Association 2018). Melanoma can be found anywhere on the body (Canadian Dermatology Association 2018), but is often found on the extremities in females, and on the trunk, head, or neck for males (Chen et al. 1996). Melanoma begins in the melanocytes, within the skin tissue (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). Melanocytes are those cells producing pigment in the skin, causing skin to tan when exposed to ultraviolet (UV) radiation. Thus, they are the most affected by overexposure to UV radiation, including sun burns. Melanoma can grow into nearby tissue, as well as spread to other organs of the body (Canadian Cancer Society 2018). There are three common types of melanomas that are related to being exposed to the sun and tend to be found on areas of the skin regularly exposed to
UV radiation: superficial spreading, nodular, and lentigo maligna (WHO (IARC) 1992). Superficial spreading melanoma is the most common type, accounting for approximately 70% of all melanomas (Canadian Cancer Society 2018). This type tends to spread across the surface of the skin but can grow deeper into the skin as well, often originating from moles already on the skin. Nodular melanoma is the second most common type of melanoma, accounting for 15 to 20% of all melanomas (Canadian Cancer Society 2018). This type grows deep into the skin, appearing rapidly as a bump on the skin (American Society of Clinical Oncology 2017). Lentigo maligna melanoma accounts for 10 to 15% of all melanomas (Canadian Cancer Society 2018). This type often occurs later in life, on unprotected skin commonly exposed to UV radiation (McGovern et al. 1980). Lentigo tumours often extend down hair follicles and present as long-term sun damaged skin (Markovic et al. 2007).

A fourth type of melanoma is not related to UV exposure (Canadian Cancer Society 2018). Acral lentiginous melanoma accounts for approximately 5% of all melanomas and is commonly found in people with dark skin (Bradford et al. 2019; Markovic et al. 2007). This type is often found on the soles of feet, palms of the hand, and nail beds (Canadian Cancer Society 2018; Markovic et al. 2007). This type is associated with lower survival rates than all other malignant melanomas, likely due to delayed diagnosis (Bradford et al. 2019).

Non-melanoma skin cancers (NMSC), or keratinocyte carcinomas, are the more common and less deadly types of skin cancer, when compared to melanoma (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). The two most
common subtypes of NMSC are squamous cell carcinoma (SCC) and basal cell carcinoma (BCC) (Lomas et al. 2012). SCC affects the thin layer of cells (squamous cells) in the outer most layers of skin. SCC tends to be the more aggressive cancer of these two types, as it is more likely to spread to other parts of the body, including fatty tissues and lymph nodes (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). The most common sites of SCC are the head and neck (Green and McBride 2014). BCC affects the layer of round skin cells found under the squamous cells (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). BCC is a slower growing NMSC, and rarely spreads to other tissues. However, if left untreated for an extended time, BCC can spread to nearby tissues and bone (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). BCC tumours occur on areas of the skin frequently exposed to UV radiation, most commonly on the head and neck (Rubin et al. 2005). These tumours often affect vital facial structures, such as the eyes, nose, mouth, and ears (Shingler et al. 2013).

1.2.2 Incidence and Prevalence

Although skin cancer is one of the most preventable cancers, it is the most common cancer in Canada, and its incidence is rising (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). Together, cases of melanoma and NMSCs equate to the same number of cancer cases as the four major cancers (lung, breast, colon, and prostate) combined (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014).
Incidence rates of melanoma have been steadily increasing in both males and females over the past 25 years (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2017). Melanoma ranks as the sixth most frequently diagnosed cancer overall in Western countries (Erdmann et al. 2013). In 2012, there were over 230,000 incident cases of melanoma skin cancer estimated worldwide (Ervik et al. 2016). In 2017, there were over 7,300 incident cases of melanoma skin cancer estimated in Canada (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2017). More than 4,000 of these cases occurred in males, which is 3.9% of all incident cancer cases in males, while 3,300 of these cases occurred in females, approximately 3.2% of all incident cancer cases in females (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2017). Overall, this suggests that melanoma is a more common type of cancer in males than in females in Canada. One in 59 Canadian males will develop melanoma in their lifetime, while one in 73 Canadian females will develop melanoma in their lifetime (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014).

Incidence trends for melanoma in Ontario are similar to those in Canada. The most recent statistics from Ontario in 2012, estimate that there were approximately 3,100 incident cases of melanoma skin cancer (Cancer Care Ontario 2016). More than 1,700 of the incident cases in Ontario occurred in males, approximately 3.9% of all incident cancer cases in males, while 1,300 occurred in females, approximately 3.5% of all incident cancer cases in females (Cancer Care Ontario 2016).
When melanoma is detected early, it is often associated with a positive prognosis (Canadian Dermatology Association 2018). However, if left untreated it can become deadly. Worldwide, melanoma is responsible for approximately 80% of all skin cancer deaths, and approximately 2% of all cancer-related deaths (Arnold et al. 2014). Mortality rates from melanoma have increased significantly in Canada over the last 25 years (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014).

Approximately one in 290 males and one in 395 females die from melanoma in their lifetime (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). In Ontario, an increasing melanoma mortality rate has been seen in both males and females over the past ten years (Cancer Care Ontario 2016). In Ontario in 2012, 460 deaths were attributable to melanoma, which is approximately 1.7% of all cancer related deaths (Cancer Care Ontario 2016). These increases in melanoma mortality are likely associated with the increases in melanoma incidence.

Melanoma survival rates are around 90% in Canada, and 85% in Ontario. Survival is dependent on early stage detection, and certain anatomical sites (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014; Cancer Care Ontario 2016). Melanoma of the extremities (arms and legs) have better prognoses than other parts of the body, with the worst prognosis for melanoma of the scalp or neck (Pollack et al. 2011). Females also show higher survival rates than males (Cancer Care Ontario 2016). As of 2009, approximately 39,500 Canadians had been diagnosed with melanoma in the previous ten years and were still alive (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2017). Similarly, in Ontario in 2013, 18,700
Ontarians had been diagnosed with melanoma in the previous ten years and were still alive (Cancer Care Ontario 2016). In Canada, melanoma accounts for 5% of all 10-year prevalent cancer cases due to the high survival rate associated with melanoma (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2017).

The World Health Organization estimates that 2 to 3 million cases of NMSC occur worldwide each year (The World Health Organization 2017b). Studies from around the world suggest that the incidence of NMSCs are increasing (Lomas et al. 2012). In 2014, an estimated 76,100 incident cases of NMSC occurred in Canada (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). NMSC accounts for 40% of all incident cancer cases in Canada, 77% of which are BCC and 23% are SCC (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). Although NMSC make up approximately 30% of malignant cancers diagnosed among Ontarians each year, there is no consistent reporting method for these cancers, no national cancer registry for NMSC, and as such, no data on the incidence or prevalence of NMSC in Ontario (Cancer Care Ontario 2016).

1.2.3 Risk Factors

The main risk factor for all types of skin cancer is exposure to UV radiation, either naturally occurring from the sun, or artificially from indoor tanning devices (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014; WHO (IARC) 1992). Importantly, exposure to UV radiation is modifiable, and mostly preventable through the use of sun protection, avoiding sun exposure when possible, and avoiding all indoor tanning devices (Merten et al. 2017). Women are more likely to sunbathe and use
indoor tanning devices than men, increasing their risk of skin cancer (Falk and Anderson 2013; Farley et al. 2015; Woo and Eide 2010). However, men who are physically active outdoors and/or work outdoors are also at an increased risk of skin cancer (Merten et al. 2017).

Youth and young adults are especially vulnerable to UV radiation. UV radiation and sun exposure behaviour early in life is likely the most important risk factor for skin cancer (Nelemans et al. 1993). UV exposure during adolescence and young adulthood is especially concerning because it contributes to skin cancer risk later in life (Merten et al. 2017). There is evidence of a dose–response relationship between indoor tanning and cutaneous melanoma (Boniol et al. 2012; El Ghissassi et al. 2009; The International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer 2006; Veierød et al. 2010), with the highest risk associated with indoor tanning at a young age (Boniol et al. 2012; Whiteman et al. 2001). Similarly, having a history of sunburns during childhood is a main risk factor for melanoma (Ali et al. 2013; Kaskel et al. 2001; Nelemans et al. 1993). Specifically, more than five severe sunburns over a lifetime is associated with a two-fold increased risk of melanoma (Nelemans et al. 1993). Therefore, both indoor tanning and sunburn avoidance, especially in childhood, should be an important goal for melanoma prevention (Kaskel et al. 2001).

In addition to the skin cancer risk from UV radiation, there are other non-modifiable risk factors. These other risk factors include fair skin pigmentation, light hair and eye colour, family or personal history of skin cancer, a weakened immune system, and the presence of large, and numerous skin lesions on limbs (Canadian Cancer
1.2.4 Prevention

The main mechanism for skin cancer prevention is through minimizing harmful UV exposure for all individuals (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2014). This includes limiting time in the sun, seeking shade, wearing protective sunscreen and clothing, and avoiding the use of artificial UV radiation emitting devices. All children, as well as fair-skinned adults, are at a heightened risk of UV related morbidities including sunburns and should be especially careful of their exposure to UV radiation (Kaskel et al. 2001). For the public to practice sun-safe options, knowledge of the dangers associated with UV exposure and ways to mitigate these risks must be shared widely.

Public health campaigns have been used to address the risks associated with UV radiation and the link to skin cancer. Public education around the risks of UV radiation exposure have resulted in some increased sun-safety behaviours and decreases in outdoor sunbathing (Altsitsiadis et al. 2012). However, artificial UV exposure has not decreased in the same way. Individuals are often aware of the health risks associated with indoor tanning, and still engage in it (Altsitsiadios et al. 2012; Schneider et al. 2009). Health education campaigns should continue to share the risks associated with UV, and should focus on removing the positive association between tanned skin and healthy skin, while emphasizing the long-term appearance-related negative health outcomes associated with all UV radiation (Altsitsiadios et al. 2012; Holman et al. 2013).
Skin cancer screenings are used as a secondary prevention method in some countries. For example, free skin cancer screenings by volunteer dermatologists across the US have been provided since 1985 (Stoff and Grant-Kels 2017). These screenings have led to the identification of 27,500 cases of melanoma (Stoff and Grant-Kels 2017). In Germany, a nationwide cancer-screening program was implemented in 2008 (Choudhury et al. 2012). These programs have been implemented to increase early detection and decrease the burden of skin cancer on health care systems (Choudhury et al. 2012; Stoff and Grant-Kels 2017).

1.3 Indoor Tanning

Having tanned skin is desirable to some individuals. This has led to a ‘suntanning industry’, especially in Europe, Australia, and North America, where individuals purposefully expose themselves to artificial UV radiation from indoor tanning beds and lamps for getting a tan (International Agency for Research on Cancer 2005; WHO (IARC) 1992). This occurs either in concurrence with or as a replacement for solar UV radiation (WHO (IARC) 1992). Commercial tanning was first introduced in the 1970s, and since then its popularity has increased substantially (Pawlak et al. 2012). The indoor tanning industry has proliferated into a $3 billion per year industry in the US (IBIS 2018). Unlike the sun, indoor tanning is available during all seasons and times of day, and the UV radiation is always at the highest intensity (Benet and Kraft 2016). Solar UV radiation reaches its peak midday (Marrett et al. 2016), while artificial UV radiation can be turned on to the maximum intensity whenever an individual wishes to get a tan (Benet and Kraft 2016).
1.3.1 Participation in Indoor Tanning

Indoor tanning is widely practiced in developed countries (The International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer 2006). Despite the health risks, the popularity of indoor tanning remains high, especially among youth and young adults. Previous research has shown that the typical sunbed user is female, between the ages of 17 and 30 years old (Amir et al. 2000; Schneider and Krämer 2010). In 2014, an international systematic review of 16 countries found approximately 18% of adolescents had been exposed to indoor tanning in the past year (Wehner et al. 2014). Additionally, in 2013, an estimated 11.3 million Americans used indoor tanning devices, with 1.6 million of them under the age of 18 (Guy et al. 2016). Results from the 2017 American Youth Risk Behaviour Survey indicate that 5.6% of high school students used an indoor tanning device at least once over the previous year (Kann et al. 2018). In Canada, an estimated 1.35 million Canadians participated in indoor tanning in 2014 (Qutob et al. 2017). Nearly 23,000 of these Canadians were under the age of 18 (Qutob et al. 2017). Across 7 provinces in Canada, the 2015 Cancer Risk Assessment in Youth (CRAYS) survey indicated that 4.4% of grade 10 and 11 high school students had ever used an ultraviolet (UV) tanning device (Nadalín et al. 2018). In Ontario, in 2015, nearly 8% of adolescents reported using indoor tanning devices in the past year (Nadalín et al. 2018).

1.3.2 Indoor Tanning Motivators

One of the primary, unchanging motivations for indoor tanning is a desire for a tanned appearance (Amir et al. 2000; Börner et al. 2009; Demko et al. 2003; Hoerster et
Additional reasons given for indoor tanning include the belief it is healthy, or to prepare the skin before UV exposure (base-tan) (Cokkinides et al. 2009; Qutob et al. 2017; Schneider and Krämer 2010). Many individuals also tan to relax, reporting mood enhancement, which can lead to dependence (Heckman et al. 2016; Nolan et al. 2009). Thus, indoor tanning can be addictive. Research has suggested that addictive tanning behaviour is associated with psychological dependence, and factors associated with other addictive behaviours (i.e. age at initiation of smoking) are similar to those associated with difficulty quitting tanning (Mosher and Danoff-Burg 2010).

A positive attitude towards having a tanned appearance is associated with indoor tanning behaviour (Cokkinides et al. 2002; Lazovich and Forster 2005; Stryker et al. 2004). This is true for both adults and adolescents. There is also a social motivation for indoor tanning. Peer participation in indoor tanning, as well as parental participation and acceptance of indoor tanning are associated with adolescent indoor tanning (Cokkinides et al. 2002; Magee et al. 2007; Stryker et al. 2004).

1.3.3 Health Risks of Indoor Tanning

The indoor tanning trend is a concerning public health issue as approximately 450,000 cases of non-melanoma skin cancers per year and 10,000 cases of melanoma skin cancers per year in Europe, Australia, and the US combined are attributable to indoor tanning (Wehner et al. 2014). In Canada, it is estimated that 7% of melanomas, 5% of basal cell carcinomas, and 8% of squamous cell carcinomas each year are attributable to indoor tanning (Sullivan et al. 2019). Exposure to indoor tanning is
associated with a 29% and 67% increased risk of basal cell carcinoma and squamous cell carcinoma, respectively (Wehner et al. 2012). Importantly, the risk of lifetime melanoma skin cancer increases by 59% with use of indoor tanning devices before the age of 35 (Boniol et al. 2012). This risk is greatest for those 20–29 years of age (Veierød et al. 2003). Excessive artificial UV radiation can also lead to premature ageing of the skin (wringling, age spots, loss of collagen), eye disease (cataracts, ocular melanoma), and immune suppression (Centers for Disease Control and Prevention 2016; The International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer 2006). Given these dangers, the World Health Organization’s International Agency for Research on Cancer (IARC) classifies UV radiation from indoor tanning beds as a Group 1 carcinogen, in the same category as smoking tobacco and exposure to asbestos (El Ghissassi et al. 2009; International Agency for Research on Cancer 2005).

1.3.4 Indoor Tanning in the Media

Having tanned skin is a common North American beauty ideal, perpetuated through mass media (Martin et al. 2009). The media promotes a tanned appearance as attractive, propagated through many images of tanned celebrities, which in turn encourages individuals to tan (Greenman and Jones 2010). Tanning has also been promoted as fashionable and embraced within popular culture (Greenman and Jones 2010). Additionally, failing to provide health risk information associated with tanning often occurs in the media. For example, popular Canadian women’s magazines often
fail to provide health risk information associated with tanning (McWhirter and Hoffman-Goetz 2015a).

Although popular media often encourages the tanned ideal, there have been instances where the media has disseminated the negative health risks associated with indoor tanning, and its link to skin cancer. The classification of UV radiation from an indoor tanning device as a Group 1 carcinogen led to an increase in media coverage on tanning and skin cancer (McWhirter and Hoffman-Goetz 2015b, 2015c). In Australia, mass media campaigns discouraging indoor tanning use, coupled with legislation, led to a decrease in the number of indoor tanning facilities (Makin and Dobbinson 2009). Media also played a role in the indoor tanning ban in Australia (Sinclair et al. 2014). Since media has played a large role in communicating the risks of indoor tanning and its link to skin cancer (Robinson et al. 2008), public health should continue to use the media to share health risk information widely. Dissemination of health risk information through the media presents an opportunity to increase knowledge about health risks associated with indoor tanning use, and potentially influence indoor tanning behaviour by changing social norms.

1.3.5 Indoor Tanning Industry Marketing Tools

The indoor tanning industry uses marketing and advertising strategies to encourage indoor tanning use (Greenman and Jones 2010). Their marketing strategies often dismiss health concerns, make false claims about health benefits, and promote the social acceptability of indoor tanning (Green et al. 2018). The indoor tanning industry strategically targets their messaging to populations most likely to participate in
indoor tanning, often female youth and young adults (Seidenberg et al. 2015). In 2006 in Australia, 50% of indoor tanning facility websites made false health claims related to indoor tanning, while 36% of indoor tanning facility websites stated that indoor tanning was safe, responsible, or controlled (Team and Markovic 2006). Visual images were also used by these indoor tanning facilities, with images of tanned bodies, and mostly images of women (Team and Markovic 2006). In 2015, Australia passed legislation banning commercial tanning salons (Sinclair et al. 2014).

The indoor tanning industry promotes a tanned appearance as attractive (Greenman and Jones 2010). Tanning advertisements focus on feelings of relaxation, and appeal to beauty ideals (Greenman and Jones 2010; Levine et al. 2005). They often play on female body insecurities, claiming that a tan will make you look and feel better. Additionally, the indoor tanning industry strives to convince people that indoor tanning is a healthy behaviour (Greenman and Jones 2010; Levine et al. 2005). For example, the indoor tanning industry often states that a tan protects the skin from burning, and sunburns cause cancer, so indoor tanning is therefore protective against skin cancer (Levine et al. 2005). Although there is a social norm associated with having tanned skin, and in-turn indoor tanning is widely accepted as a reasonable behaviour (Amir et al. 2000; Holman et al. 2013), tanned skin indicates there is damage to the skin (Gilchrest 2011; Gilchrest and Eller 1999). This creates a challenge for public health attempting to deter indoor tanning bed use.
1.3.6 Availability and Access to Indoor Tanning

Indoor tanning can occur in a variety of settings, but two of the most common are tanning salons and gyms with indoor tanning devices (Nadalin et al. 2016, 2018). Eighty-seven percent of high school aged youth in Canada indoor tan at tanning salons (Nadalin et al. 2018). However, many tanners, including 27% of youth, report accessing indoor tanning at gyms (Nadalin et al. 2018). In a previous study across Canada, 43% of gyms surveyed offered indoor tanning, and 4% of those not already offering indoor tanning indicated they were planning to offer indoor tanning in the future (Huang and Kirchhof 2017). A study in the US found that 24% of indoor tanners had indoor tanned at a gym (Pagoto et al. 2018). Those tanners in the gym were younger than other tanners. The presence of indoor tanning in gyms is concerning and may encourage the misconception that indoor tanning is a healthy behaviour.

Not only is the availability of indoor tanning of concern, but also the access to indoor tanning, especially for youth. A study conducted in the US found that adolescents living closer to indoor tanning facilities were significantly more likely to have participated in indoor tanning than those living farther away (Mayer et al. 2011). Previous US research has demonstrated that indoor tanning salons are often found near schools, especially high schools (Nahar et al. 2018; Olson et al. 2013; Patel et al. 2007).

1.3.7 Prevention of Indoor Tanning

Knowledge of the risks of indoor tanning allows customers to make informed decisions; however, the public lacks knowledge and understanding of indoor tanning risks (Holman et al. 2013; Magee et al. 2007). Public health continuously strives to
educate the public about the negative health risks associated with indoor tanning. However, research has shown that education alone is ineffective at reducing indoor tanning behaviour. Providing information and increasing awareness of the health risks associated with indoor tanning do not change indoor tanning behaviour of teenagers, young adults, or working adults (Knight et al. 2002; Robinson et al. 2008; Saraiya et al. 2004). It is important to continue to educate the public about health risks; however, public health may need to use alternative interventions to deter indoor tanning behaviour.

Appearance focused interventions are likely the most effective way to change attitudes, intentions, and behaviours of indoor tanning (Hillhouse and Turrisi 2002; Mahler et al. 1997). Although other interventions have been used to deter indoor tanning behaviour, such as warning of the negative health risks including skin cancer, communicating appearance-based risks have been shown to be effective (Holman et al. 2013; McWhirter and Hoffman-Goetz 2012). Messages focused on the appearance-related effects of indoor tanning may also lead to long-term health behaviour change (Hillhouse et al. 2008; Hillhouse and Turrisi 2002; Mahler et al. 2007).

One way to decrease indoor tanning behaviour may be through providing alternatives to indoor tanning. Since the goal is to darken the skin, providing alternative sunless tanning products, such as tanning lotions or spray-tans, will still provide an individual with the desired tanned look, but without the harmful UV radiation (Sivamani et al. 2009). In the US, approximately 10-15% of adults and adolescents report using sunless tanning products (Cokkinides et al. 2010; Stryker et al. 2007). In Canada, 15%
of adolescents report using sunless tanning products (Nadalin et al. 2018). Research has found that 50% of young adult women (aged 18-34) who are sunless tanning product users decreased or stopped using indoor tanning devices altogether while using sunless tanning products (Mahoney et al. 2012). Additionally, individuals who solely use sunless tanning products practice better sun protection habits than both tanners (indoor and outdoor) and non-tanners (Stryker et al. 2007). Both young adults and adolescents who use sunless tanning products believe these products provide a safer way to get a tan (Brooks et al. 2006; Cokkinides et al. 2010).

Public education coupled with regulation to reduce indoor tanning behaviour have resulted in some controversy, as the indoor tanning industry has pushed back against negative messaging about indoor tanning (Schneider and Krämer 2010). It is necessary to continue to educate the public about the health risks associated with indoor tanning, especially youth and their parents (Cokkinides et al. 2002; Magee et al. 2007; Stanganelli et al. 2016). Previous research suggests parental indoor tanning behaviour is a strong predictor of youth indoor tanning behaviour, and of having positive attitudes towards indoor tanning (Holman et al. 2013; Mayer et al. 2011). Improving public awareness of indoor tanning health risks, as well as altering the positive social norms associated with tanned skin, could discourage tanning bed use. Campaigns to deter tobacco use have been associated with decreased tobacco use and support for tobacco control (Blake et al. 2010; Durkin et al. 2012). While education and behaviour interventions are important, policy also plays a role in deterring indoor tanning behaviour.
1.4 Legislation

Legislation is the most widely used and most powerful policy instrument available to governments (Jordan and Zito 2005). Legislation can influence social norms, beliefs, and health risk behaviours (Holman et al. 2013; Seidenberg et al. 2015). It has the power to both educate and protect the public. However, an effective enforcement program is required to ensure any regulation meets its intended impact (Mcdonnell and Elmore 1987).

1.4.1 Legislation Restricting Health Risk Behaviours

Legislation has commonly been used as a tool to restrict health behaviours. Many health risk behaviours begin in adolescence (Kann et al. 2018). The leading causes of morbidity and mortality are often linked to negative health risk behaviours beginning in adolescence (Kann et al. 2018; Kolbe et al. 1993). These behaviours include tobacco use, alcohol use, and unhealthy dietary behaviours (Brener and Collins 1998; Kann et al. 2018). Some youth targeted interventions have been successful in reducing these types of voluntary risk behaviours. For example, restricting youth access to tobacco has been an important component of tobacco legislation (Richardson et al. 2009). Prohibiting tobacco sales to youth, conducting unannounced inspections, and raising the legal purchasing age, have significantly decreased youth tobacco sales (Seidenberg et al. 2015). Additionally, raising the legal tobacco purchasing age above 18 or 19 to 21 is seen as a favourable way to prevent youth tobacco use (King et al. 2015). However, their location and availability also play a role.
The availability of built-environment resources has been linked to health behaviours, both healthy and unhealthy (Alaniz 1998; Diez Roux et al. 2007; Leatherdale and Strath 2001; Novak et al. 2006; L. M. Powell et al. 2007; Trapp et al. 2018). For example, adults living in areas with a high density of fitness resources, including team sports, conditioning activities, and other individual activities, participate in more physical activity (Diez Roux et al. 2007). Similarly, adolescents with greater access to commercial physical activity facilities participated in more vigorous physical activity (Powell et al. 2007). In contrast, high rates of underage smoking have been found in areas with high numbers of tobacco retail locations, especially when located close to schools (Leatherdale and Strath 2001). Additionally, having a liquor store within 800 m of an adolescent’s home or school has been associated with ever drinking, and binge drinking (Trapp et al. 2018).

Legislation has been used for some of these risk behaviours, combining public health initiatives with land use policies to protect health and prevent disease. One focus has been on the promotion of physical activity through neighbourhood design, creating more walkable neighbourhoods (Powell 2005). Legislation has also been used to address rising obesity rates, especially among children, including policy changes around the availability of sugar sweetened beverages in schools, and soda taxes to reduce consumption (Story et al. 2009). Positive trends in adolescent diet quality have occurred after the implementation of nutrition policies restricting high fat and high sugar foods within schools (Cullen and Watson 2009; Cullen et al. 2008; Fung et al. 2013). Just as policy has been an instrumental public health tool in these aforementioned
issues, it is also in use to help curb indoor tanning to help reduce exposure to UV radiation.

1.4.2 Indoor Tanning Legislation

The elevated risk of negative health outcomes associated with indoor tanning, especially skin cancer, has been a major driver for the implementation of indoor tanning legislation, especially banning youth access (Boniol et al. 2012; Pawlak et al. 2012; The World Health Organization 2017c). There are serious consequences associated with sunbed use including personal negative health consequences, and national costs to healthcare systems (The World Health Organization 2003). The World Health Organization strongly advises against the use of UV tanning devices for cosmetic purposes and recognizes the need for legislative control to reduce the risks associated with indoor tanning use (The World Health Organization 2003). Additionally, the International Agency for Research on Cancer classifies the use of UV-emitting tanning devices as “Group 1” (carcinogenic to humans) (El Ghissassi et al. 2009). Together, these positions on indoor tanning, and the growing body of literature on the health risks associated with indoor tanning, have led many jurisdictions across the Americas, Europe, and Australia, to implement legislation restricting indoor tanning use (Madigan and Lim 2016). Most of these legislations restrict youth indoor tanning.

Canada is one such country with indoor tanning legislations. In Canada, federal regulations provide tanning device construction and function standards (e.g. safety features, light bulbs) and federal warning labels to be posted on indoor tanning equipment (Government of Canada 2005), but do not restrict indoor tanning use.
Rather, each province in Canada dictates its own legislation regarding indoor tanning use. To date, all ten provinces and one territory have enforceable indoor tanning legislation (Gosselin and McWhirter 2019). Ontario’s Skin Cancer Prevention Act (Tanning Beds) (SCPA) came into effect in May 2014 (Skin Cancer Prevention Act (Tanning Beds), 2013). The main goal of this Act is to prevent youth tanning. As such, the main provisions prevent the sale of indoor tanning services to individuals under 18, require age verification for individuals who appear less than 25 years old who want to indoor tan, and prohibit advertising or marketing to individuals under 18. Additionally, the legislation mandates the posting of warning signs, the presence of an attendant during indoor tanning, and the provision of protective eyewear. Finally, indoor tanning businesses are required to register with the Medical Officer of Health in their jurisdiction (Skin Cancer Prevention Act (Tanning Beds), 2013). In Ontario, each jurisdiction has a Medical Officer of Health within each Public Health Unit (PHU). PHUs are health agencies under the Ontario Prevention and Promotion Act, responsible for administering promotion and prevention programs (Ontario Ministry of Health and Long-Term Care 2014). Each of the 35 PHUs in Ontario are responsible for implementation, inspection, compliance monitoring, and enforcement of the SCPA within their jurisdiction.

There is still much to be uncovered about the implementation and impact of Ontario’s SCPA, but there has been some initial research conducted. After the SCPA was passed between 2012 and 2013, there was a 23.7% decrease in the number of indoor tanning salon listings in Ontario (McWhirter et al. 2018). Between 2013 and 2014 when the SCPA was enacted, there was another 4.2% decrease in the number of
indoor tanning salon listings (McWhirter et al. 2018). Although this decrease in the number of indoor tanning salons is promising, a survey conducted in Ontario found no change in adolescent indoor tanning before and one year after the implementation of the SCPA (Nadalin et al. 2018). This leads to questions and concerns about compliance with and enforcement of the SCPA requirements.

1.4.3 Key Indoor Tanning Legislative Components

1.4.3.1 Age Restriction

In addition to Canada, numerous countries have implemented indoor tanning legislation, focusing especially on banning minors’ access to protect the health of the public. France was the first country to ban youth under the age of 18 from indoor tanning in 1997, with Brazil enacting similar legislation in 2002 (Pawlak et al. 2012). Since then, several countries have followed, and some have passed even more stringent access legislations.

In the United States, 44 states and the District of Columbia have enforceable indoor tanning legislation, including restricting access to and use of indoor tanning facilities by minors (National Conference of State Legislatures 2018). Age restrictions are determined by each state, and as such they vary state-to-state. For example, Georgia, Idaho, Maine, North Dakota, and West Virginia ban minors under 14 from indoor tanning, while California, Delaware, DC, Hawaii, Illinois, Louisiana, Minnesota, Nevada, New Hampshire, North Carolina, Oregon, Texas, Vermont, and Washington all ban minors under 18 from indoor tanning (Williams et al. 2018). Additionally, some
states allow for parental consent and/or accompaniment for minors to tan. Lower age restrictions coupled with parental consent appear to be ineffective in most cases (Cokkinides et al. 2009). Low parental knowledge is also associated with adolescent tanning and lack of parental knowledge of the risks of indoor tanning is common (Magee et al. 2007).

In Canada, each province dictates access to indoor tanning beds (Gosselin and McWhirter 2019). All ten provinces, including Ontario, and one territory prohibit youth from accessing indoor tanning. Age restrictions are either under 18 or under 19, depending on the jurisdiction (Gosselin and McWhirter 2019). For example, in Ontario, minors under 18 are prohibited from indoor tanning, while in Newfoundland and Nova Scotia, minors under 19 are banned. Five provinces with age restrictions allow for medical exemptions to access indoor tanning (British Columbia, Alberta, Saskatchewan, Manitoba, Prince Edward Island) (Gosselin and McWhirter 2019). Additionally, all provinces and territories with indoor tanning legislation require indoor tanning attendants to check for age identification for individuals that appear young (Gosselin and McWhirter 2019). It is likely that checking age identification of indoor tanning facility customers who appear to be under 25 would reduce minor access to indoor tanning facilities. This is a similar practice to what is used to restrict the sale of tobacco and alcohol to minors, where age identification requests have been shown to reduce sales (Richardson et al. 2009). Unlike tobacco or alcohol, indoor tanning cannot be purchased by someone else and provided to a minor. Therefore, enforcement of age bans, and
age identification checks should be more successful in reducing minor accessing to indoor tanning facilities.

1.4.3.2 Eye Protection

Eye protection is an important component of indoor tanning legislation because artificial UV radiation can cause acute eye damage and ocular melanoma (Le Clair and Cockburn 2016; Walters and Kelley 1987). Some states in the US require indoor tanning facilities to provide free eyewear, while others allow for the sale of eyewear (National Tanning Training Institute 2015). In Canada, 4 provinces or territories include protective eyewear provisions in their indoor tanning legislations (Gosselin and McWhirter 2019). Depending on the jurisdiction, clients may either provide their own protective eyewear, or the indoor tanning facilities are required to provide the eyewear to clients (Gosselin and McWhirter 2019). In Ontario, tanning facility operators are required to provide protective eyewear, and instructions for eyewear use to individuals using the tanning services/UV light treatments (Ontario Ministry of Health and Long Term Care 2013).

1.4.3.3 Warning Labels

Effective health communication is an important tool used by public health to alter risk behaviours. It is important for individuals to be aware of exposure to health risks, especially if the risk is harmful, yet avoidable. Knowledge of the risks of indoor tanning can allow customers to make informed decisions; however, the public lacks knowledge and understanding of indoor tanning risks (Holman and Watson 2013; Magee et al.
26. Providing health risk information, not using misleading health benefit claims, enforcing risk restrictions, and posting informative warning signs, are all important ways to ensure the communication of appropriate and correct health and risk information.

Warning labels are an important method of communicating health risk information. In the context of other health risk behaviours besides indoor tanning, they raise awareness of avoidable health issues, influence health behaviours, and even support other aspects of related health policies (Giesbrecht and Hammond 2006; Stockwell 2006; Wettlaufer et al. 2009). In addition, health warning labels increase conversations about risky behaviour, and can shift social norms about these health behaviours (Martin-Moreno et al. 2013).

The US Food and Drug Administration (FDA) requires indoor tanning bed manufacturers to permanently attach federal warning statements to beds during assembly (National Tanning Training Institute 2015; The Food and Drug Administration 2014). These warning signs must be clearly visible (US Department of Health and Human Services 2007). In contrast, state-level indoor tanning facility warning labels differ between states and must be affixed, and sometimes even created by operators, as is the case in California (California Codes Business and Professions Code 1988; National Tanning Training Institute 2015; Sypes and McWhirter 2019).

In Canada, federal legislation and regulation mandate federal warning labels to be posted on indoor tanning equipment (Government of Canada 2005). Additionally, all provinces and territories with indoor tanning legislation require warning signs to be
posted in indoor tanning facilities (Gosselin and McWhirter 2019). The number, locations, and content of warning signs varies between provinces. All jurisdictions require information about the minimum age required for indoor tanning. Some also require the provision of health risk information or aesthetic risk information (Gosselin and McWhirter 2019). In Ontario, PHUs are required to make warning signs available to operators of tanning facilities (Ontario Ministry of Health and Long-Term Care 2018) and in addition, all warning signs and a list of their required locations are available online (Ontario Ministry of Health and Long Term Care 2013). In Ontario, tanning facilities are required to post a point of sale warning sign, a health warning sign, an age restriction and identification decal, and an employee reminder decal (Ontario Ministry of Health and Long Term Care 2013).

1.4.4 Enforcement of Indoor Tanning Legislation

Two US studies have investigated indoor tanning legislation inspection and enforcement practices regarding age, parental consent, eye protection, and warning signs (Hickle et al. 2005; Mayer et al. 2008). With regards to age, 60% to 94% of inspectors routinely inspected documentation of customer age (Hickle et al. 2005; Mayer et al. 2008), and 55% of inspectors gave penalties for age-related infractions (Mayer et al. 2008). In addition, 40% to 88% of inspectors routinely inspected documentation of parental consent (Hickle et al. 2005; Mayer et al. 2008), and 48% gave penalties for not obtaining parental consent for minors (Mayer et al. 2008). Most inspectors (71%-90%) routinely inspected whether eyewear was provided to customers.
while there was a wider range for routinely inspecting whether warning signs were displayed (57%-100%) (Hickle et al. 2005).

Effective indoor tanning legislations have the potential to significantly reduce skin cancer rates and health care costs. Results of a modelling study suggest that if all youth in the US under 18 were banned from indoor tanning, and this was adhered to, 61,839 melanoma cases and 6,735 melanoma deaths would be prevented, resulting in 142,659 life years saved, and 342 million USD in melanoma treatment costs saved, over the lifetime of these youth (Guy et al. 2016).

1.5 Conclusions, Research Gaps, and Objectives

1.5.1 Conclusions

As the most common type of cancer in Canada, skin cancer is a major public health concern. Skin cancers represent a significant burden to the health care system, due to the high prevalence in the population and significant treatment costs. While highly preventable, individuals often purposefully expose themselves to high levels of UV radiation, either naturally from the sun or artificially from indoor tanning devices.

Indoor tanning is associated with many detrimental health outcomes, most notably an increased risk of skin cancer. Other health risks include premature ageing, eye disease, and compromised immune function (Centers for Disease Control and Prevention 2016; The International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer 2006). These health risks are heightened when indoor tanning begins at a young age. Given the research evidence around risks
associated with indoor tanning, especially to youth, the importance of legislation restricting access to and use of indoor tanning beds is heightened.

Legislation can educate the public about the severity of health behaviours, and change health-related behaviours; specifically, associated with indoor tanning device use. Research has shown that when legislation is used effectively, through proper implementation and enforcement, it is the most important policy instrument available, and has the power to change behaviours and social norms. Legislation must be evaluated to determine whether it is effective.

1.5.2 Research Gaps and Objectives

Several important gaps in the literature related to indoor tanning legislation exist. Numerous jurisdictions have indoor tanning legislation, and while studies have been published on compliance with indoor tanning legislation, and impact of these legislations, the results have not been systematically synthesized. Evidence synthesis is helpful both in research and practice, as it provides a comprehensive overview of the available peer-reviewed literature and acknowledges gaps in the literature. Additionally, although research has evaluated the impact of the SCPA on indoor tanning use in the first year after enactment (Nadalin et al. 2018), it is important to evaluate how this legislation is being implemented, enforced, and complied with in a jurisdiction with newly implemented legislation, as this may uncover potential areas for improvement to inform policy makers and public health professionals and help to explain why youth are still indoor tanning post-legislation. Given the risks associated with indoor tanning at a young age, and that proximity to tanning facilities has been associated with youth indoor
tanning, it is important to determine the relationship between locations of indoor tanning facilities and locations of schools in Ontario, which has not yet been established.

The overall objective of this doctoral thesis research was to determine compliance, implementation, impact, and enforcement of indoor tanning legislations, as well as access to indoor tanning facilities, and to provide suggestions for legislative amendments and improvements. This research has a focus on youth access to and use of indoor tanning facilities.

The specific objectives of this research were as follows:

1) To systematically synthesize the available peer-reviewed, published evidence about compliance with indoor tanning legislation internationally, in the numerous jurisdictions with indoor tanning legislation, especially with respect to restricting youth access (Chapter 2);

2) To systematically synthesize the available peer-reviewed, published evidence about the impact of indoor tanning legislation on youth indoor tanning prevalence and frequency of youth indoor tanning (Chapter 3);

3) To evaluate how the indoor tanning legislation in place in Ontario, Canada has been implemented, enforced, and complied with, and to note the barriers to and facilitators of inspection and enforcement by PHUs (Chapter 4);

4) To determine the location of indoor tanning facilities in relation to schools in Ontario, Canada as a measure of ease of access for youth (Chapter 5).
1.5.3 Thesis Organization

This doctoral research is formatted in a manuscript style, consisting of four related chapters. This includes chapters which have been published (Chapter 2, 3, and 4) and one prepared for submission (Chapter 5). This thesis includes six chapters, including the introductory literature review chapter and a conclusion chapter.

In Chapters 2 and 3, systematic reviews were conducted to synthesize the available peer-reviewed literature, evaluating the compliance with indoor tanning legislations around the world, and determining whether indoor tanning legislation has impacted the prevalence and frequency of youth indoor tanning. Chapter 4 evaluates how the Skin Cancer Prevention Act (Tanning Beds) is being implemented, enforced, and complied with in Ontario. Chapter 5 reports on the ease of access to indoor tanning facilities by individuals in Ontario, especially youth, based on the locations of indoor tanning facilities relative to schools. Together, these four chapters create a body of knowledge which highlight compliance, implementation, impact, and enforcement of indoor tanning legislations, as well as the ease of access of indoor tanning, especially for youth, and lead to recommendations for legislative amendments to protect the health of the population.
1.6 References


Canadian Cancer Society’s Advisory Committee on Cancer Statistics. (2014). *Canadian*


Hillhouse, J. J., & Turrisi, R. (2002). Examination of the efficacy of an appearance-


IBIS. (2018). *Tanning Salons Industry in the US.* https://www.ibisworld.com/industry-


usage: what are parents thinking? Pediatric Dermatology, 24(3), 216–221.


Ontario Ministry of Health and Long-Term Care. (2014). Health Services in Your Community: Public Health Units.


Ontario Ministry of Health and Long Term Care. (2013). The Skin Cancer Prevention
Act (Tanning Beds), 2013.


attitudes and behaviour. Centre for Addictions Research of BC.


CHAPTER 2 | A systematic review of compliance with indoor tanning legislation

The work in this chapter has been published as:


2.1 Abstract

**Background:** Many jurisdictions have enacted indoor tanning legislation in response to the health risks of artificial ultraviolet (UV) radiation exposure. Key components of these legislations include banning minors’ access, requiring parental consent or accompaniment, providing protective eyewear, posting health warning signs, and communicating important health risk information. However, legislation must be complied with to be impactful. Evidence around compliance with indoor tanning legislations has not been synthesized and is an important step toward determining changes in practice due to legislation.

**Methods:** A systematic review was conducted to obtain peer-reviewed literature about compliance with indoor tanning legislation worldwide. Six databases were searched, resulting in 12,398 citations. Sixteen studies met the inclusion criteria (peer-reviewed scientific studies, published in English, focused primarily on compliance with indoor tanning legislations, and focused on commercial indoor tanning in indoor tanning facilities).

**Results:** Compliance with most aspects of indoor tanning legislation varied widely. There was good compliance for provision of protective eyewear (84% to 100%; mean=
92%; SD= 8). Compliance with age restrictions ranged from 0% to 100% (mean= 65%; SD= 25), while compliance with posting warning labels in the required locations within a tanning facility ranged from 8% to 72% (mean= 60%; SD= 29). Variation in compliance may be due to true differences, study methodology, or temporal trends.

**Conclusions:** Variability in compliance with indoor tanning legislation, as found in this systematic review, indicates the legislations may not be having their intended protective effects on the public’s health. The reasons for such low and varied compliance with certain aspects of legislation, and high compliance with other aspects of legislation, deserve further attention in future research to inform best practices around ensuring high and consistent compliance with indoor tanning legislations worldwide.
2.2 Background

The incidence of skin cancer is increasing [1]. One in every three cancers diagnosed worldwide is a form of skin cancer [2]. Approximately 2 to 3 million cases of non-melanoma skin cancers (NMSC) and 132,000 cases of melanoma skin cancer occur globally each year [3]. Ultraviolet (UV) radiation is the main risk factor for skin cancer [4]. Artificial UV radiation exposure from indoor tanning (IT) is responsible for an increasing number of skin cancers [5] and, unlike solar UV exposure, is an entirely avoidable type of UV exposure.

IT is common in North American and most European countries, especially among female young adults and adolescents [5]. This trend is a concerning public health issue as approximately 450,000 cases of non-melanoma skin cancers per year and 10,000 cases of melanoma skin cancers per year in Europe, Australia, and the US combined are attributable to IT [6]. Exposure to IT is associated with a 29% and 67% increased risk of basal cell carcinoma and squamous cell carcinoma, respectively [7]. Importantly, the risk of lifetime melanoma skin cancer increases by 59% with use of IT devices before the age of 35 [8]. This risk is greatest for those 20-29 years of age [9]. Excessive artificial UV radiation can also lead to premature ageing of the skin (wrinkling, age spots, loss of collagen), eye disease (cataracts, ocular melanoma), and immune suppression [10, 11]. Given these dangers, the World Health Organization’s International Agency for Research on Cancer (IARC) classifies UV radiation from IT beds as a Group 1 carcinogen, in the same category as smoking tobacco and asbestos [12].
Numerous countries have implemented IT legislation, focusing especially on banning minors’ access to protect the health of the public. France was the first country to ban youth under the age of 18 from IT in 1997, with Brazil enacting similar legislation in 2002 [13]. Since then, several countries have followed, and some have passed even more stringent access laws. For example, in 2011 Brazil banned IT for all age groups, and in 2015 Australia banned commercial tanning salons [13, 14]. At the time of writing, Canada, the United States (US), Australia, European countries, including France and Germany, and South American countries, including Chile, have enforceable IT legislation. These legislations include banning minor access, requiring parental consent or accompaniment, requiring protective eyewear, posting of warning signs, and communicating important health risk information. In the US specifically, 44 states and the District of Columbia have enforceable IT legislation, including restricting access to and use of IT facilities by minors [15]. Additionally, the Food and Drug Administration (FDA) and Federal Trade Commission (FTC) regulate IT at the Federal level, through labelling and manufacturing of IT devices, and prohibiting false or misleading health claims about IT device use [16].

Legislation has the power to influence social norms, beliefs, and health risk behaviours [17–19]. It is one of the most powerful policy tools available to governments, and is the most widely used [20]. An effective enforcement program is required to ensure any regulation meets its intended impact [21]. While studies have been published on compliance with IT legislation, the results have not been synthesized. To
address this research gap, we conducted a systematic review to evaluate the compliance with IT legislations around the world.

2.3 Methods

2.3.1 Search Strategy

Following PRISMA guidelines (Table A1.1)[22], a systematic review of business, medical, policy, and psychology databases was conducted in November 2016 to obtain peer-reviewed literature about compliance with IT legislations worldwide. Databases were chosen based on their coverage of relevant subject matter. Search terms were generated using the topic of the review, keywords from known relevant studies, MESH terms, and database thesauri. Search terms were grouped by themes and combined using appropriate Boolean operators. The search terms for IT included: indoor tanning, artificial tanning, suntan, tanning bed, sunbed, sunbathing, sunlamp, tanning facilities, solarium, tanning device. The policy-related search terms were: policy, policies, legislat*, regulat*, act, bill, law, ban, restrict, enforce, control, compliance, government legislations, license, licensure, national health policy, youth access, adolescent access, minor, evaluation. The skin cancer-related search terms were: melanoma, skin cancer, skin neoplasm, basal cell carcinoma, squamous cell carcinoma, malignant melanoma, and cutaneous melanoma. IT search terms or skin cancer search terms were combined with policy search terms to retrieve all articles relating to IT and policy or skin cancer and policy. The databases searched, and the number of results returned from each, were: PubMed (n=6 447), Medline (n=5 241), JSTOR (n=133), ABI/INFORM (n=149), Business Source Complete (n=197), PsycINFO (n=230). In total, 12 398 studies were
found: 5 492 were duplicates, resulting in 6 906 unique studies to be screened. Reference lists from relevant studies were also searched for additional studies to include; however, this process did not identify any new studies that the database search had not already identified.

2.3.2 Selection Criteria

To be included in this systematic review, studies had to be peer-reviewed scientific studies, published in English, focused primarily on IT legislation (compliance with legislations, not voluntary guidelines), and focused on commercial IT in IT facilities. There were no restrictions regarding year or country. Compliance was defined broadly by the authors as the criteria provided by the included studies, in relation to fulfilling the requirements of the legislation of interest for each included study (whether Federal/National, or State level). The exclusion criteria were systematic reviews or commentary style studies, grey literature, studies about spray/lotion/solar tanning, and studies about the impact of IT legislation on youth IT. Impact of IT legislation was defined as studies describing the change in prevalence and frequency of IT attributable to the implementation of IT legislation restricting youth access. After applying inclusion and exclusion criteria, 6 836 studies were excluded based on title and abstract screening. Another 58 studies were excluded after full text screening using the same inclusion and exclusion criteria. Overall, 12 studies met all inclusion criteria and were thus included in the review. The authors returned to the literature in June 2018 to check for additional studies to be included. Web of science was used to search for studies citing those already included in the review. This uncovered four additional studies, for a
total of 16 studies included in this review. Figure 2.1 outlines the process of exclusion of studies based on exclusion criteria.

Two additional files present the critical appraisal as supplementary information. Additional Table A2.1 provides supplementary information for the critical appraisal tool used. Each study, critical appraisal question, and the resulting score can be found in Additional Table A2.2.

2.3.3 Data Extraction

The first author conducted data extraction. The information extracted from each study included the following: author names, title, date of publication, country, population or site of interest, study design, sample size, outcome(s) of interest, and key findings relevant to compliance and enforcement of IT legislation. These results were grouped by aspect of the legislation they dealt with. A summary of this information appears in Table 2.1. Additionally, means and standard deviations were calculated where possible.

2.4 Results

2.4.1 Study Characteristics

An overview of the general study characteristics and key study outcomes can be found in Table 2.1. Most studies were conducted in the US (n=12), with the others conducted in Germany (n=1), France (n=1), Australia (n=1), and Chile (n=1). Of those conducted in the US, they most commonly examined legislation in one state (n=6), two states (n=1), and four states (n=2), while one study evaluated legislation compliance in 14 states, one evaluated 42 states and the District of Columbia, and one evaluated all
50 states. Specific legislative requirements examined in the included studies can be found in Table 2.2.

All the studies used observational, cross-sectional designs (n=16). The studies focused on IT facilities, their operators, IT users, and other aspects of the IT business. The most common location or population of interest was IT facility operators (n=12), with the remaining studies focused on IT facilities (n=1), IT users (n=1), individual IT beds (n=1), and IT facility websites (n=1). Sample sizes varied widely by study: IT facility operators (n=24 to n=3,647); IT users (n=357) IT facilities (n=32); IT beds (n=224 devices from n=85 facilities); and IT facility websites (n=71).

A variety of methods for investigating compliance were used in the studies, alone and in various combinations, but most commonly included telephone or in-person “secret shopper” strategies. These strategies included research assistants posing as potential clients in the following combinations: underage telephone secret shoppers (n=7), underage telephone secret shoppers plus underage in-person secret shoppers (n=2), underage in-person secret shoppers with facility observation (n=2), underage in-person secret shoppers with follow-up telephone interview (n=1), in-person facility observation by researchers (n=1), online website observation (n=1), and facility inspection (n=1). Additionally, one study interviewed IT users on the telephone.

2.4.2 Study Outcomes

The outcomes of the 16 studies are grouped into the following compliance categories: age restriction (n=9), parental consent or accompaniment (n=8), protective
eyewear (n=5), warning labels (n=6), health risk information (n=8), health benefit information (n=4), and risk restrictions (n=2). We summarize the findings for each of these outcomes below. Table 2.3 highlights the means and ranges of percent compliance for each outcome.

### 2.4.2.1 Age Restriction

Nine studies investigated compliance with age restrictions by noting if IT facilities state age restrictions verbally and adhere to them. Age compliance was evaluated using underage telephone secret shopper requests to buy IT services [23–28], underage in-person secret shopper requests [29], or both [30, 31].

In two studies minimum age requirements in IT facilities were evaluated. In Chile, 62% of IT facility operators reported having a minimum age requirement (telephone inquiry)[29]. In Minnesota and Massachusetts, 19% of IT facilities self-reported serving minors, regardless of stated age restrictions (in-person inquiry)[30]. For both studies, perfect compliance would be 100% of the facilities having and following the minimum age requirement.

Eight studies investigated compliance with specific age restrictions (i.e., 13, 14, 15, 16, 17, 18 years of age), six via telephone, and two via in-person inquiries. In three US states (Illinois, Texas, and Wisconsin) with an under 13 age restriction, compliance ranged from 23% to 89% (telephone inquiry) [25]. In this case, operators reported that they would not permit someone under 13 to tan. In five US states with an under 14 age restriction (Georgia, Indiana, Maine, North Dakota, and West Virginia), compliance
ranged from 10% to 70% (telephone inquiry) [28]. In one US state with an under 15 age restriction (Alabama), no IT facilities complied [28]. Compliance with an under 16 age restriction was 70% [26], 77% [25] and 80% [28] in one US state (Wisconsin) (telephone inquiry). Additionally, in another US state with an under 16 age restriction (Pennsylvania), compliance was 70% [28]. Legislation restricting access to either those under 17 or 18 years of age was complied with by 80% of IT facilities across 14 US states, when the operator was asked if the underage caller could use the IT facilities (telephone inquiry) [23]. More specifically, legislation with an under 17 age restriction in three US states (Connecticut, New Jersey, and New York) ranged from 50% to 70%, and legislation with an under 18 age restriction in 14 states (California, Delaware, DC, Hawaii, Illinois, Louisiana, Minnesota, Nevada, New Hampshire, North Carolina, Oregon, Texas, Vermont, Washington) ranged from 50% to 100% [28]. Additionally, legislation prohibiting those under 18 years of age was complied with by 77% [24] of IT operators in California (telephone inquiry), 81% of IT facilities in Texas (telephone inquiry) [27], 31% [30] of IT facilities in Minnesota and Massachusetts (in-person inquiry), and 20% [31] of IT facilities in Australia (in-person inquiry).

Two studies investigated compliance with age inquiries and requests for age identification. An Australian study using telephone inquiry found 23% of IT operators inquired about the customer’s age and 10% informed them age identification was required [31]. In person, 77% of Australian IT operators inquired about the customer’s age, and 17% asked for age identification [31]. Overall, 80% of operators allowed an underage shopper to tan if age was concealed, and 3% of underage shoppers were
allowed to tan who openly disclosed their age [31]. A study in Minnesota and Massachusetts [30] using in-person inquiry found that 60% of operators assessed age eligibility, 57% inquired about age, but did not assess age identification, and 3% assessed age identification. Age inquiries and requests for age identification proved important for whether a minor was able to make a successful purchase in this study: when operators did not inquire about age and identification was not assessed, a purchase attempt was successful 98% of the time; when operators inquired about age but identification was not assessed, a purchase attempt was successful 50% of the time; and when identification was assessed, a purchase attempt was successful 35% of the time [30].

Temporal lapse, the time between when legislation was enacted and when compliance was evaluated, was considered in the context of age restriction compliance. When the time lapse between passing legislation and measuring compliance was one to two years, compliance was lower (n=3; 20% to 77%; mean=46%, SD=28) than when the time lapse was 11 to 14 years (n=4; 70% to 89%; mean=77%, SD=7). However, the mean for compliance of age restrictions at one to two years post-legislation may be biased by one study that investigated compliance at a recent update to a law that had already been in place for 25 years [32]. Upon update of the literature and the inclusion of a new study which is the largest to date (44 states), and most recent study published at the time of writing, this temporal relationship did not remain [28].
2.4.2.2 Parental Consent or Accompaniment

Eight studies investigated compliance with parental consent or accompaniment requirements [25, 26, 28–30, 33–35]. Seven of these were conducted in the US and evaluated state-level legislation; one was conducted in Chile and evaluated national legislation.

Compliance with parental consent aspects of legislations ranged from 13% to 93%. This varied by assessment method: higher compliance was reported via telephone, (30% to 93%) [25, 26, 28, 30, 35]; lower compliance was reported with in-person visits (13% to 64%) [29, 30, 33–35]. When the time lapse between passing legislation and checking compliance was one to two years compliance was lower (6% to 50%; n=3; mean=23%, SD=23) than when the time between was 11-14 years (32% to 87%; n=3; mean=64%, SD=14).

Compliance with parental accompaniment was investigated in three US studies via telephone. In Texas 6% of operators complied with parental accompaniment legislation [25]. In a study of Indiana and Texas, conducted four years later, 43% of facilities complied [26]. In a study conducted more recently, 30% to 70% of operators complied with under 14 parental accompaniment legislation (Kentucky, Massachusetts, Mississippi, and Tennessee), 30% of operators complied with an under 15 parental accompaniment legislation (Wyoming), 50% and 70% of operators complied with under 16 parental accompaniment legislations (Indiana and Nebraska), and 90% of operators complied with an under 18 parental accompaniment legislation (Utah) [28].
2.4.2.3 Eye Protection

Four studies investigated compliance with the availability and/or provision of protective eyewear through in-person inquiries at IT facilities. One additional study asked IT users about their experiences with eye protection [36]. Two of these studies were conducted in the US [33, 34], one in Australia [31], one in Chile [29], and one in Germany [36]. Most (84% to 100%) IT facilities provided protective eyewear as required by the legislation [31, 33, 34]. When IT users themselves were asked, 87% reported they had been provided with protective eyewear, while 85% reported they were advised to use protective eyewear [36]. This legislation requires the provision and recommended use of protective eyewear [36]. Additionally, individual states have their own warning label compliance rules (see Table 2.2 for details). Three studies evaluated whether facilities were compliant with requiring clients to use the provided protective eyewear. Of the IT facilities providing protective eyewear in California, 89% required the use of that protective eyewear [33]. In contrast, even though legislation in Chile stipulates both provision and mandatory use of protective eyewear, 25% of IT facilities in Chile made the use of protective eyewear mandatory [29]. Additionally, when IT users were asked, 68% had actually used protective eyewear during their last IT [36].

2.4.2.4 Warning Labels

Compliance with displaying required warning labels varied widely among the six studies using in-person inquiries [29, 31, 33, 34, 37, 38]. Compliance with sign location varied from 8% to 97%. In Chile, 8% of IT facilities had an obligatory sign in the
reception area, 20% had a warning sign posted in the IT area, and 63% had a sign in the IT booth [29]. Legislation in Chile stipulates that signs must be visible in the IT facility reception and in IT service areas [29]. In the US, the FDA requires a clearly visible warning sign on each IT bed [39]. Three US studies observed warning labels on 65% [37], 78% [34], and 85% [33] of IT beds; but, even when warning labels were observed, there were problems with their visibility. Twenty-five percent of IT beds had warning labels that were “clearly visible” and 1% of IT beds had warning labels that were “completely visible” [37]. Additionally, 78% of warning signs were easily viewed by customers and 72% of warning signs were posted within 1 meter of IT stations [34]. In Australia, 97% of IT facilities displayed mandatory warning signs indicating skin cancer risk [31]. One study investigated warning statements on IT facility websites; 35% of French websites complied with the legislative requirement to include France’s black box legal warning [38]. Two studies in the US assessed compliance of the text content of warning labels. FDA warning label content requirements can be found in Table 2.2. A study in North Carolina found 90% of warning signs had text that was compliant with federal legislation [34]. A study in California found that of IT facilities, 15% had warning signs that were correct (as well as accessible and legible), 74% had danger labels that were correct (as well as accessible and legible), and 74% had exposure labels that were correct (as well as accessible and legible) [33].

2.4.2.5 Health Risk Information

Seven studies reported compliance with the provision of health risk information by IT facility operators, using in-person methods [29, 33, 34], telephone methods [23,
24, 40], or both [31]. One additional study reported compliance with health risk information through telephone interviews with IT users [36].

In addition to the required posting of warning labels containing health risk information, health risk information is also legally required in oral or written formats depending on the jurisdiction. Three studies evaluated compliance with written health risk information: in one, 19% of IT facilities had a consumer statement about risks available for customers to sign, as required by state legislation [34]; and in another, 0% provided written information about IT beds, which the IT facilities are required to provide to customers [29]. In the third study, 33% of IT users were ever offered written health risk information [36]. With respect to compliance with oral information, 61% of operators denied any dangers from IT booths when asked [24], which conflicts with the legislation from California stating IT facilities “shall not claim, or distribute promotional materials that claim, that using an ultraviolet tanning device is safe or free from risk or that indoor tanning has any known health benefits” [32]. A more recent study, across multiple US states, found 90% of operators did not deny the dangers of IT [23]. Additionally, 43% of IT users were ever advised of negative health risks of IT by operators [36].

Compliance with the provision of specific types of risk information (i.e., skin cancer, sunburn, premature ageing) was assessed in five studies. In US states, when asked explicitly about skin cancer, an average of 49% of IT facility operators reported that skin cancer was a potential health risk of IT [33, 40]. In US states, when asked general, non-specific questions about health risks, an average of 18% of IT facility operators reported that skin cancer was a potential health risk [23, 24]. One Australian
study evaluated whether operators reported skin cancer as a risk both on the telephone and in-person: 10% of operators mentioned skin cancer as a risk over the telephone, while 97% mentioned skin cancer in-person [31]. In US states, when asked explicitly about sunburns, an average of 89% of IT facility operators reported that a sunburn was a potential health risk of IT [33, 40]. In US states, when asked about general, non-specific health risks, an average of 32% of IT facility operators reported that a sunburn was a potential health risk [23, 24]. In US states, when asked explicitly about premature ageing, an average of 54% of IT facility operators reported that premature ageing was a potential health risk of IT [40]. In US states, when asked about general, non-specific health risks, an average of 3% of IT facility operators reported that premature ageing was a potential health risk [23, 24].

2.4.2.6 Health Benefit Information

Four studies reported non-compliance with legislation prohibiting beneficial health claims. In general, false, and misleading health claims about the health benefits of IT are prohibited by IT legislations. In the US, the FTC mandates that IT facilities must avoid all claims that suggest a health benefit of IT [16]. During in-person inquiries, 72% of IT facility operators in the US [24] and 29% [29] of IT facility operators in Chile promoted IT as healthy. On the telephone, 89% of IT facilities in the US claimed false and misleading health benefits, which are prohibited by the legislation under study [23]. In France, claiming any beneficial health effects of IT is forbidden, and 7% of IT facility websites did not comply with legislation, by mentioning supposed beneficial health effects of IT [38].
2.4.2.7 Risk Restrictions

Two studies evaluated compliance with state-specific legislations regarding exposure schedules and skin type [24, 31]. In direct conflict with US FDA exposure schedules, in California 59% of IT facility operators stated that daily IT was acceptable and 22% of IT facility operators stated that unlimited IT was acceptable [24]. In Australia, legislation mandates a minimum of 48 hours is required between IT exposures, however, customers with fair skin that burns easily (“Type 1”) are banned from IT [41]. Although 90% of operators complied with minimum time requirements between IT sessions when asked, 47% of fair-skinned secret shoppers were granted access to an IT facility [31].

2.5 Discussion

In this systematic review of 16 studies across four countries, compliance with IT legislation varied. Although the studies indicated relatively high (92% on average) and somewhat consistent compliance for the provision of protective eyewear, there was variability and suboptimal compliance for other components of legislation. For example, compliance with warning signs was lower (60% on average) and compliance with age-restrictions was much lower (34% on average with in-person methods). Variability may be due to true differences, or methodological, jurisdictional, or temporal factors. IT legislation is clearly not meeting its intended outcome of total compliance. We can, however, use lessons learned from other successful health legislations to suggest areas for improvement. The most effective strategy may be through youth-focused and knowledge-based approaches, along with the use of effective enforcement.
2.5.1 Youth Access

The elevated skin cancer risk to young people has been a major impetus for the implementation of legislation to restrict the age of those using IT devices [42]. The long-term risks of melanoma associated with artificial UV radiation exposure at young ages is a serious public health problem [3, 8]. However, compliance with age restrictions and parental consent varied, and during in-person inquiries was, on average, very low.

Greater efforts around enforcement of youth access legislation are necessary to reduce the prevalence of IT among youth. Stronger public health interventions are needed to address the significant health and economic burden of youth IT [19]. As with other risky behaviours, IT often begins during adolescence [43], and youth targeted interventions have been successful regarding reducing other voluntary risk behaviours, including tobacco use. Restricting youth access to tobacco has been an important component of tobacco legislation [44]. Prohibiting tobacco sales to youth, conducting unannounced inspections, and raising the legal purchasing age, have significantly decreased youth tobacco sales [19]. Indeed, raising the legal tobacco purchasing age above 18 or 19 to 21 is seen as a favourable way to prevent youth tobacco use [45]. IT legislation should mandate an age restriction of at least 18, and possibly higher than 18, and the mandatory checking of age identification as it increases compliance with age restrictions [30, 31]. Relatedly, it is likely that checking age identification of IT facility customers who appear to be under 25 would reduce minor access to IT facilities. This would be similar to what is used to restrict the sale of tobacco and alcohol to minors, where age identification requests have been shown to reduce sales [44]. Unlike tobacco
or alcohol, IT cannot be purchased by someone else and provided to a minor. Therefore, enforcement of age bans, and age identification checks should be more successful in reducing minor access to IT facilities.

Differences in compliance across studies with respect to age and parental consent may be due to different methodological approaches across studies. On average, just over two-thirds of IT facility operators complied with age restrictions when contacted by telephone, but only one-third did so in-person. Similarly, two-thirds of IT facility operators complied with parental consent over the telephone, but less than half did so with in-person inquiries. There was higher reported compliance with telephone methods and lower compliance with in-person “secret shopper” methods. Hence, compliance with IT legislation estimated by telephone methods may be overestimated. In-person methodologies may more closely resemble real-life scenarios and may provide a more accurate reflection of true compliance with IT legislation, while social acceptability bias impacts telephone methodologies. Although two of the studies commented that telephone methods and in-person methods are similar in their accuracy of evaluation of compliance [26, 35], the results of this review suggest otherwise. One exception was the study by Hurd et al. (2006); however, for both the in-person and telephone methods in that study, the IT facility operator was prompted with a question. All studies using telephone methodologies used prompting when asking about age or parental consent. Such direct questions about age compliance or parental consent do not necessarily directly measure, or accurately reflect, the business behaviour (i.e., selling IT sessions to minors).
Compliance appeared to vary with the time between when legislation was passed and when compliance was examined. Compliance with youth access aspects of IT legislation increased as time from enactment to evaluation increased. When the time lapse between passing a law, and measuring compliance was two years or less, compliance with age and parental consent was lower than when the time lapse was more than 10 years. Such temporal trends were also reported with smaller time differences (e.g., less than one year, one to two years, two or more years) [23]. These differences may have occurred because operators may take more time to become aware of, and comply with, new legislations, or enforcement may not occur promptly following the enactment of new legislations.

Upon our update to the literature and the inclusion of newly published studies, the temporal relationship between the implementation of IT legislation and when research was conducted became less clear. Rather, there may be a relationship between the overall number of jurisdictions with legislation and higher compliance even with short time lapses between implementation and evaluation. Perhaps as more jurisdictions implement IT legislation, compliance with new legislation occurs more quickly, as these types of restrictions are expected by the IT facilities and their clients. There may have previously been a temporal relationship with those jurisdictions first adopting IT legislations, but with time this has lessened. Even the results from the 44-state study conducted in 2018 did not show a temporal relationship between implementation and evaluation of IT legislation [28], while the 14-state study conducted in 2017 explicitly discussed the presence of a temporal relationship [23]. This difference
may have occurred because more states are adopting IT legislation in the US and around the world, or because the number of states included in the two studies differed, among other possible reasons.

There were insufficient studies from countries other than the US to evaluate between-country differences; however, we have noted some jurisdictional trends in findings from the US studies. There are regional differences in compliance with IT legislation across the US. When compliance across multiple US states was investigated, relative to other states with similar legislation, states in the south reported lower compliance with IT legislation for youth access [23, 25, 28]. It is unclear why this is the case, but could be due to differences in climate, political and social environment, or state differences in legislation or enforcement. Regarding the latter, for example, legislation regarding youth access in Texas outlines strict enforcement, but penalties are less severe than in other states [25].

### 2.5.2 Risk Communication

Effective health communication is an important tool used by public health to alter risk behaviours. It is important for individuals to be aware exposure to health risks, especially if the risk is harmful, yet avoidable. This research examined compliance with communication-related aspects of IT legislation, including communicating health risks, use of warning labels, and risk restrictions. Knowledge of the risks of IT can allow customers to make informed decisions; however, the public lacks knowledge and understanding of IT risks [46, 47]. Providing health risk information, not using misleading health benefit claims, enforcing risk restrictions, and posting informative
warning signs, are all important ways to ensure the communication of appropriate and
correct health and risk information.

The provision of health risk information varied, as did using misleading health
benefit claims. The combination of insufficient risk information communicated
appropriately, and IT facility operators claiming health benefits from IT will lead to wholly
misinformed customers. In two studies evaluating risk information, IT facility operators
were either asked about general health risks [24], or specifically about skin cancer and
sunburn [33]. Compliance rates were higher when operators were asked about specific
health problems relative to general health problems, but even then, less than half of IT
facility operators warned of skin cancer as a health risk, while nearly three quarters
warned of sunburn. Possible explanations may include that operators are not
knowledgeable about the health risks of IT [24, 40], or they may fear they are deterring
potential customers and selectively choose to communicate risk information. However,
we do not know how customers are asking about risk information, and therefore are
unable to determine if they are receiving specific and appropriate health risk
information.

Warning labels are an important method of communicating health risk
information. In the context of other health risk behaviours besides IT, they raise
awareness of avoidable health issues, influence health behaviours, and even support
other aspects of related health policies [48–50]. In addition, health warning labels
increase conversations about risky behaviour, and can shift social norms about these
health behaviours [51]. Given the low compliance with the provision of health risk
information at IT facilities, the communicative role of warning labels is heightened. Compliance with location and content of warning labels varied and, on average, was poor. Two-thirds of IT facility operators complied with both warning sign location and the content needed on those warning signs which varied from jurisdiction to jurisdiction (Table 2.2). While both were suboptimal, average compliance was higher for warning label content than location.

Warning label compliance ranges were narrower for federal US legislation (65%-85%) [33, 34, 37] than US state-level warning label legislation (20%-90%) [33, 34], suggesting a trend by scope of jurisdiction. The US FDA requires IT bed manufacturers to permanently attach federal warning statements to beds during assembly [16, 39, 52]. In contrast, state-level IT facility warning labels differ between states and must be affixed, and sometimes even created by operators, as is the case in California [16, 32]. In comparison, manufacturers are required to include warning labels on cigarette packaging before they can be provided for sale [53] leading to high compliance with warning label requirements for tobacco.

2.5.3 Protective Eyewear

Compliance was high for the provision of protective eyewear, with all studies reporting over 80% compliance, rendering it rather anomalous relative to all other IT legislation components investigated. Eye protection is important because artificial UV radiation can cause acute eye damage and ocular melanoma [54, 55]. Explanations for this high compliance include that it is relatively easy to implement, is low cost, and it likely has little or no negative impact on business because individuals can still tan. It is
also possible protective eyewear may be an additional revenue stream for IT facility operators. Some states in the US require IT facilities to provide free eyewear, while others allow for the sale of eyewear [16].

Although a high percentage of IT facilities provided protective eyewear, there was lower compliance with requiring clients to wear the provided protective eyewear [29, 33, 36]. Although it may be relatively easy to provide protective eyewear to clients, it is difficult to ensure the use of eyewear because it involves checking on the client as they enter the IT bed. More research is needed to investigate the extent to which clients are wearing what is provided with respect to eyewear, and whether provision and use are closely correlated.

2.5.4 Policy Implications and Recommendations

The variation in compliance, and relatively low compliance, with most aspects of IT legislation, leads to concerns about enforcement. One possible reason why low compliance was reported could be due to low enforcement. Some studies have shown variability in inspection and enforcement practices by health inspectors [56, 57]. Reduction of harm from IT beds for all individuals, including youth, cannot be fully realized without proper enforcement [58]. To increase compliance, an increased level of inspection and enforcement is imperative. This has been seen with enforcement of tobacco legislation [44]. A universal IT tax is one way to fund IT facility inspections [59]. Furthermore, if IT clients are required to pay a higher tax percent, this could become a deterrent to IT use. IT legislation without enforcement, including penalties, is not expected to lead to change.
Overall, greater provisions for enforcement of IT legislation are needed, as without enforcement, compliance is unlikely to improve. Optimal compliance with all areas of IT legislation will likely require increased inspection, and mandatory and stricter penalties for infractions. Increased inspection could be funded by moneys collected through a federal IT tax or an IT business license, which are both already used in some jurisdictions [59]. Protection of youth from the dangers of IT could be improved by mandatory age identification checks, and age identification checks should encompass ages higher than the minimum identified by the legislation. Further, parental consent compliance was low and thus does little to protect youth. We therefore suggest there be no parental consent exceptions, and that all clients under the minimum age be refused service, as is the case in the context of tobacco control. Compliance with warning labels was also suboptimal. In addition to enhanced inspection and penalties, standardization of warning label content and provision of warning labels to IT facility operators may also increase compliance. Further, health "benefit" information should be more widely and aggressively restricted through IT legislation, and the provision of health risk information through other means in addition to warning labels ought to be considered. A multi-pronged approach to risk communication, as used in alcohol and tobacco control, may be more effective. Finally, given the discrepancies in findings between methodological approaches, we suggest policy makers consider in-person checks be considered a best practice in the evaluation of IT legislation.
2.5.5 Limitations

Only English-language, peer-reviewed studies were included. One author conducted all data extraction. We restricted the review to assess compliance and not impact. Compliance levels inform public health practitioners and policy makers about IT legislations and are a necessary first step. We restricted the review to compliance with legislation and not with voluntary guidelines, because the latter shows poor compliance [31, 60, 61]. Due to differences in legislation and how each study operationalized compliance, the definition of compliance with legislations of interest varied between studies. Further, the broader heterogeneity of studies including variable study designs, temporal and geographical differences, and the different study sites (IT facilities, websites, IT beds, public health inspectors) made comparisons across studies challenging.

2.5.6 Future Research

Given the lower compliance with in-person inquiries compared to telephone inquiries, we encourage researchers to use in-person data collection techniques, which may more accurately reflect day-to-day business practices. The variability in compliance suggests that high-compliance for key aspects of IT legislation is possible, as was noted in some studies. More carefully determining of the variables that contribute to high compliance with IT legislation is a priority area for future research, as such findings could inform best practices. Future research should strive to explicitly operationalize compliance, to allow for clearer understanding of research findings.
Future research should also consider the temporal relationship between the implementation of IT legislation, and the timing of compliance research. Time frames as short as one year may be insufficient. Researchers may wish to explore how compliance with legislation in a jurisdiction changes over time to further describe temporal trends, which should clarify some of the difference in compliance, and shed some light on how long it takes for a legislation to become impactful. Most studies on compliance were conducted in the US, suggesting a need for studies from more countries with different IT legislation experiences. Research is also needed to evaluate why regional differences exist.

Additionally, in-depth case study evaluations identifying factors contributing to successful compliance with and enforcement of a specific jurisdiction’s IT legislation (e.g., process and implementation evaluations) may lead to a more robust understanding of the hindrances and facilitators to high compliance. An understanding of these differences might shed light on ways to improve compliance through legislative amendments.

2.6 Conclusions

The results of this review demonstrate variability and suboptimal compliance with IT legislation. Compliance variability could be partly explained by methodology (in-person vs. telephone), temporal considerations (time proximity to enactment of legislation), level of legislation (federal vs. state), and aspect of legislation (e.g., protective eyewear vs. age restrictions). Compliance with provision of protective eyewear was relatively high, though still imperfect. Importantly, compliance was low for
all other key aspects of IT legislation. This was especially true when focused on results from in-person compliance checks, including the highly important age restrictions, as well as for parental consent, warning labels, and health risk and benefit information. Greater compliance is required for youth access, and more effective risk communication is needed, which can be accomplished through increased enforcement and legislative amendments. Future IT policy research and practice endeavours should consider successful strategies from other public health initiatives, such as alcohol and tobacco control.
2.7 References


23. Choy CC, Cartmel B, Clare RA, Ferrucci LM. Compliance with indoor tanning bans
for minors among businesses in the USA. Transl Behav Med. 2017; 7:637-44.


2.8 Figures

Figure 2.1- Flow Chart for search and selection of studies of compliance with indoor tanning policy

Articles identified through database searching (n = 12398)

Articles after duplicates removed (n = 6906)

Articles screened (n = 6906)

Full-text articles assessed for eligibility (n = 70)

Articles included in the systematic review (n = 16)

Additional articles identified through reference list searches (n = 0)

Articles excluded based on title and abstract (n = 6836)

Articles excluded, after full-text review (n = 58)

Update of literature search (n = 4)
### 2.9 Tables

**Table 2.1 - Compliance with Indoor Tanning Legislation Outcomes of Interest**

<table>
<thead>
<tr>
<th>First Author (Year)</th>
<th>Country (State)</th>
<th>Date of Data Collection</th>
<th>Legislation</th>
<th>Methods</th>
<th>Site of Study</th>
<th>Outcomes of Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brouse (2011) [37]</td>
<td>US (NY)</td>
<td>2010</td>
<td>Federal</td>
<td>In-person observation of the facility (N=224 IT beds in 85 facilities)</td>
<td>Individual IT beds within IT facilities</td>
<td><strong>Warning Labels:</strong> 65% of IT beds had warning labels present, 14% had warning labels that were barely visible, 24% were moderately visible, 25% were clearly visible, and 1% were completely visible</td>
</tr>
</tbody>
</table>
| Choy (2017) [23]    | US (14 states)  | 2015                    | State       | Underage telephone shoppers (N=412) | IT facilities and their operators | **Age:** 80% of facilities complied with under 17 or under 18 age restrictions  
**Health Effects:** 20% of operators reported skin cancer, 52% reported sunburn, and 4% reported premature ageing. 10% denied any dangers from IT  
**Health Benefits:** 89% of operators reported specific health benefits |
| Culley (2001) [33]  | US (CA)         | 1998                    | State and Federal | In-person underage shoppers with observation of the facility (N=54) | IT facilities and their operators | **Parental Consent:** 43% of facilities required parental consent for ages 14-18  
**Eye Protection:** 100% of facilities provided protective eyewear, 89% required protective eyewear  
**Warning Labels:** 85% of facilities had warning labels present, 74% had warning labels accessible, legible, correct, 85% had other (exposure) labels present, 74% had other (exposure) labels accessible, legible, correct, 20% had a warning sign posted in the IT area, and 15% had a warning sign that was legible, accessible, and correct  
**Health Effects:** 32% of operators reported skin cancer, and 98% reported skin burns |
<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Year</th>
<th>Type</th>
<th>Setting</th>
<th>N (website)</th>
<th>N (facility)</th>
<th>Results</th>
</tr>
</thead>
</table>
| De Maleissye (2011) [38]     | France            | 2009 | National                    | Online website observation   | N=71        |              | **Warning Labels:** 35% of websites mentioned the 'black box' legal warning  
**Health Benefits:** 7% of websites reported health benefits |
| Fleischer (1993) [34]        | US (NC)           | 1991 | State and Federal           | Facility inspection by researchers | N=32        |              | **Parental Consent:** 13% of facilities had a minor consent form available and in use  
**Eye Protection:** 84% of facilities had protective eyewear available  
**Warning Labels:** 78% of facilities had warning signs that were easily viewed by customers, 72% had a warning sign posted within 1 meter of IT stations, 90% had warning sign text that was compliant, and 78% had warning labels attached to the sunlamp  
**Health Effects:** 19% of facilities had a consumer statement about risks available for customers to sign |
| Forster (2006) [30]          | US (MN, MA)       | Not Reported                      | State                        | In-person underage shoppers (N=200 facilities x 2 = 400 facility visits), followed up by telephone interviews (N=136) | N=200      | N=136        | **Age:** By telephone, 19% of operators reported having a minimum age requirement; In person, 31% of operators did not sell an IT session to an underage buyer, 60% of operators assessed age eligibility, 57% asked for age, but did not assess identification, and 3% checked identification. When age was not asked and identification was not checked, a purchase attempt was successful 98% of the time, when age was asked but identification was not checked, a purchase attempt was successful 50% of the time, and when identification was checked, a purchase attempt was successful 35% of the time  
**Parental Consent:** By telephone, 87% of operators complied with parental consent. In person, 32% of operators complied with parental consent |
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Year</th>
<th>Scope</th>
<th>Sample Size</th>
<th>Eye Protection:</th>
<th>Health Effects:</th>
<th>Age:</th>
<th>Health Benefits:</th>
<th>Risk Restrictions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gorig (2018)</td>
<td>2015</td>
<td>Germany</td>
<td>National</td>
<td>Telephone interviews (N=357)</td>
<td>Individuals who had used IT facilities since 2012</td>
<td>87% of sunbed users were provided with protective eyewear, 85% were advised to use protective eyewear, and 68% used protective eyewear during their last sunbed use. <strong>Health Effects</strong>: 57% of sunbed users were given the opportunity to determine their skin type. 43% of sunbed users were ever advised of the negative health effects of IT, while 33% were ever offered written risk information.</td>
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</tr>
<tr>
<td>Grewal (2013)</td>
<td>2013</td>
<td>US (CA)</td>
<td>State</td>
<td>Underage telephone shoppers (N=338)</td>
<td>IT facilities and their operators</td>
<td><strong>Age</strong>: 77% of facility operators complied with under 18 age restrictions. <strong>Health Effects</strong>: 16% of operators reported skin cancer, 11% reported sunburn, and 2% reported premature ageing. 61% of operators denied any dangers from IT. <strong>Health Benefits</strong>: 72% of operators reported specific health benefits. <strong>Risk Restrictions</strong>: 59% of operators stated daily IT was acceptable, and 22% of operators stated that unlimited IT was acceptable.</td>
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<tr>
<td>Heilig (2005)</td>
<td>2003</td>
<td>US (CO, IL, TX, WI)</td>
<td>State</td>
<td>Underage telephone shoppers (N=400)</td>
<td>IT facilities and their operators</td>
<td><strong>Health Effects</strong>: 54% of operators reported skin cancer (42% to 81%), 87% of operators reported sunburn (76% to 93%), and 54% of operators reported premature ageing (41% to 79%).</td>
<td></td>
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</tr>
<tr>
<td>Hester (2005)</td>
<td>2003</td>
<td>US (CO, IL, TX, WI)</td>
<td>State</td>
<td>Underage telephone shoppers (N=400)</td>
<td>IT facilities and their operators</td>
<td><strong>Age</strong>: 23% of operators in TX, 74% of operators in IL, and 89% of operators in WI complied with under 13 age restrictions. 77% of operators in WI complied with under 16 age restrictions. <strong>Parental Consent</strong>: 74% of operators complied with parental consent in IL, 6% complied with parental accompaniment in TX.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Hurd (2006)</td>
<td>2004</td>
<td>US (CA)</td>
<td>State</td>
<td>Underage telephone shoppers and in-person underage</td>
<td>IT facilities and their operators</td>
<td><strong>Parental Consent</strong>: By telephone, 73% of operators complied with parental consent. In person, 64% of operators complied with parental consent.</td>
<td></td>
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</tr>
<tr>
<td>Author</td>
<td>Location</td>
<td>Year</td>
<td>Type</td>
<td>Sample Description</td>
<td>Sample Size</td>
<td>Findings</td>
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</tr>
</tbody>
</table>
| Makin (2011) [31] | Australia (Victoria) | 2009 | State  | Underage telephone shoppers and in-person underage shoppers (N=30)                   | IT facilities and their operators | Age: By telephone, 23% of operators inquired about the customer’s age and 10% informed them identification was required. In person, when age was concealed, 80% of underage research assistants were granted access by operators, and 3% were allowed access who openly disclosed their age.  
Eye Protection: 97% of facilities provided eyewear.  
Warning Labels: 97% of facilities displayed the mandatory warning sign with the risk of skin cancer.  
Health Effects: 10% of operators reported skin cancer as a risk over the telephone, and 97% reported skin cancer in-person.  
Risk Restrictions: 90% of facilities complied with minimum time between exposures, 53% complied with skin type restrictions, 87% complied with whether they conducted a skin type assessment, and 83% complied with customer consent forms. |
| Pichon (2009) [26] | US (50 states)    | 2006 | State  | Underage telephone shoppers (N=3647 facilities)                                      | IT facilities and their operators | Age: 70% of operators complied with under 16 age restrictions in Wisconsin.  
Parental Consent: 93% of operators complied with parental consent, and 43% complied with parental accompaniment.                                                                                   |
| Salomone (2009) [29] | Chile             | 2008 | National | In-person underage shoppers with observation of the facility (N=24 facilities)         | IT facilities and their operators | Age: 62% of facilities complied with stating under 18 age limits.  
Parental Consent: 50% of facilities complied with parental consent  
Eye Protection: 25% of facilities complied with compulsory use of goggles  
Warning Labels: 8% complied with use of obligatory warning sign in the reception, 63%                                                                                                               |
<table>
<thead>
<tr>
<th>Tripp (2017) [27]</th>
<th>US (TX)</th>
<th>2015</th>
<th>State</th>
<th>Underage telephone shoppers (N=635)</th>
<th>IT facilities and their operators</th>
<th><strong>Age</strong>: 81% of facilities complied with under 18 age restriction.</th>
</tr>
</thead>
</table>
| Williams (2018) [28] | US (42 states and the District of Columbia) | 2015-2016 | State | Underage telephone shoppers (N=427) | IT facilities and their operators | **Age**: Percent of operators complying with age restrictions by state:  
  Under 14: GA (50%), ID (10%), ME (70%), ND (70%), WV (20%)  
  Under 15: AL (0%)  
  Under 16: PA (70%), WI (80%)  
  Under 17: CT (50%), NJ (70%), NY (70%)  
  Under 18: CA (90%), DE (90%), DC (50%), HI (86%), IL (100%), LA (70%), MN (90%), NV (60%), NH (100%), NC (50%), OR (100%), TX (80%), VT (70%), WA (60%)  
  **Parental Consent**: Percent of operators complying with parental consent by state:  
  Under 15: VA (70%)  
  Under 18: AZ (90%), AR (40%), MA (70%), MI (30%), MS (40%), OH (90%), RI (70%), SC (90%)  
  Percent of operators complying with parental accompaniment by state:  
  Under 14: KY (30%), MA (70%), MS (40%), TN (40%)  
  Under 15: WY (30%)  
  Under 16: NB (70%), IN (50%)  
  Under 18: UT (90%) |
1-Language is consistent with what was found in the study, with respect to the legislation. Detailed legislative requirements can be found in Table 2.2
<table>
<thead>
<tr>
<th>First Author (Year)</th>
<th>Country (State)</th>
<th>Relevant Legislation (Year of Implementation)</th>
<th>Legislation Requirements Examined in the Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brouse (2011) [37]</td>
<td>US (NY)</td>
<td>21 Code of Federal Regulations (CFR) 1040.20 (1985)</td>
<td>Each sunlamp product must have a warning label.² The warning label must be “permanently affixed or inscribed on an exterior surface of the product when fully assembled for use so as to be legible and readily accessible to view by the person being exposed immediately before the use of the product.”</td>
</tr>
<tr>
<td>Country</td>
<td>Regulations/Provisions</td>
<td>Warning Details</td>
<td>Compliance Details</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>France</td>
<td>Decret no 97-617 relatif à la vente et à la mise à disposition du public de certains appareils de bronzage utilisant des rayonnements ultraviolets. (1997)</td>
<td>'Black box' legal warning: 'Artificial ultraviolet radiation may damage the skin and eyes. These biological effects depend on the type and intensity of the radiation dose and on individual skin sensitivity (skin phototype). Claiming any beneficial health effect of IT is forbidden.'</td>
<td>Warning sign legible, accessible, correct² Danger labels present Danger statement legible, accessible, correct Other (exposure) labels present Other (exposure) labels legible, accessible, correct</td>
</tr>
<tr>
<td>US (NC)</td>
<td>15A NCAC, Section 1400 (1990) 21 Code of Federal Regulations (CFR) 1040.20 (1985)</td>
<td>Minor consent form for parental/guardian signature available and in use Protective eyewear available and compliant Ultraviolet light warning signs easily viewed by customer, posted within 1 meter of tanning stations, and text compliant with statute Equipment compliant with federal regulations, has product labels² Consumer statement outlining risks available for customer to sign</td>
<td></td>
</tr>
<tr>
<td>US (MN, MA)</td>
<td>Massachusetts statutes. Tanning facilities. 105 SMR Vol 123 (1994) Minnesota statutes. Regulation of tanning facilities. 325H (1993)</td>
<td>Parental consent through signing a required warning statement in person, witnessed by an employee, before the initial tanning session (16 years in MN, 14-17 years in MA) Parental accompaniment required under 14 in MA.</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>Regulation of hazardous artificial ultraviolet radiation (2012)</td>
<td>Provide and require use of protective eyewear Determine the skin type of the customer Provision of information on the hazards and health risks of exposure to ultraviolet radiation (in oral and written formats)</td>
<td></td>
</tr>
<tr>
<td>US (CA)</td>
<td>State of California, Section 22706 of the Business and Professions Code (2012)</td>
<td>Ban under 18 Must sign a statement with acknowledgment of risks Ban of claims that state IT is safe or have any known health benefits Limited exposure times</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Source</td>
<td>Rule Description</td>
<td>Age Restrictions</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Australia (Victoria)</td>
<td>Makin (2011) [31]</td>
<td>Victorian Government. Radiation Amendment (Tanning Units and Fees) Under section 139 of the Radiation Act (2008)</td>
<td>Ban under 18 Protective eyewear must be worn Require a signed warning statement which says that exposure to UV radiation contributes to skin cancer Set a minimum of 48 h between exposures Ban individuals with skin type 1</td>
</tr>
<tr>
<td>US (50 states)</td>
<td>Pichon (2009) [26]</td>
<td>State level legislation for the included states (States with youth access legislation as of 2006)</td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td>Salomone (2009) [29]</td>
<td>Reglamento de Solariums o Camas Solares. Decreto No. 70/06 (2007)</td>
<td>Age limits must be stated Parental consent under 18 Provide and require the use of protective eyewear Warning signs must be present in the reception and tanning areas Require a signed warning statement about the risks of IT</td>
</tr>
</tbody>
</table>
| Williams (2018) [28] | US (42 states and DC) | State level legislation for the included states (States with youth access legislation as of 2015/2016)\(^3\) | Ban under 14: GA, ID, ME, ND, WV  
Ban under 15: AL  
Ban under 16: PA, WI  
Ban under 17: CT, NJ, NY  
Ban under 18: CA, DE, DC, HI, IL, LA, MN, NV, NH, NC, OR, TX, VT, WA  
Parental consent under 15: VA  
Parental consent under 18: AZ, AR, MD, MI, MS, OH, RI, SC  
Parental accompaniment under 14: KY, MA, MS, TN  
Parental accompaniment under 15: WY  
Parental accompaniment under 16: NB, IN  
Parental accompaniment under 18: UT |
|---|---|---|---|

2- This regulation requires each sunlamp product to have a label that contains a warning statement with the words: “DANGER — Ultraviolet radiation. Follow instructions. Avoid overexposure. As with natural sunlight, overexposure can cause eye and skin injury and allergic reactions. Repeated exposure may cause premature aging of the skin and skin cancer. WEAR PROTECTIVE EYEWEAR; FAILURE TO MAY RESULT IN SEVERE BURNS OR LONG-TERM INJURY TO THE EYES. Medications or cosmetics may increase your sensitivity to the ultraviolet radiation. Consult physician before using sunlamp if you are using medications or have a history of skin problems or believe yourself especially sensitive to sunlight. If you do not tan in the sun, you are unlikely to tan from the use of this product.”

3- Relevant legislations for studies with more than 15 states are not listed. To access a detailed list of US legislations, please visit http://www.ncsl.org/research/health/indoor-tanning-restrictions.aspx
# Table 2.3 - Ranges and Means of Compliance for Key Outcomes of Interest

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Range (%)</th>
<th>Mean (%)</th>
<th>Standard Deviation</th>
<th>Number of Studies</th>
<th>Studies (First Author, Date)</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 13</td>
<td>23 – 89</td>
<td>62</td>
<td>35</td>
<td>1</td>
<td>Hester, 2005</td>
<td>IL, TX, WI</td>
</tr>
<tr>
<td>Under 14</td>
<td>10 – 70</td>
<td>44</td>
<td>28</td>
<td>1</td>
<td>Williams, 2018</td>
<td>GA, ID, ME, ND, WV</td>
</tr>
<tr>
<td>Under 16</td>
<td>70 – 80</td>
<td>74</td>
<td>5</td>
<td>3</td>
<td>Hester, 2005; Pichon, 2006; Williams, 2018</td>
<td>PA, WI</td>
</tr>
<tr>
<td>Under 17 or 18</td>
<td>20 – 100</td>
<td>72</td>
<td>22</td>
<td>6</td>
<td>Choy, 2017; Forster, 2006; Grewal, 2013; Makin, 2011; Tripp, 2017; Williams, 2018</td>
<td>CA, CT, DC, DE, HI, IL, LA, MA, MN, NC, NH, NJ, NV, NY, OR, TX, VT, WA, WI</td>
</tr>
<tr>
<td>Overall</td>
<td>0 – 100</td>
<td>65</td>
<td>25</td>
<td>9</td>
<td>Choy, 2017; Forster, 2006; Grewal, 2013; Hester, 2005; Makin, 2011; Pichon, 2006; Salomone, 2009; Tripp, 2017; Williams, 2018</td>
<td>AL, CA, CO, CT, DC, DE, GA, HI, ID, IL, LA, MA, ME, MN, NC, ND, NH, NJ, NV, NY, OR, PA, TX, VT, WA, WI, WV, Australia, Chile</td>
</tr>
<tr>
<td>Telephone</td>
<td>0-100</td>
<td>65</td>
<td>25</td>
<td>8</td>
<td>Choy, 2017; Forster, 2006; Grewal, 2013; Hester, 2005; Makin, 2011; Pichon, 2006; Tripp, 2017; Williams, 2018</td>
<td>AL, CA, CO, CT, DC, DE, GA, HI, ID, IL, LA, MA, ME, MN, NC, ND, NH, NJ, NV, NY, OR, PA, TX, VT, WA, WI, WV, Australia, Chile</td>
</tr>
<tr>
<td>In Person</td>
<td>20 – 62</td>
<td>34</td>
<td>24</td>
<td>3</td>
<td>Forster, 2006; Makin, 2011; Salomone, 2009</td>
<td>MA, MN, Australia, Chile</td>
</tr>
<tr>
<td><strong>Parental Consent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>13 – 93</td>
<td>62</td>
<td>24</td>
<td>8</td>
<td>Culley, 2001; Fleischer, 1993; Forster, 2006; Hester, 2005; Hurd, 2006; Pichon, 2009; Salomone, 2009; Williams, 2018</td>
<td>AR, AZ, CA, CO, FL, GA, IL, LA, MA, MD, ME, MI, MN, MS, NC, NH, OH, OR, RI, SC, TN, TX, VA, WI, Chile</td>
</tr>
<tr>
<td>Telephone</td>
<td>30 – 93</td>
<td>71</td>
<td>21</td>
<td>5</td>
<td>Forster, 2006; Hester, 2005; Hurd, 2006; Pichon, 2009; Williams, 2018</td>
<td>AR, AZ, CA, CO, FL, GA, IL, LA, MA, MD, ME, MI, MN, MS, NC, NH, OH, OR, RI, SC, TN, TX, VA, WI, Chile</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>References</td>
<td>States/Regions</td>
<td></td>
</tr>
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</tr>
<tr>
<td><strong>In Person</strong></td>
<td>13 – 64</td>
<td>40</td>
<td>19</td>
<td>5</td>
<td>Culley, 2001; Fleischer, 1993; Forster, 2006; Hurd, 2006; Salomone, 2009</td>
<td></td>
</tr>
<tr>
<td><strong>Parental Accompaniment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CA, NC, MA, MN, Chile</td>
<td></td>
</tr>
<tr>
<td>Overall (Telephone)</td>
<td>6 – 90</td>
<td>47</td>
<td>24</td>
<td>3</td>
<td>Hester, 2005; Pichon, 2009; Williams, 2018</td>
<td></td>
</tr>
<tr>
<td><strong>Eyewear Availability and Provision</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CA, NC, Australia</td>
<td></td>
</tr>
<tr>
<td>Required Use</td>
<td>84 – 100</td>
<td>92</td>
<td>8</td>
<td>3</td>
<td>Culley, 2001; Fleischer, 1993; Makin, 2011</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25 – 89</td>
<td>57</td>
<td>45</td>
<td>2</td>
<td>Culley, 2001; Salomone, 2009</td>
<td>CA, Chile</td>
</tr>
<tr>
<td><strong>Warning Labels</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CA, NC, NY, Australia, Chile, France</td>
<td></td>
</tr>
<tr>
<td>Location Compliance</td>
<td>8 – 97</td>
<td>60</td>
<td>29</td>
<td>5</td>
<td>Brouse, 2011; Culley, 2001; De Maleissye, 2011; Fleischer, 1993; Makin, 2011; Salomone, 2009</td>
<td></td>
</tr>
<tr>
<td>Content Compliance</td>
<td>15 – 90</td>
<td>63</td>
<td>33</td>
<td>2</td>
<td>Culley, 2001; Fleischer, 1993</td>
<td>CA, NC</td>
</tr>
<tr>
<td><strong>Health Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CA, CO, CT, DC, DE, HI, IL, LA, MN, NC, NV, NY, OR, TX, VT, WA, WI, Chile</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>0 – 98</td>
<td>45</td>
<td>31</td>
<td>7</td>
<td>Choy, 2017; Culley, 2001; Fleischer, 1993; Grewal, 2013; Heilig, 2005; Salomone, 2009</td>
<td></td>
</tr>
<tr>
<td>General Question</td>
<td>2 – 52</td>
<td>18</td>
<td>18</td>
<td>2</td>
<td>Choy, 2017; Grewal, 2013</td>
<td>CA, CO, IL, TX, WI</td>
</tr>
<tr>
<td>Explicit Question</td>
<td>32 – 98</td>
<td>65</td>
<td>24</td>
<td>2</td>
<td>Culley, 2001; Heilig, 2005</td>
<td>CA, CO, CT, DC, DE, HI, IL, LA, MN, NV, NY, OR, TX, VT, WA, WI</td>
</tr>
<tr>
<td>Skin Cancer</td>
<td>10 – 97</td>
<td>43</td>
<td>29</td>
<td>5</td>
<td>Choy, 2017; Culley, 2001; Grewal, 2013; Heilig, 2005</td>
<td></td>
</tr>
<tr>
<td>Sunburn</td>
<td>11 – 98</td>
<td>73</td>
<td>31</td>
<td>4</td>
<td>Choy, 2017; Culley, 2001; Grewal, 2013; Heilig, 2005</td>
<td></td>
</tr>
<tr>
<td>Premature Ageing</td>
<td>2 – 79</td>
<td>37</td>
<td>29</td>
<td>3</td>
<td>Choy, 2017; Grewal, 2013; Heilig, 2005</td>
<td></td>
</tr>
</tbody>
</table>

ME, MI, MN, MS, NH, OH, OR, RI, SC, TN, TX, VA, WI
| Health Benefits Claimed<br>Health Benefits | 7 – 895 | 495 | 38 | 4 | Choy, 2017; De Maleissye, 2011; Grewal, 2013; Salomone, 2009 | CA, CT, DC, DE, HI, IL, LA, MN, NV, NY, OR, TX, VT, WA, France, Chile |

4- Gorig, 2018 was not included in the calculation of means, since individuals who use tanning facilities were surveyed, rather than the people running the facilities or the facilities themselves. Doing so allowed for the denominator (tanning facilities/operators) to be consistent.

5- Health benefits claimed are reported as non-compliance. Studies reported the number of facilities who claimed health benefits even though legislation does not allow health benefit claims. All other outcomes are reported as compliance.
CHAPTER 3 | Impact of legislation on youth indoor tanning behavior: A systematic review

The work in this chapter has been published as:


3.1 Abstract

Jurisdictions around the world have implemented indoor tanning legislations, which aim to protect all individuals, especially youth, from dangers of artificial ultraviolet radiation exposure. The objective of this study was to conduct a systematic review to synthesize the available peer-reviewed literature to determine whether indoor tanning legislation has impacted the prevalence of youth indoor tanning. Following PRISMA guidelines, six databases were searched in 2016. Reference lists from relevant articles were also searched. An updated literature search was conducted in 2018. Each article was critically appraised using a merged checklist created from two previously validated checklists. All articles meeting the inclusion criteria were retained after appraisal. Seven studies, all conducted in the US, met the inclusion criteria. All studies used an observational, cross-sectional design. There were small absolute decreases in youth indoor tanning prevalence after legislation vs before (n=3, mean= 3% decrease, range=1%-6% decrease). Prevalence of youth indoor tanning was significantly lower in states with indoor tanning legislation vs states without legislation (n=4, mean=5% lower, range=1%-18% lower). Prevalence of youth indoor tanning was lower in states with longer standing indoor tanning legislation vs states with more recently implemented legislation (n=2, mean=9% lower, range=2%-20% lower). Indoor tanning legislation is
generally associated with lower indoor tanning prevalence among youth. The small percent differences equate to millions of youth at the population level. Longer time lapses from legislation implementation to evaluation, coupled with greater enforcement, compliance, legislative stringency, and public education may result in even more pronounced declines in youth indoor tanning prevalence.
3.2 Introduction

Indoor tanning is a health risk behaviour requiring legislative efforts to curb its use and prevent disease. Artificial ultraviolet (UV) exposure can have many negative health impacts, especially for skin [1]. Exposure to artificial UV radiation causes DNA damage and mutation of skin cells, which can ultimately result in skin cancer [2].

Despite the health risks, the popularity of indoor tanning remains high, especially among youth and young adults [3]. In 2013, an estimated 11.3 million Americans used indoor tanning devices, with 1.6 million of them under the age of 18 [4]. Results from the 2017 American Youth Risk Behaviour Survey indicate that 5.6% of high school students used an indoor tanning device at least once over the previous year [5]. Additionally, in 2014, an international systematic review of 16 countries found approximately 18% of adolescents had been exposed to indoor tanning in the past year [6]. Indoor tanning before the age of 35 increases the lifetime risk of melanoma by 59% [7]. Together, this points to adolescence as a critical period for UV exposure [8]. In response, a growing number of governments have implemented legislation to reduce indoor tanning access and use [9]. Most of these legislations are focused on banning youth, as recommended by the WHO [10]. In 2011, 11 countries had legislation banning youth under the age of 18 from indoor tanning [9]. Specifically, in the US, 44 states and the District of Columbia have legislation restricting youth indoor tanning [11].

While numerous jurisdictions have indoor tanning legislation restricting youth access, the results of studies on the impact of this legislation have not been systematically compiled. To address this research gap, we conducted a systematic
review to synthesize the available peer-reviewed literature to determine whether indoor tanning legislation has impacted the prevalence and frequency of youth indoor tanning and to characterize any such changes.

3.3 Materials and Methods

3.3.1 Search Strategy

Following PRISMA guidelines (Table A1.2) [12], six databases were systematically searched in November 2016 to obtain peer-reviewed literature concerning the impact of indoor tanning legislation on youth tanning. Search terms, published elsewhere [13], were used in the following databases to yield articles: PubMed (n=6 447), Medline (n=5 241), JSTOR (n=133), ABI/INFORM (n=149), Business Source Complete (n=197), and PsycINFO (n=230). In total, 12 398 articles were located; 5 492 were duplicates, leaving 6 906 unique articles to be screened. Reference lists from relevant articles were searched, uncovering three additional articles. We returned to the literature in June 2018 to update the search, which uncovered one new article for screening. Web of Science and Google Scholar were used to search for new studies citing those already included in the review.

3.3.2 Selection Criteria and Data Extraction

Articles had to meet the following inclusion criteria: peer-reviewed, written in English, focused on the impact of indoor tanning legislation regulating the commercial indoor tanning industry, focused on indoor tanning use by youth, and had a comparison group. Exclusion criteria included: systematic reviews or commentary style articles, grey literature, studies about spray/lotion/solar tanning, and studies about awareness of
existing indoor tanning legislation. Using the inclusion and exclusion criteria, 6,836 articles were excluded based on title and abstract screening. Full text screening excluded 64 articles, resulting in seven included articles. Figure 3.1 details the course of article omission. Information was extracted from each article and is summarized in Table 3.1.

3.3.3 Critical Appraisal

Each article was critically appraised using a merged checklist [14, 15], which has been used previously [13]. Each critical appraisal item was given a score of up to 1, where 0 indicated the criteria were not met, 0.5 was assigned if some but not all criteria were met, and 1 was assigned if the criteria were met fully. Other systematic reviews have also utilized partial scores [13, 16]. An article could receive “not applicable (NA)” or “not reported (NR)” if the criteria were not related to or described in that study. To account for this, the denominator for an article with NA or NR was decreased to include only applicable items. Table A2.1 details the critical appraisal tool. Table A2.3 presents each article’s critical appraisal score. Critical appraisal scores ranged from 78% to 100%, (average = 88%) and did not lead to the exclusion of any articles.

3.4 Results

3.4.1 Study Characteristics

Although there were no geographic restrictions in the search, all studies included in this review were conducted in the US (n=7). Of these studies, two studies included one state [17, 18], one study included two states [19], one study included 32 states [20], one study included 34 states [21], one study included 37 states [22], and one included a
national scope [23]. All seven studies used an observational, cross-sectional design. Studies used in-person completion of questionnaires (n=5) [17–20, 22] and telephone surveys (n=2) [21, 23] to collect data. The population of interest for most of the studies were middle and/or high school students (n=5) [17–20, 22], with sample sizes ranging from n=1 850 to n=41 313 students. Adolescent-caregiver pairs were the population of interest for two studies [21, 23] and included sample sizes ranging from n =1 196 to n=6 125 pairs.

### 3.4.2 Study Outcomes

All seven studies measured the impact of indoor tanning legislation on prevalence (whether participants used an indoor tanning device at least once in the past year), and one study also measured frequency (number of times an individual used an indoor tanning device in the past year), of indoor tanning by youth. These studies made several comparisons: the differences in prevalence of youth indoor tanning before and after the implementation of legislation (n=3) [17–19]; the prevalence of youth indoor tanning in states with and without legislation (n=4) [20–23]; and the prevalence of youth indoor tanning in states with newly implemented legislation (1-6 years prior) and in states with longer standing legislation (7-17 years prior) (n=2) [19, 23]. These comparisons and corresponding differences in youth indoor tanning prevalence are shown in Table 3.2. In addition, the prevalence of indoor tanning relative to policy type (i.e., parental permission vs. complete age restriction) was compared (n=3) [20-22].
3.4.2.1 Before and After Legislation

Three studies investigated the differences in indoor tanning prevalence by youth before and after the implementation of age restriction legislations [17–19]. In general, there was a decrease in youth indoor tanning prevalence after the implementation of legislation; however, this was not always statistically significant. All three studies stratified youth by gender. Among female youth, indoor tanning prevalence consistently decreased after the implementation of indoor tanning legislation (one was a statistically significant decrease). Among male youth, indoor tanning prevalence decreased in two studies (one was a statistically significant decrease) and increased in one study (not statistically significantly different).

One study found a significant decrease in youth indoor tanning when averaged across gender (12% before to 8% after) [18]. When youth were stratified by gender in that study, both female and male indoor tanning prevalence decreased statistically significantly by 6% and 2%, respectively [18]. A second study found non-significant decreases in indoor tanning prevalence [19]. When youth were stratified by gender, female indoor tanning prevalence numerically decreased by 2%, while male indoor tanning prevalence numerically decreased by 3% [19]. A third study found no change in youth indoor tanning before and after implementation of age restriction legislation (7% both before and after legislation) [17]. When youth were stratified by gender, female indoor tanning prevalence numerically decreased by 2%, while male indoor tanning prevalence numerically increased by 3%, although these differences were not
statistically significant [17]. This small increase for males was anomalous among the results.

### 3.4.2.2 State-to-State Legislation Comparison

Four studies reported the differences between the prevalence of youth indoor tanning in states with legislation addressing youth use of indoor tanning, compared to states without such legislation [20–23]. All four studies found a lower past year prevalence of youth indoor tanning in states with indoor tanning legislation compared to states without indoor tanning legislation; however, not all were statistically significant.

One study reported a numerical difference in past year prevalence of youth indoor tanning in states with indoor tanning legislation compared to states without indoor tanning legislation in 1998 (8% with vs 9% without) and then again in 2004 (10% with vs 13% without) [23]; however, these findings were not statistically significant. A second study reported the past year prevalence of youth indoor tanning in states with indoor tanning legislation addressing minors’ use was 3% lower than the prevalence of youth indoor tanning in states without indoor tanning legislation addressing minors’ use [21]. However, in the multivariable analysis, the association between the presence of indoor tanning legislation and the prevalence of youth indoor tanning was no longer significant [21].

Two studies reported statistically significant differences in the prevalence of past year indoor tanning in states with indoor tanning legislation compared to states without indoor tanning legislation [20, 22]. Guy et al (2014) reported the prevalence of female
youth indoor tanning in states with any indoor tanning legislation was 9% lower than the prevalence of female youth indoor tanning in states without indoor tanning legislation [20]. Further, the prevalence of female indoor tanning was lowest in states with legislations that had systems access (warning statements and signs, restricted advertising, mandatory protective eyewear, operator incident reports, and penalties for violation), parental permission (laws that prohibit minors younger than a certain age without parental consent or accompaniment), and age restrictions compared to states without any laws [20]. Indoor tanning prevalence for males in this study was 1% lower in states with legislation compared to those without, but this was not statistically significant [20]. Qin et al (2018) reported the prevalence of past year female youth indoor tanning was 25% in states with no legislation, 20% in states with parental permission legislation, and 7% in states with age restriction legislation [22]. This trend of lower prevalence was statistically significant. Additionally, the adjusted prevalence of indoor tanning was statistically significantly lower by 47% among females affected by age restriction legislation, compared to females not affected by any indoor tanning legislation [22]. They also reported numerically lower past year prevalence of male youth indoor tanning in states with varying age restriction legislations. The prevalence of past year male youth indoor tanning was 6% in states with no legislation, 5% in states with parental permission legislation, and 3% in states with age restriction legislation, but this difference was not statistically significant [22].
3.4.2.3 Policy Type

Two studies evaluated policy type [20, 22] by examining indoor tanning prevalence where legislations allow for parental permission (i.e., age restriction is present, but minors can indoor tan with parental permission) relative to no legislation or a complete age restriction. These studies found the prevalence of female youth indoor tanning in states with indoor tanning legislation (systems access, parental permission), but without a complete age restriction, was no different than the prevalence in states without indoor tanning legislation, suggesting complete age restriction legislation is key [20]. Qin et al (2018) reported the prevalence of youth indoor tanning was 13% lower among females (statistically significant), and 2% lower among males, in states with complete age restrictions compared to states with legislation that allow for parental permission [22]. Guy et al (2014) reported the prevalence of youth indoor tanning was 9% lower among females (statistically significant), and 2% lower among males, in states with age restriction legislations (and systems access and parental permission) compared to states with just systems access and parental permission [20].

3.4.2.4 New vs. Long Standing Legislation

Two studies compared the prevalence of youth indoor tanning in US states with newer legislation to states with longer standing legislation [19, 23]. These studies did not test for statistically significant differences, but both found numerically lower prevalence of youth indoor tanning in states with longer standing legislation. One study compared the prevalence of youth indoor tanning in Alabama (newer legislation) to the prevalence of youth indoor tanning in Florida (longer standing legislation) [19]. This
study reported lower prevalence of indoor tanning in Florida where there was longer standing legislation, for both females (20% lower) and males (5% lower) [19]. The other study, conducted across 50 US states, similarly found a numerically lower prevalence of youth indoor tanning in states with legislation implemented before 1997 compared to states with legislation implemented between 1997 and 2004 (8% for longer standing legislation vs 10% for newer legislation) [23].

3.4.2.5 Frequency of Use

One study investigated the frequency of indoor tanning use by youth relative to legislation. In this study, the average frequency of indoor tanning use by youth was six times per year. This frequency did not change significantly whether there was an age restriction legislation in effect (three times per year with longer-standing legislation, nine times per year with newer legislation) or no age restriction legislation in effect (five times per year) [23].

3.5 Discussion

This systematic review of seven US-based studies describes a lower trend in the prevalence of youth indoor tanning associated with indoor tanning legislation. This was true for comparisons before and after legislation, among states with and without legislation, for states with complete age restrictions (no parental permission), and for longer standing compared to newly implemented legislation. The percent differences in youth indoor tanning prevalence found in this review were, on average, small; however, the population level value equates to millions of youth not participating in indoor tanning. While the general trend of lower indoor tanning prevalence is very encouraging, the
results also indicate youth are still indoor tanning across the US despite prohibitive laws. Hence, though indoor tanning legislation is having some positive impact, it may not yet be having its full intended impact.

Effective indoor tanning legislations have the potential to significantly reduce skin cancer rates and health care costs. Results of a modelling study suggest that if all youth in the US under 18 were banned from indoor tanning, and this was adhered to, 61,839 melanoma cases and 6,735 melanoma deaths would be prevented, resulting in 142,659 life years saved, and $342 million USD in melanoma treatment costs saved, over the lifetime of youth [4]. The findings of this review suggest the results of these models cannot be fully realized. There may be ways to improve the effect of indoor tanning legislation, including through greater compliance and enforcement, increased legislative stringency, and attention to policy type.

Poor compliance with indoor tanning legislation reduces effectiveness, and therefore the impact [4]. Compliance with age restriction legislations remains imperfect and varies considerably from jurisdiction to jurisdiction, as has been reported in previous research [13]. For example, 30% of indoor tanning facility employees stated that a 15-year old could indoor tan at their facility, directly non-compliant with Wisconsin's age restriction legislation in 2009 [24]. More recent research has found age compliance to be as high as 80-100% (e.g., CA, TX) in some states and as low as 50-60% in others (e.g., NC, DC) [22]. A lack of inspection for age documentation and infrequent penalties for age restriction infractions may be contributing factors [25, 26].
legislations intended to restrict their use [27, 28]. Greater enforcement around age restrictions, and awareness of legislation, may lead to even higher age-related compliance and, in turn, greater impact.

There was a lower prevalence of youth indoor tanning in states with indoor tanning legislation compared to states without indoor tanning legislation. The mean difference in prevalence was 5% lower; however, statistical significance was not always achieved. There are several possibilities why these differences were not always statistically significant: the studies may not have had enough power to detect a significant difference; there may have been inadequate levels of compliance and poor enforcement of the legislations; and possibly that legislations are not working as intended [20, 21, 23]. Despite the lack of statistical significance in some cases, the fact remains that even small changes in prevalence translate to reductions in risk exposure that are of public health significance. Further, in some cases, quite large changes were noted. The most recently published study included in this review, for example, reported larger changes in youth indoor tanning prevalence than earlier studies; the adjusted prevalence of female youth indoor tanning was 47% lower in states with age restriction legislation compared to states without any age restriction legislation [22]. State-level indoor tanning legislation appears to be associated with lower indoor tanning prevalence among youth.

Reported prevalence of youth indoor tanning was also lower with longer standing indoor tanning legislation compared newer indoor tanning legislation. This has also been supported in some studies about compliance with indoor tanning legislation [13, 29, 30]. Hence, the time lapse between legislation implementation and impact
evaluation should be considered carefully in research design. All studies evaluating changes in prevalence before legislation implementation compared to after legislation implementation evaluated the legislation one year after implementation [17–19]. Measurable changes in prevalence of indoor tanning may take more than one year to emerge, and this may be a reason for the modest changes noted in this review. For example, one included study evaluating newer legislation relative to longer-standing legislation compared a time lapse of one year to a time lapse of 17 years, finding no significant change after one year [19]. Future research should investigate how to accelerate compliance for greater impact.

Prevalence of youth indoor tanning differed by gender. It is widely known that more females than males indoor tan [20, 21]. Studies in this review described larger and more statistically significant impacts of legislation on youth indoor tanning prevalence for females relative to males. This may be because fewer males are indoor tanning to begin with, and male indoor tanning behaviour is often initiated at an older age [20, 31]. The numerical differences in male indoor tanning prevalence therefore are expected to be smaller. Although there was a larger numerical difference for females, the proportional difference for females and males was very similar. Both genders should continue to be deterred from indoor tanning.

Although indoor tanning legislation generally resulted in lower prevalence of youth indoor tanning, it is unclear why only some studies reported statistically significant findings, while other studies, using the same methodology, did not. More specifically, one study found significant decreases in the prevalence of past year indoor tanning,
following implementation of age restriction legislation [18] and two studies found significantly lower prevalence of youth indoor tanning in states with indoor tanning legislation compared to states without legislation [20, 22]. It is possible that the study evaluating indoor tanning prevalence before and after legislation was implemented found significant decreases in indoor tanning prevalence after because the state investigated had relatively strict legislation [18]. In contrast, states evaluated in the other studies had more lenient legislations, including lower age restrictions (e.g., banning <16 vs. <18) and parental permission [17, 19]. It is likely that stringent youth access restrictions are more effective at preventing youth indoor tanning; however, the somewhat conflicting results require further investigation.

The stringency of a state’s indoor tanning legislation is important and influential [20, 21, 32]. Stringency is a measure of the strictness of legislation through legislative components including age restrictions, enforcement, and penalties [33]. One study included in this review provided national estimates of indoor tanning prevalence, finding the lowest prevalence of youth indoor tanning in states with the most stringent indoor tanning legislations [21]. Stringency in this case was determined by a score assigned based on a comprehensive set of criteria (minors’ access, customer notification of risks, UV exposure control, equipment standards, facility operations, operator training, sanitation, enforcement, and penalties for violation) [33]. Other research supports this: indoor tanning operators in a state with high penalties for non-compliance provided clients with better health risk information compared to states with less severe penalties.
More stringent legislation is needed for more significant impact. Future research would do well to explore which aspects of stringency are most impactful.

We attempted to determine the impact of policy type. For the studies where reporting and design made this feasible, parental permission was the policy type examined. Indoor tanning legislations with parental permission are more lenient, less restrictive, and not as effective as complete age restrictions [18, 20, 22]. In this sense, parental permission could be considered one element of legislative stringency. As noted in the results, two studies compared complete age restrictions to parental permission, finding lower prevalence of youth indoor tanning in states with complete age restrictions [20, 22]. This review included studies that evaluated many states with parental permission legislation, which may be one reason indoor tanning prevalence changed in some studies (and often only modestly) and not others. For example, Blashill et al found no difference in the prevalence of youth indoor tanning before and after implementing legislation allowing parental permission [19], while Cokkinides et al found a significant decrease [18]. Lower age restrictions coupled with parental consent appear ineffective in most cases [23]. These somewhat conflicting results, which may be due to the inclusion of different states and time periods, make it difficult to draw definitive conclusions about the best type of indoor tanning legislation but most of the evidence suggests parental permission is less impactful than complete age restrictions. States should remove parental permission laws in favour of age bans and, especially in states that continue to allow parental permission, parents must be informed about indoor tanning risks. Low parental knowledge is also associated with adolescent tanning and
lack of parental knowledge of the risks of indoor tanning is common [34]. Low knowledge of indoor tanning health risks, coupled with state laws allowing parental consent for youth indoor tanning, likely results in lesser impact of indoor tanning legislation.

Although studies focused on prevalence of use, one study focused on frequency of indoor tanning use by youth. Researchers found the frequency with which individuals tan did not change [23]. This is of concern because of the dose-response relationship between UV radiation and skin cancer, especially starting at a young age [35]. Further, high frequency of indoor tanning use is associated with skin burns [23]. More research is needed to determine what relationship, if any, exists between legislation and frequency of indoor tanning.

3.6 Conclusions

3.6.1 Limitations

Given that many countries have indoor tanning legislation, it is important to study and synthesize the impact of these legislations on prevalence of use in other jurisdictions outside of the US. We also only included studies that were written in English. Three studies in the review had some overlapping data but were retained because the results, years, and states evaluated differed.

Legislation content and stringency varied across jurisdictions. As well, studies differed in terms of methodology, location and dates of data collection, and populations of interest. Some studies were unclear about which states, corresponding legislations,
and legislative elements were examined in their evaluations. Combined, these factors made evidence synthesis challenging and restrictive. In future work, researchers should more clearly indicate relevant legislations in effect at the time of the study, and the included states.

Our intention to understand the frequency of indoor tanning by youth relative to legislation was restricted by the inclusion of only one study on the topic. More research evaluating the frequency of indoor tanning use by youth is needed.

3.6.2 Conclusions

Overall, indoor tanning legislation was associated with a slight decrease in the prevalence of indoor tanning use by youth but did not eliminate youth tanning; however, small percent differences equate to millions of youth at the population level potentially avoiding a risky exposure. Variations in legislative impact may be due to differences in stringency of legislation or time lapse from implementation to evaluation, among other factors. Current indoor tanning legislations appear to be impactful, and the trends are in the right direction, but they may not yet be reaching their optimal effects. Complete age restrictions should be favoured over legislations that allow for parental permission. Improved knowledge of the legislations, more stringent legislations (e.g., no parental permission), greater compliance with and enforcement of legislations, and positive parental influence may contribute to more significant declines in indoor tanning by youth. Those concerned with disease prevention should advocate for stringent indoor tanning legislation.
3.7 References


3.8 Figures

Figure 3.1- Flow Chart for the Search and Selection of Studies

Articles identified through database searching
(n = 12,398)

Additional articles identified through reference list searching
(n = 3)

Articles after duplicates removed
(n = 6,906)

Articles excluded based on title and abstract
(n = 6,836)

Articles screened
(n = 6,906)

Full-text articles assessed for eligibility
(n = 70)

Articles excluded after full-text review
(n = 64)

Articles included in the systematic review
(n = 7)

Update of literature search
(n = 1)
3.9 Tables

Table 3.1 - Overview of Studies

<table>
<thead>
<tr>
<th>First Author (year)</th>
<th>Country (State)</th>
<th>Date of Data Collection</th>
<th>Legislation</th>
<th>Methods (Sample Size)</th>
<th>Population of Interest</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blashill (2017) 6</td>
<td>US (AL, FL)</td>
<td>2013 &amp; 2015</td>
<td>State</td>
<td>In-person multiple-choice survey (N=14,389)</td>
<td>High school students (grades 9-12)</td>
<td><strong>Prevalence of Use:</strong> In Alabama, in 2013, before the youth ban, the prevalence of female past year indoor tanning was 27%, which decreased to 26% in 2015, after the ban. In 2013, before the ban, the prevalence of male past year indoor tanning was 13%, which decreased in 2015 to 11%, after the ban. None of these differences were statistically significant. Both female and male youth in Alabama reported higher indoor tanning rates than youth in Florida (comparison state). This occurred before and after legislation was implemented in Alabama in 2014 (Females: 2013 AL=27%, FL=8%; 2015 AL=26%, FL=6%) (Males: 2013 AL=13%, FL=6%; 2015 AL=11%, FL=6%).</td>
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<tr>
<td>Cokkinides (2009)</td>
<td>US (50 states)</td>
<td>1998 &amp; 2004</td>
<td>State</td>
<td>Telephone survey (1998: N=1,196) (2004: N=1,613)</td>
<td>Adolescent (ages 11-18) and caregiver pairs</td>
<td><strong>Prevalence of Use:</strong> In 1998, prevalence of past year indoor tanning in states with legislation was 8% compared to states without legislation where it was 9%. In 2004, prevalence of past year indoor tanning in states with indoor tanning legislation was 10% compared to states without legislation where it was 13%. These findings were not statistically significant. <strong>Frequency of Use:</strong> There were no statistically significant differences in the frequency of indoor tanning from 1998 to 2004, whether there was an age restriction legislation or not.</td>
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<tr>
<td>Coups (2016)</td>
<td>US (NJ)</td>
<td>2012 &amp; 2014</td>
<td>State</td>
<td>In-person multiple-choice</td>
<td>High school students</td>
<td><strong>Prevalence of Use:</strong> Overall, in 2012 before the youth ban, the prevalence of youth past year indoor tanning was 7%, which did not change in 2014,</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Years</td>
<td>Survey Type</td>
<td>Sample Size</td>
<td>Findings</td>
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<tr>
<td>Guy Jr. (2014)</td>
<td>US (32 states)</td>
<td>2009 &amp; 2011</td>
<td>State</td>
<td>In-person multiple-choice survey (N=25,758)</td>
<td>Prevalence of Use: Overall, 23% of females participated in indoor tanning, with a lower prevalence in states with indoor tanning legislations than states without indoor tanning legislations (21% vs 30%; p=0.03). The lowest prevalence of female indoor tanning was in states with legislation including age restrictions (17%). These findings were statistically significant. Overall, 6% of males participated in indoor tanning, with no significant difference in the prevalence of indoor tanning in states with indoor tanning legislations compared to states without indoor tanning legislations (6% vs 7%; p=0.70). The prevalence of male indoor tanning was 6% in states with legislation including age restrictions. These findings were not statistically significant.</td>
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<tr>
<td>Mayer (2011)</td>
<td>US (34 states &amp; DC)</td>
<td>2005</td>
<td>State</td>
<td>Telephone survey (N=6,125) and caregiver pairs</td>
<td>Prevalence of Use: Prevalence of past year indoor tanning use in states with legislation addressing youth use was 9%, compared to prevalence of past year indoor tanning use in states without legislation was 12%. These findings were not statistically significant.</td>
<td></td>
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<tr>
<td>Simmons (2014)</td>
<td>US (UT)</td>
<td>2011 &amp; 2013</td>
<td>State</td>
<td>In-person multiple-choice survey (2011: N=15,609) (2013: N=15,184)</td>
<td>Prevalence of Use: Overall, the prevalence of youth past-year indoor tanning significantly decreased from 12% in 2011 to 8% in 2013, after legislation compared to before (p &lt; 0.0001). Female indoor tanning prevalence significantly decreased from 18% to 12%(p=0.002), while male indoor tanning prevalence significantly decreased</td>
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from 6% to 4% (p=0.002). These findings were statistically significant.

|------------|----------------|---------------------|-------|---------------------------------------------|----------------------------------|

**Prevalence of Use:** Overall, 18% of females participated in past-year indoor tanning. The prevalence of female past-year indoor tanning was 25% among those not affected by age restriction legislation, 20% among those affected by parental permission legislation, and 7% among those affected by age restriction legislation (p<0.001). The adjusted prevalence of indoor tanning was 47% lower among females affected by age restriction legislation, compared to females not affected by age restriction legislation (APR=0.53; p<0.001). Overall, 5% of males participated in past-year indoor tanning. The prevalence of male past-year indoor tanning was 6% among those not affected by age restriction legislation, 5% among those affected by parental permission legislation, and 3% among those affected by age restriction legislation.

6. These studies used the Youth Risk Behaviour Survey Data. They present different results from different states and different years.
<table>
<thead>
<tr>
<th>Study (First Author, Date)</th>
<th>Comparison</th>
<th>Prevalence of Youth Indoor Tanning Before Legislation</th>
<th>Prevalence of Youth Indoor Tanning After Legislation</th>
<th>Prevalence of Youth Indoor Tanning in States Without Legislation (or New Legislation)</th>
<th>Prevalence of Youth Indoor Tanning in States with Legislation (or Longer Standing Legislation)</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simmons, 2014</td>
<td>Before vs After Legislation</td>
<td>All: 12% Female: 18% Male: 6%</td>
<td>All: 8% Female: 12% Male: 4%</td>
<td>—</td>
<td>—</td>
<td>All: 4% Decrease **</td>
</tr>
<tr>
<td>Coups, 2016</td>
<td>Before vs After Legislation</td>
<td>All: 7% Female: 8% Male: 5%</td>
<td>All: 7% Female: 6% Male: 8%</td>
<td>—</td>
<td>—</td>
<td>All: 0% Change</td>
</tr>
<tr>
<td>Blashill, 2017 7,8</td>
<td>Before vs After Legislation</td>
<td>Female: 27% Male: 13%</td>
<td>Female: 26% Male: 11%</td>
<td>—</td>
<td>—</td>
<td>Female: 1% Decrease</td>
</tr>
<tr>
<td>State to State (2 states)</td>
<td>—</td>
<td>—</td>
<td>Female: 26% Male: 11%</td>
<td>Female: 6% Male: 6%</td>
<td>Female: 20% 10</td>
<td>Male: 5% 10</td>
</tr>
<tr>
<td>Mayer, 2011</td>
<td>State to State (34 states &amp; DC)</td>
<td>—</td>
<td>—</td>
<td>All: 12%</td>
<td>All: 9%</td>
<td>All: 3%</td>
</tr>
<tr>
<td>Guy Jr, 2014 7</td>
<td>State to State (32 states)</td>
<td>—</td>
<td>—</td>
<td>Female: 30% Male: 7%</td>
<td>Female: 21% Male: 6%</td>
<td>Female: 9% *</td>
</tr>
<tr>
<td>Qin, 2018 7</td>
<td>State to State (37 states)</td>
<td>—</td>
<td>—</td>
<td>Female (No Legislation): 25% Female (Parental Permission): 20% Male (No Legislation): 6% Male (Parental Permission):5%</td>
<td>Female (Age Restriction): 7%</td>
<td>Female: No Legislation to Age Restriction: 18%**</td>
</tr>
</tbody>
</table>

Prevalence of youth indoor tanning was compared in two ways: 1. Prevalence before implementation of legislation compared to prevalence after legislation; 2. Prevalence in states with indoor tanning legislation compared to prevalence in states without indoor tanning legislation.
7- These studies used the Youth Risk Behaviour Survey Data. They present different results from different states and different years.
8- Compared prevalence of youth indoor tanning in a state with longer standing legislation (Florida) compared to a state with newer legislation (Alabama).
9- This study conducted two identical surveys, one in 1998 and one in 2004, to assess the prevalence of youth indoor tanning in states with legislation compared to the prevalence of youth indoor tanning in states without legislation at the time of each survey.
10- Statistical significance not tested.
* - Boldface indicates statistical significance $p < 0.05$.
** - Boldface indicates statistical significance $p < 0.001$. 
4 CHAPTER 4 | A Process Evaluation of the Skin Cancer Prevention Act (Tanning Beds): A Survey of Ontario Public Health Units

The work in this chapter has been published as:


4.1 Abstract

**Introduction:** Evidence of the dangers of indoor tanning and its popularity including among youth, led the Government of Ontario to pass the Skin Cancer Prevention Act (Tanning Beds) (SCPA) in 2014. This legislation includes prohibiting the sale of indoor tanning services to individuals under 18, requiring warning signs be posted, and other safety regulations.

**Objective:** We collected information from Ontario Public Health Units to conduct a process evaluation of the SCPA to: understand legislation implementation; assess available evidence about compliance, inspection, and enforcement; and, note barriers and facilitators related to inspection and enforcement.

**Methods:** Data were collected March – April 2018. All 36 Ontario Public Health Units were invited to participate in an online questionnaire about the SCPA. Questions covered complaints, inspection, and enforcement, and used both close- and open-ended questions.

**Results:** Participants from 20 Public Health Units responded to the questionnaire; a response rate of 56%. These agencies reported 485 facilities offer indoor tanning. Since
2014, there have been 242 infractions by tanning facility owner/operators related to the SCPA, with most being uncovered during non-mandatory routine inspections (n=234, 97%), rather than mandatory complaint-based inspections (n=8, 3%). Most infractions were related to warning signs (n=201, 83%). No charges were issued for any infractions. Instead, providing education (n=90, 62%) and issuing warnings (n=33, 23%) were the most common enforcement strategies.

**Conclusions:** SCPA amendments are needed, including mandatory, routinely scheduled inspections. In addition to providing education, fines may improve compliance. More resources are required for inspection and enforcement of the SCPA.
4.2 Introduction

Skin cancer is the most common cancer in Canada, and also one of the most preventable cancers [1]. Together, cases of melanoma and keratinocyte carcinomas (non-melanoma skin cancers) equate to the same number of cancer cases as the four major cancers (lung, breast, colon, and prostate) combined [1]. In 2013, there were 3409 incident cases of melanoma skin cancer reported in Ontario [2]. The main risk factor for melanoma and keratinocyte carcinomas is exposure to ultraviolet (UV) radiation, either naturally from the sun, or artificially from indoor tanning devices [1]. Indoor tanning devices emit UV radiation, but at a higher intensity than the sun [3, 4]. Therefore, exposure to UV radiation is a significant public health concern, and one deserving of policy action.

In 2003, the World Health Organization recommended governments around the world implement legislation, especially with a focus on banning indoor tanning by youth under 18 years of age [5]. Since 2009, UV radiation from indoor tanning beds has been classified as a known cancer-causing agent in humans [6]. Indoor tanning significantly increases the lifetime risk of melanoma, and there is evidence of a dose-response relationship between indoor tanning and cutaneous melanoma [6–9], with the highest risk associated with indoor tanning at a young age [9, 10].

The increase in the risk of skin cancer has been a major driver for the implementation of indoor tanning legislation, especially banning youth access [9, 11, 12]. In response to evidence of the health risks of indoor tanning, many jurisdictions
across the Americas, Europe, and Australia, have implemented legislation restricting indoor tanning [5, 6, 13].

In Canada, federal legislation and regulation provide tanning equipment construction and function standards (e.g., safety features, UV-emitting light bulbs) and mandate federal warning labels to be posted on indoor tanning equipment [14], but do not address use or access. In Canada, legislation regarding indoor tanning equipment use is dictated by each province and, as of 2108, all ten provinces, and one territory have indoor tanning legislation [15]. In Ontario, the Skin Cancer Prevention Act (Tanning Beds) (SCPA), became enforceable in May 2014 [16]. The SCPA prevents the sale of indoor tanning services to individuals under 18, requires age verification for individuals who appear less than 25 years old, prohibits advertising or marketing to individuals under 18, mandates the posting of signs warning of health effects, requires the presence of an attendant during indoor tanning, requires the provision of protective eyewear, and requires indoor tanning businesses to register with the Medical Officer of Health (MOH) in their jurisdiction (Table 4.1) [16]. In 2014, the Ontario Ministry of Health and Long-Term Care issued a protocol to direct boards of health on how to implement and enforce the SCPA [17]. According to the Tanning Beds Compliance Protocol, 2014, enforcement is complaint-driven. Public Health Units (PHUs) are the agencies governed by boards of health under the Ontario Health Protection and Promotion Act (HPPA) and are responsible for administering promotion and prevention programs [18]. Each of the 36 PHUs in Ontario are responsible for implementation, inspection, compliance monitoring, and enforcement of the SCPA within their respective jurisdictions.
Although the SCPA has been enforceable since 2014, the functioning of the legislation has not been assessed. Just prior to the legislation’s enactment, seven percent of Ontario youth had ever used indoor tanning devices [19]. Research conducted since the implementation of the legislation suggests it may not be achieving optimal effects, as there was no reduction in the percentage of youth using indoor tanning devices the year after the legislation was enacted [20]. It is unclear why there was no change in youth tanning in the first year after enactment; however, examining enforcement of the legislation by Ontario’s PHUs and the extent to which indoor tanning businesses are complying may assist with our understanding of this issue.

Although research has evaluated the impact of the SCPA on indoor tanning use in the first year after enactment [20], it is important to evaluate how this legislation is being implemented, enforced, and complied with in Ontario, as this may uncover potential areas for improvement to inform policy makers and public health professionals. Hence, the objective of this study was to collect information from Ontario PHUs to: 1) understand how this legislation has been implemented; 2) assess available evidence of compliance, inspection, and enforcement from PHU records; and, 3) note the barriers to and facilitators of inspection and enforcement according to PHU staff.

4.3 Methods

4.3.1 Questionnaire Development

We sought to electronically survey Ontario’s 36 PHUs about the SCPA. A questionnaire developed by the authors with input from members of the Ontario Sun Safety Working Group (OSSWG), was based on the overall objectives of the study. The
questions were created based on the legislation itself, the government-issued Tanning Facility Inspection Report form used by PHU staff to record details of inspection visits to indoor tanning facilities, the protocol document issued by the Ontario Ministry of Health and Long-Term Care to provide direction to boards of health about the implementation and enforcement of the SCPA [21], and through discussions with public health personnel tasked with conducting inspections related to the Act. To ensure questions were comprehensive, clear, and interpreted as intended, multiple iterations of the questions were shared and discussed with a public health inspector, other front-line public health professionals working with the legislation, and additional stakeholders who contributed to the creation and evaluation of the legislation. With their input, questions were edited for wording accuracy, clarity, and comprehension.

Twenty-four questions were used to determine the type of inspection and enforcement activity conducted by the PHUs related to the SCPA. Respondents were queried about: the number of indoor tanning facilities in their jurisdiction; who at the PHU is responsible for inspecting and enforcing the SCPA’s requirements; and, whether training had been provided to employees responsible for inspection and enforcement. In addition, core questions covered: whether inspections conducted were education/routine and/or complaint-based inspections; the number of complaints regarding the SCPA that the PHU had received for each of the possible categories of offence (Table 4.1) each year since SCPA enactment; and the number of infractions, and actions taken in response to infractions, arising from both routine/education and complaints-driven inspections. Open-ended questions were also included to gain an
understanding of the respondents’ opinions and perceptions of the SCPA by asking if they had anything further to share on each of the topics.

4.3.2 Questionnaire Distribution

The project was approved by the University of Guelph Research Ethics Board (REB # 17-12-013). The MOH or their designate was contacted at each PHU. They were each sent a hardcopy letter by mail introducing the questionnaire and inviting their PHU’s participation, followed by an email that included the questionnaire link. The MOH or their designate was asked to delegate the completion of the questionnaire to the most appropriate individual on staff at the PHU. Hence, study respondents were employees at Ontario PHUs.

Questionnaire responses were de-identified two weeks after the questionnaire closed and all findings are presented in aggregate so that individual PHUs cannot be identified. Questionnaire responses were collected through Qualtrics (Qualtrics, Provo, UT), a self-administered online survey tool. Based on inspection records and SCPA enforcement experiences, respondents answered questions that were formatted as binary (yes or no), multiple choice, numerical entry, and open-ended. Respondents had the option to select “unknown”, “prefer not to answer”, or skip the question if they did not wish to answer a question. Respondents were also given the opportunity to input written comments into text boxes for the open-ended questions.

The questionnaire was available online starting March 1, 2018, and the last completed questionnaire was submitted on April 19, 2018. One reminder was sent to
the MOH at each PHU four weeks after the initial email was sent, reminding them to have an employee complete the questionnaire if they had not already done so.

4.3.3 Analysis

All statistical analyses were performed using STATA version 13.1 (StataCorp LP, 2013. College Station, Texas, USA). Descriptive statistics based on frequencies (counts) were generated. Qualitative data from open-ended responses was used to further understand quantitative findings by identifying common themes and insightful responses to illustrate the opinions of the respondents.

4.4 Results

4.4.1 Demographics

Twenty PHUs completed the online questionnaire and were included in the subsequent analysis; a 56% response rate. Responding PHUs can be categorized as being from five urban areas, six rural areas, and nine urban-rural mixed areas, based on population centre size from the 2016 census [22]. Responding PHUs were in low and high population density areas, and a variety of geographic regions (e.g., North, South, East, West) throughout Ontario.

4.4.2 Indoor Tanning Facilities

Most (n=19) of the responding PHUs indicated they had a listing of the facilities offering indoor tanning services in their jurisdiction. PHUs reported, in total, 485 facilities offer indoor tanning in their jurisdictions. Most records of indoor tanning facilities were updated within the past year (2017-2018) (n=18/19 of PHUs). One PHU reported not
having updated their list of facilities since the legislation in 2014, “as there have not been complaints under the Act.”

Regarding the maintenance of the list of tanning facilities, most respondents noted technology (i.e., inspector software and/or databases), inspectors, and tanning operator telephone calls in their open-ended responses \( n=19/19 \). However, responses generally did not articulate how the list is kept up to date (i.e., how new facilities are determined to be added, and closed facilities removed). One PHU indicated, “some facilities have not reported opening as a new establishment,” suggesting there were establishments unknown to them because tanning facility operators were not reporting their operation as required by law. Another PHU highlighted their use of the municipal licensing system to aid in keeping track of new facilities: “Tanning bed operators […] must file for an annual business license; we have established a system with the licensing dept of [the city] that includes joint inspections.”

The number and type of indoor tanning business in each PHU jurisdiction varied, from one to 129 facilities per jurisdiction (mean=26; [SD= 28]). Indoor tanning services were reported in tanning salons \( n=214, 44\% \), beauty salons or spas \( n=145, 30\% \), gym and fitness facilities \( n=122, 25\% \), and other types of facilities \( n=4, 1\% \) (e.g., university residence, or wellness centres). These facilities reported by PHUs encompass 51\% (214/420) of indoor tanning salons and 46\% (122/268) of gyms with indoor tanning in Ontario [23].
4.4.3 Complaints

All PHUs indicated that when a complaint is reported, they record the complaint regarding the SPCA and follow-up with an inspection of the indoor tanning facility. However, from 2014-2017, only 40% (n=8) of responding PHUs reported receiving complaints about possible or actual SCPA infractions by indoor tanning facilities, and of these, seven maintained records of the complaints, and six specified these complaints.

Since the SCPA was enacted in 2014, there were 20 complaints to six PHUs about possible or actual infractions by indoor tanning facilities (mean=3, range=1-7). Complaints most commonly related to signage (n=8, 40%) and underage sale (n=4, 20%). Additional details pertaining to complaints received by PHUs about SCPA non-compliance appear in Table 4.2.

Responding PHUs were queried through open-ended questions if there was any other information the PHUs collect about complaints or responses to complaints. Of those that responded, half (n=11/20) indicated there was no additional information collected and that there had been few complaints overall, while emphasizing the provision of pre-emptive education. For example: “We have not received any complaints”; and “Not many complaints. We strive to educate first.”

4.4.4 Inspection, Infractions, and Enforcement

Public health inspectors were identified as those primarily responsible for inspecting and enforcing the SCPA’s requirements (n=16/20). Other PHU employees responsible for inspecting and enforcing the SCPA’s requirements include public health
nurses (n=2/20), public health promoters (n=1/20), and tobacco enforcement officers (n=2/20). Most (n=18/20) employees responsible for inspection and enforcement were trained. Of the responding PHUs, 90% (n=18/20) conducted mandatory complaint-based inspections, while 65% (n=13/20) conducted non-mandatory routine inspections related to the SCPA.

Respondents were asked, through an open-ended question, about the minimum number of routine inspections conducted per year. Responding PHUs (n=13/20) typically inspect each tanning facility once annually at minimum, while a few of these responding PHUs (n=3/13) noted that each tanning facility received one inspection in the first year, followed by complaint-based inspections only thereafter. For example, “We conducted one full round of inspections in the first year [of the Act]. From that point, it has been complaint-based only.” Respondents were also asked through an open-ended question if there was any other information the PHU would like to share related to inspection and enforcement. Responses (n=6/20) typically focused on the importance of routine inspections and one response highlighted the need for resources to facilitate this: “There needs to be mandatory compliance, education and routine inspections for the Act. If this occurs, there needs to be more resources allocated […].” Additionally, one response outlined a possible alternative to complaints-based inspections: “We are exploring a youth test-shopping program. We feel that complaint-based inspections for underage provisions are an inadequate measure to ensure compliance.”

Since 2014, half (n=10/20) of the responding PHUs noted infractions, totalling 242 SCPA infractions (mean=19, range=1-115). Eight of these infractions were derived
from mandatory complaint-based inspections noted by four PHUs (mean=2, range=1-3, n=4/18), while 234 were from non-mandatory routine inspections noted by nine PHUs (mean=26, range=1-115, n=9/13). Most infractions were related to the posting of warning signs (n=201, 83%), followed by business registration (n=18, 7%). There were six (2%) infractions for age verification (failing to request age identification), and one infraction (0.4%) related to underage sale (illegally permitting the sale of tanning services to minors). There were no infractions related to self-tanning (tanning without an operator present). Details of the infractions recorded by PHUs are found in Table 4.3.

In response to infractions, PHUs reported a variety of enforcement activities (Table 4.4): providing education (n=90, 62%) was the most common, followed by issuing warnings (n=30, 23%), and follow-up visits (n=22, 15%). No charges (n=0, 0%) were issued for any infractions.

As can be seen when comparing the total infractions in Table 4.3 and the total responses to infractions in Table 4.4, there are fewer responses than infractions. For example, 201 infractions related to signage were reported; however, only 120 enforcement responses to these infractions were reported. This discrepancy occurred because some PHUs did not report follow-up to infractions, some reported single follow-up, and others reported multiple follow-ups (e.g., warning, follow-up, and education provided for each signage infraction).
4.5 Discussion

Our results indicate that as of Spring 2018, 485 Ontario facilities were offering indoor tanning within the jurisdictions of the 20 PHUs that responded to the questionnaire. Almost all responding PHUs conducted complaint-based inspections, while two-thirds conducted non-mandatory routine inspections. Since 2014, there have been 20 complaints and 242 infractions related to the Act. Most infractions were the result of routine inspections and most were related to warning signage. In response, PHUs often provided education or issued warnings, and did not issue any fines for infractions.

Both the 2014 and 2018 versions of the compliance protocol issued by the Ontario Ministry of Health and Long-Term Care to the boards of health dictate inspections of indoor tanning facilities related to the SCPA occur on a complaints-driven basis [21]. Between 2014 and 2017, 40% of responding PHUs reported receiving complaints about possible or actual infractions. This suggests more than half of PHUs have not been receiving complaints, and thus have not been required to conduct inspections for compliance with the SCPA. Further, seven of the responding PHUs solely conduct complaint-based inspections, and only one of these PHUs has ever received a complaint. This suggests that six of the PHUs have not conducted any inspections related to the SCPA. We can assume that while there have not been complaints in many PHU jurisdictions, indoor tanning facility compliance is imperfect. Although complaints-driven inspections are important, they are likely insufficient on their own.
Approximately two-thirds of responding PHUs also conduct non-mandatory routine inspections, beyond what is required by the SCPA [16]. Importantly, most infractions reported by PHUs were derived from these routine inspections (97%), rather than complaints-driven inspections. It is possible that these routine inspections were conducted during other mandated types of inspections, perhaps under the HPPA [24]. Routine inspections are associated with positive outcomes, including increased compliance with legislation [25, 26], as has been demonstrated in the realms of tobacco control and food safety [27, 28]. Further, routine, unannounced inspections may be most effective for tanning service compliance [29, 30]. With tobacco control, the use of unannounced inspections significantly increased compliance with youth access legislation [28, 30]. Routine inspections, complemented by complaints-based inspections as they arise, would likely help make the SCPA a more impactful piece of legislation.

Additionally, a schedule for how often these routine inspections occur should be dictated by the legislation. A recent indoor tanning policy scan found routine inspections are handled differently from one Canadian province to the next, but do not include a specific inspection schedule to follow, and rather state inspections are conducted on a vague schedule, such as “from time to time” [15]. With a dictated routine inspection schedule, at least annually, in combination with follow-up to complaints, greater enforcement related to the SCPA would be expected.

PHUs are required to make warning signs available to operators of tanning facilities [21] and, in addition, all warning signs and a list of their required locations are
available online [16]. Despite their availability, most of the reported infractions were related to the posting of warning signs (83%). Previous literature has similarly described a lack of compliance with posting of warning signs in indoor tanning facilities [31]. This suggests the indoor tanning industry may be resistant to posting warning signs, possibly because they have the potential to deter indoor tanning use by communicating risk information to consumers. A lack of required warning signs could result in consumers being under-informed about the risks associated with indoor tanning, and the legal requirement of being at least 18 years of age. Warning signs communicate health risk and legal information in indoor tanning facilities; therefore, ensuring they are posted in accordance with legislative requirements is important, as a lack of compliance prevents the risk communication aspects of the SCPA to be fully realized.

Indoor tanning businesses are also required to provide Notice of Operation to the MOH in their jurisdiction [21]. The second most common infraction was related to business registration (7%): two PHUs reported this type of infraction (i.e., there were indoor tanning businesses in their jurisdiction that failed to report their operation). Additionally, several of the open-ended comments revealed a challenge with keeping track of new indoor tanning facilities, with respondents revealing that there is no good way to ensure new tanning businesses register with the MOH, and some tanning businesses have been operating without being registered. These results indicate a better system to keep track of indoor tanning facilities is needed. In jurisdictions with business licensing requirements, municipal licensing officials could require registration with the MOH, and an initial inspection, for an indoor tanning facility to obtain a business
license. If indoor tanning facilities are not registered with the PHU, it is difficult to ensure they are inspected and fully compliant with the SCPA.

Typically, PHUs responded to infractions by providing education to the owners/operators of the tanning facilities. Previous research suggests there are low levels of operator knowledge regarding UV radiation exposure, safety, and health risks [32–34] and that false and misleading health information is provided by some tanning businesses [23, 35, 36]. Hence, in addition to ensuring operators are educated about the SCPA, more must be done to ensure accurate risk communication by operators to patrons. PHUs may have a role to play in this regard, an idea supported in the open-ended responses. Relatedly, the infractions noted for marketing indoor tanning services to youth are concerning, especially when coupled with recent findings that misleading health claims are being made by tanning salons [23]. Enforcing this component of the legislation could help to reduce the misinformation supplied by indoor tanning facilities. It is unclear how inspections for these types of infractions were conducted, or where the infractions occurred (e.g., in person, in print, or online).

Previous research suggests businesses are less likely to comply with legislation if non-compliance is not penalized [29]. Although charges for noncompliance are outlined in the Schedule of Fines for the SCPA, between $50 and $300 per infraction [37], PHU respondents to our questionnaire indicated no charges have been laid in response to any of the reported infractions. Using fines will likely encourage indoor tanning operators to comply with the SCPA. Previous research has shown lenient penalties for non-compliance with youth access legislations are associated with lower
compliance [38]. Therefore, small penalties may not be enough to encourage compliance. For example, a fine of $300 [37] for youth access may not deter sale of indoor tanning services to youth. Health policy makers should consider whether the SCPA should be amended to increase these fines, and include a schedule of fines, to encourage compliance amongst tanning salon owners and operators.

Responding PHUs indicated there was only one recorded infraction associated with youth access, which is an underestimate of youth tanning. Indeed, 7% of youth in Ontario participated in indoor tanning in the year after the implementation of the SCPA, which did not differ from the percent of youth indoor tanning prior to implementation of the SCPA [20]. This is of concern owing to the increased lifetime risk of melanoma when indoor tanning occurs early in life [9]. A better method to check for compliance with youth indoor tanning could be done through “secret shoppers”, whereby youth attempt purchases to monitor compliance with legislation prohibiting underage sales [39]. The “secret shopper” method is used for tobacco control, and previous research supports this method as a way to improve youth identification checks, increasing legislative compliance with youth access [39]. For indoor tanning, in-person checks provide the most accurate reflection of true compliance with indoor tanning legislation [31]. Ontario PHUs could implement “secret shopper” methods as one way to combat the rates of youth indoor tanning, although this would be resource-intensive. SCPA infractions noted in questionnaire responses reflect what is more easily inspected (e.g., warning signs), where inspections for compliance with age restrictions is more involved.
and thus, difficult in a limited resource environment. Hence, resource availability may be influencing infraction records.

A lack of resources is likely a significant barrier to inspection and enforcement related to the SCPA. This was reported by PHUs throughout the open-ended responses. Results of this research suggest more resources are needed for those conducting inspections related to the SCPA. Possible ways to increase funds available for inspection and enforcement could include an indoor tanning business registration fee or an indoor tanning tax, as has been implemented in the US [40], which may also help to deter the behaviour.

4.5.1 **Policy Implications and Recommendations**

Complaint-based inspections are sub-optimal to ensure indoor tanning facilities are complying with the SCPA. Thus, we recommend the legislation be amended to mandate routine inspections and include a schedule for PHUs to conduct such inspections. Complaints-driven inspections should be retained to complement routine inspections.

Providing education to indoor tanning facility operators should continue as a part of the response to an infraction. The SCPA enables fines to be issued in response to infractions; PHUs may find compliance increases when fines are issued. The Schedule of Fines indicates fines for infractions are low; increasing the severity of these fines to encourage compliance, especially for non-compliance with underage sale, should be considered.
Finally, more resources (financial and personnel) should be allocated to PHUs for enforcing the SCPA. Greater resource allocation for this issue should lead to better enforcement and, in-turn, greater compliance with the SCPA.

4.5.2 Limitations

We did not assess whether certain types of tanning facilities (e.g., tanning salons vs gyms with tanning) differed regarding complaints or infraction type or quantity as the data did not enable linkage between facility type and complaints or infractions. Complaints and infractions were not equally distributed across participating PHU jurisdictions and may have clustered around certain jurisdictions. Our data did not enable us to address this. Our data may underestimate the number of infractions related to Business Registration. The Tanning Facility Inspection Report Form used by PHUs to record infractions does not include a section for this type of infraction, which may or may not influence how PHUs track this and, in turn, how they reported on it in the questionnaire. Although we achieved a reasonable response rate of 56%, had even more health units agreed to participate, we would have even more confidence in generalizing our results across the province.

4.6 Conclusions

To our knowledge, this study provides a first look at how the SCPA is being inspected and enforced in Ontario. The purpose of this legislation is to protect the health of the population from the risks associated with artificial UV radiation from indoor tanning. For the SCPA to be more effective, amendments must be made. These include requiring routine inspections, improving the way youth access is being inspected and
enforced, and increasing the resources allocated to PHUs to better facilitate inspection and enforcement.
4.7 References


### 4.8 Tables

**Table 4.1 - Skin Cancer Prevention Act (SCPA) Sections and Descriptions**

<table>
<thead>
<tr>
<th>SCPA Section (Ontario Regulation 99/14)</th>
<th>Description and Section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Underage sale</strong></td>
<td>Selling, offering for sale, or providing tanning services/UV light treatments to individuals less than 18 years old? 2(1)</td>
</tr>
<tr>
<td><strong>Age verification</strong></td>
<td>Failing to request identification for individuals who appear less than 25 years old before providing tanning services/UV light treatments? 2(2)</td>
</tr>
<tr>
<td><strong>Self-tanning</strong></td>
<td>Permitting self-tanning (i.e., services or treatments without requiring the presence of an attendant)? 3(1)</td>
</tr>
<tr>
<td><strong>Underage marketing</strong></td>
<td>Advertising or marketing tanning services/UV light treatments to persons who are less than 18 years old? 4(1)</td>
</tr>
</tbody>
</table>
| **Signage** | Failure to post signage in accordance with regulations:  
Point of sale warning sign? 5(2)  
Health warning sign? 5(3)  
Age restriction and identification decal? 5(4)  
Employee reminder decal? 5(5)  
Signage in general (type not specified)? 5(1) |
<p>| <strong>Eyewear</strong> | Failure to provide protective eyewear, and instructions, to individuals using the tanning services/UV light treatments? 6(2), 6(3) |
| <strong>Business registration</strong> | Failure to provide Medical Officer of Health with notice of operation including business name, address, and telephone number? 7(1) |</p>
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<tr>
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<th>2014</th>
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<th>2016</th>
<th>2017</th>
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<td>2</td>
<td>0</td>
<td>4</td>
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<tr>
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<td>0</td>
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</tr>
<tr>
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<td>0</td>
<td>1</td>
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<tr>
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<td>0</td>
<td>3</td>
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<tr>
<td><strong>Total per year</strong></td>
<td><strong>2</strong></td>
<td><strong>6</strong></td>
<td><strong>4</strong></td>
<td><strong>8</strong></td>
<td><strong>20</strong></td>
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Table 4.3 - Compliance: SCPA Infractions Reported by Ten Ontario PHUs (2014-2017)

<table>
<thead>
<tr>
<th>SCPA Section</th>
<th>Infractions from Complaint Inspection</th>
<th>Infractions from Routine Inspection</th>
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<tr>
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<td>6</td>
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</tr>
<tr>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Underage Marketing</td>
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<td>8</td>
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</tr>
<tr>
<td>Business Registration</td>
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<td>Total</td>
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<sup>11</sup> One of the responding PHUs included data from 2016 and 2017 only.
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</tbody>
</table>

12 The number of infractions does not match the number of enforcement responses. Multiple infractions may have only needed one response (e.g. multiple signage infractions with only one enforcement response).
5 CHAPTER 5 | Proximity of Indoor Tanning Facilities and Schools in Ontario, Canada

The work in this Chapter has been prepared for submission to the Canadian Journal of Public Health.

5.1 Abstract

Objectives: Given the health risks of indoor tanning, especially for youth and young adults, we sought to determine the relationship between locations of indoor tanning facilities and locations of schools in Ontario, Canada.

Methods: Accessibility of indoor tanning facilities relative to schools was measured using ArcGIS 10.6 software. Buffered zones around each school and indoor tanning facility were created to determine whether the location of tanning facilities fell within 1.5 km, 2 km, or 3 km of each school. The mean and median distances between tanning facilities and schools were calculated by school type and community type. The Diggle-Cressie-Loosmore-Ford test measured clustering between indoor tanning facility locations and school locations within one urban area (Toronto, Ontario).

Results: In Ontario, 95% of indoor tanning facilities (n=655) are located within 3 km of a high school, and 44% (n=300) are located within 3 km of a college or university. The mean distance between tanning facilities and schools in Ontario is 1.3 km for high schools, and 8.0 km for colleges and universities. This mean distance was 1.0 km for high schools in urban communities in Ontario. The locations of indoor tanning facilities and schools cluster (p=0.004) in Toronto.
Conclusions: Youth and young adults have relatively easy access to indoor tanning given the close geographic distances of indoor tanning facilities to schools, especially in urban communities. Public health policy should address zoning of indoor tanning businesses to restrict the locations of facilities relative to schools, especially high schools.
5.2 Introduction

The availability of built-environment resources has been linked to health behaviours, both healthy and unhealthy (Alaniz 1998; Diez Roux et al. 2007; Leatherdale and Strath 2001; Novak et al. 2006; Powell et al. 2007; Trapp et al. 2018). For example, adults living in areas with a high density of fitness resources including team sports, conditioning activities, and other individual activities, participate in more physical activity (Diez Roux et al. 2007). Similarly, adolescents with greater access to commercial physical activity facilities participate in more vigorous physical activity (Powell et al. 2007). In contrast, high rates of underage smoking have been found in areas with many tobacco retail locations, especially when located close to schools (Leatherdale and Strath 2001). Similarly, the presence of a liquor store within 800 m of an adolescent’s home or school has been associated with ever drinking, and binge drinking (Trapp et al. 2018). Indoor tanning is another such behaviour where availability similarly increases the likelihood of participation (Mayer et al. 2011).

Indoor tanning use is associated with an increase in the risk of skin cancer, and subsequently an increased burden of skin cancer (Boniol et al. 2012; Sullivan et al. 2019; Wehner et al. 2012). In Canada in 2015, there were an estimated 6,800 cases of melanoma skin cancer and 78,300 cases on non-melanoma skin cancers including basal cell and squamous cell carcinomas (Canadian Cancer Society’s Advisory Committee on Cancer Statistics 2015). Of these cancer cases, an estimated 7% of melanomas, 5% of basal cell carcinomas, and 8% of squamous cell carcinomas were attributable to indoor tanning (Sullivan et al. 2019). Despite these risks and the
increased burden of skin cancer, an estimated 1.35 million Canadians participated in indoor tanning in 2014 (Qutob et al. 2017). Nearly 23,000 of these Canadians were under the age of 18 (Qutob et al. 2017). Indoor tanning use by youth and young adults is especially concerning considering the evidence of a dose-response relationship between indoor tanning and the risk of skin cancer, with melanoma risk nearly doubling with indoor tanning use under the age of 35 (Boniol et al. 2012). Additionally, because youth and young adults are the most frequent indoor tanners, and the use of UV tanning devices can be addictive, there is the potential to create a pattern of exposure early in life (Gordon and Guenther 2009; Mosher and Danoff-Burg 2010; Nadalin et al. 2016).

To combat the risks associated with indoor tanning bed use, especially including the risks to youth, all provincial governments and one territorial government have implemented indoor tanning legislation in Canada (Gosselin and McWhirter 2019). In Ontario, The Skin Cancer Prevention Act (Tanning Beds) (SCPA) regulates youth access to indoor tanning (Ontario Ministry of Health and Long-Term Care 2014). Importantly, the SCPA prevents indoor tanning by individuals under the age of 18, prohibits advertising or marketing to individuals under the age of 18, and requires age verification for individuals who appear to be under the age of 25 before use. Although the SCPA bans youth from participating in indoor tanning, compliance with indoor tanning legislation is often suboptimal (Reimann et al. 2018). This lack of compliance by indoor tanning facilities is cause for concern.

The number of indoor tanning facilities in Ontario consistently decreased from 2006-2017 (McWhirter et al. 2018). Specifically, after the SCPA was passed between
2012 and 2013, there was a 23.7% decrease in the number of indoor tanning salon listings in Ontario, and between 2013 and 2014 when the SCPA was enacted, another 4.2% decrease in the number of indoor tanning salon listings (McWhirter et al. 2018). In 2017, there were 388 indoor tanning salon business listings in Ontario (McWhirter et al. 2018). Although the number of tanning salons is decreasing, the prevalence of youth indoor tanning in Ontario did not change after the implementation of indoor legislation, compared to before (Nadalin et al. 2018). Additionally, results from a survey of Ontario Public Health Units (PHUs) found there has only been one infraction related to underage tanning since the implementation of the SCPA (Reimann et al. 2019). Clearly youth are still gaining access to indoor tanning facilities, regardless of legislation restricting this behaviour.

Indoor tanning can occur in a variety of settings, but two of the most common are tanning salons and gyms with indoor tanning devices (Nadalin et al. 2016, 2018; Reimann et al. 2019). Eighty-seven percent of high school aged youth in Canada who tan indoors do so at tanning salons (Nadalin et al. 2018). Interestingly, though, many tanners, including 27% of youth, report indoor tanning at gyms (Nadalin et al. 2018). In a previous study across Canada, 43% of gyms surveyed offered indoor tanning, and 4% of those not already offering indoor tanning indicated they were planning to offer indoor tanning in the future (Huang and Kirchhof 2017). A study in the US found that 24% of indoor tanners had indoor tanned at a gym (Pagoto et al. 2018), and these tanners were younger than other tanners. The presence of indoor tanning in gyms is concerning as it
increases the availability of artificial UV devices, and may encourage the misconception that indoor tanning is a healthy behaviour.

Not only is the availability of indoor tanning of concern, but also the access to indoor tanning, especially for youth. A study conducted in the US found adolescents living closer to indoor tanning facilities were significantly more likely to have participated in indoor tanning than those living farther away (Mayer et al. 2011). Previous US research has demonstrated indoor tanning salons are found near schools, especially high schools (Nahar et al. 2018; Olson et al. 2013; Patel et al. 2007).

Given the many tanning facilities in Ontario, and that proximity to tanning facilities has been associated with youth indoor tanning, we sought to determine the relationship between locations of indoor tanning facilities and locations of schools in Ontario. Our first objective was to assess the proximity of facilities offering indoor tanning relative to schools in Ontario. Second, we sought to determine the proximity between indoor tanning facilities and different types of schools (high schools, colleges and universities) in different types of communities (rural, small, medium, or large urban). Finally, our third objective was to determine if the locations of indoor tanning facilities interact with the locations of schools in using a dense urban area as a case study (Toronto, Ontario).

5.3 Methods

5.3.1 Data Collection and Measures

This cross-sectional geospatial study covered the province of Ontario, Canada. A list of tanning salons and gyms with indoor tanning was compiled in late 2017 and early
2018. First, a list of indoor tanning salons in Ontario was created by identifying businesses listed in InfoCanada’s business directory (InfoCanada 2017). Additional indoor tanning salons were identified through YellowPages.com using the search term “indoor tanning”. The location of each indoor tanning salon was recorded and verified using Google™. Salons were excluded if they were not located in Ontario, indicated as closed on Google, or if they exclusively offered non-UV tanning services (e.g., spray tanning). Next, a list of gyms with indoor tanning in Ontario, Canada was created by identifying fitness businesses listed in InfoCanada’s business directory (InfoCanada 2017). Additional gyms with indoor tanning were identified through YellowPages.com using the search terms “gym” and “fitness facility”. All exercise and fitness facilities were then searched on Google to ensure the name and location of each facility was correct. All facility websites were visited, to ensure the facility fit in the inclusion criteria (i.e., fitness facilities that contained cardio and weightlifting equipment to be used alone or in group sessions). Example exclusion criteria were: pilates studios, rock climbing gyms, martial arts centres, gymnastics studios, and university or college gyms. Gyms meeting the inclusion criteria were telephoned and asked if they had indoor tanning at their facility. The list of gyms was updated to include only those offering indoor tanning. Street addresses and longitude and latitude coordinates were collected for each identified indoor tanning salon and gym offering indoor tanning through Google Maps.

A list of all public and private schools in Ontario in 2017 was retrieved from Scholars GeoPortal (Ontario Council of University Libraries 2019). Schools classified as ‘unknown’ by the database were updated through Google searches to determine
missing school type (i.e. public, private, college, university), teaching level (i.e. junior, intermediate, senior), and grades offered (i.e. 9-12). Schools were characterized based on highest grade offered. A school was characterized as a high school if the highest grade offered was between 9 and 12, and college or university if education toward a post-secondary degree or diploma was offered. Relative walking distance to school by grade level was determined by searching for transportation eligibility criteria from school boards in Ontario. Based on school board descriptions, we determined ‘walking distance’ to school is considered less than 3.2 km for students in high school (grades 9-12) and 1.6 km for students in elementary school (Ottawa Student Transportation Authority 2018; Thames Valley District School Board 2017; Toronto District School Board 2014; Wellington-Dufferin Student Transportation Services 2017; York Region District School Board 2018). These walking distances were used to determine whether indoor tanning facilities were close to schools in data analysis. The authors determined that high schools, colleges, and universities were the schools of interest based on student age and likelihood of participating in indoor tanning. Therefore, elementary schools were excluded.

Indoor tanning salons, gyms with indoor tanning, and schools (high schools, colleges, universities) in Ontario were mapped using ArcGIS 10.6. From these geographic points, we created layers representing buffered zones around each school and indoor tanning facility, at a radius of 1.5 km, 2 km, and 3 km separately. The indoor tanning facility (gym or salon) or school was in the centre of the buffer. These distances were chosen based on the aforementioned walking distances to schools. We
considered all three of these distances as close to schools, since students are assumed to walk these distances between home and school daily. The frequency (n, %) of tanning facilities falling within these distances from schools was determined as was the frequency (n, %) of schools falling within these distances from indoor tanning facilities.

Population size and density for all areas of Ontario were collected from Statistics Canada population and dwelling counts from the 2016 census (Statistics Canada 2018). Based on Statistics Canada classifications (Statistics Canada 2017), communities were classified as large urban, medium, small, or rural, based on the population size and population density of each area (Table 5.1). Schools and indoor tanning facility locations were classified by community type. The number and percent of each school and indoor tanning facility within each community type is found in Table 5.2. To determine the proximity between indoor tanning facilities and different types of schools in different community types (i.e. rural, small, medium, or large based on population density and size), the mean distances between tanning facilities and schools were calculated by school type (i.e. high school or college/university) and community type (i.e. rural, small, medium, large urban).

5.3.2 Statistical Analysis

Ontario’s population density includes sparsely populated areas, where schools and indoor tanning facilities will be located within a small area surrounded by vastly less populated lands, which will naturally lead to strong spatial clustering between indoor tanning facilities and schools. The areas of high and low population density within the province of Ontario dictate the locations of services, including schools and businesses
Therefore, to determine whether the locations of schools and indoor
tanning facilities interact, the study area for this analysis was restricted to the
geographic area covered by the Toronto PHU, which accounts for about 40% of the
total population in Ontario and 1793 km² (Statistics Canada 2018).

Point maps were used to visualize the spatial distribution of schools and indoor
tanning facilities (tanning salons and gyms with indoor tanning) in all of Ontario and then
Toronto specifically. The maps were projected using the Universal Transverse Mercator
projection, specifically the WGS84 / UTM 17N projection, and scaled to kilometers. The
geographic distances between schools and indoor tanning facilities within Toronto follow
a skewed distribution and were summarized using median distance. For a marked point
process object in R (R Core Team 2019) (spatstat-package), the function nndist() was
used. A marked point process is a spatial process with additional information associated
with each data point (Stoyan et al. 1995). In this case, the information described
whether each data point was a school or an indoor tanning facility.

The cross L-function was used to determine if there was clustering between the
locations of indoor tanning facilities and the locations of schools. The K-function for a
single point process is interpreted as clustering of a single spatial point process. The K-
function was transformed to the L-function for easier visual interpretation. For two types
of data points (a marked point process), the K- and L-functions are replaced by the
cross-K-function and the cross-L-function respectively. The interpretation then changes
from clustering of one type of data point (process) to clustering between two types of
data points as indicated by their marks, i.e. schools vs. tanning facilities. This clustering
is interpreted as an association, meaning the locations of schools and indoor tanning facilities are not independent, but related.

The cross-L-function provided a visual assessment of the clustering between locations of schools and indoor tanning facilities. Additionally, the Diggle-Cressie-Loosmore-Ford test was applied to formally test for clustering between the locations of indoor tanning facilities and the locations of schools compared to random dispersion. The Diggle-Cressie-Loosmore-Ford test of complete spatial randomness (CSR) (Baddeley et al. 2016) was applied through the spatstat package (Baddeley and Turner 2005), a package in R statistical software for the statistical analysis of spatial point patterns (R Core Team 2019).

5.4 Results

A total of 1692 Ontario schools were included in the analysis: 1497 high schools, and 195 post-secondary school campuses (colleges and universities). A map displays the locations of high schools and colleges and universities across Ontario in 2017 (Figures 5.1 and 5.2). Of the total number of schools, 59% (n= 695) were located in large urban communities, 8% (n=130) were in medium communities, 6% (n=97) were in small communities, and 28% (n=468) were in rural communities (Table 5.2).

A total of 688 Ontario indoor tanning facilities were included in the analysis: 420 indoor tanning salons, and 268 gyms with indoor tanning. A map displays the locations of indoor tanning facilities across Ontario in 2017 (Figures 5.3 and 5.4). Of the total number of indoor tanning facilities, 62% (n=430) were located in large urban
communities, 12% (n=81) were located in medium communities, 7% (n=49) were located in small communities, and 19% (n=128) were located in rural communities (Table 5.2).

A combined map of Ontario depicts the locations of all 1692 schools and 688 tanning facilities together (Figures 5.5 and 5.6). Overall, 95% of indoor tanning facilities were located within 3 km of a high school, while 44% were located within 3 km of a college or university. Further, 78% and 18% are located within 1.5 km of high schools or colleges/universities, respectively. This differed by facility type, with a numerically higher percent of gyms with indoor tanning located within 3 km of both high schools (97%) and colleges/universities (44%) compared to indoor tanning salons (high schools: 94%; colleges/universities: 41%) (Table 5.3). Additionally, 76% of high schools and 86% of colleges or universities were located within 3 km of an indoor tanning facility. Further, 50% of high schools and 49% of colleges/universities are located within 1.5 km of indoor tanning facilities. This differed by facility type, with a numerically higher percent of high schools and colleges/universities located within 3 km of indoor tanning salons (high schools: 67%; colleges/universities: 76%) compared to gyms with tanning (high schools: 59%; colleges/universities: 67%) (Table 5.4).

Population density in people per km$^2$ was also mapped (Figures 5.7 and 5.8). Across Ontario, the mean distance between tanning facilities and high schools and colleges/universities was 1.32 km, and 7.97 km, respectively. In large urban communities, the mean distance of tanning facilities to high schools and colleges/universities was 1.00 km, and 4.10 km, respectively, in medium communities.
was 1.07 km, and 4.46 km, respectively, in small communities was 1.10 km, and 18.11 km, respectively, and in rural communities was 2.63 km, and 19.30 km, respectively (Table 5.5).

A point map was created of the Toronto study area, encompassing a total of 363 school locations (375 schools, 12 with overlapping locations) and 94 indoor tanning facility locations (Figure 5.9). The median distance from indoor tanning facility to the nearest school in Toronto was 436 m, similar to the distance between two schools (435 m). Additionally, the median distance from any given school to the nearest tanning facility was 1.03 km.

The visual assessment of the cross-L-function showed clustering. Statistical confirmation was achieved through the Diggle-Cressie-Loosmore-Ford test of CSR. The maximum distance for clustering was set at the “walking-distance” for high school students of 3.2 km. The test was applied using 999 Monte Carlo simulations and resulted in a p-value of p=0.004. This indicates that there is evidence of clustering between the locations of indoor tanning facilities and the locations of schools in Toronto, Ontario.

5.5 Discussion

In Ontario, 95% of indoor tanning facilities are located within 3 km of a high school, and 44% are located within 3 km of a college or university. The mean distance between tanning facilities and schools in Ontario is 1.3 km for high schools (1.0 km for urban high schools), and 8.0 km for colleges and universities. In the large urban area of
Toronto, Ontario, indoor tanning facilities and schools cluster. These findings suggest youth and young adults have relatively easy access to indoor tanning given the close geographic distances of such facilities to schools.

The findings in this study are similar to previous research conducted in the US showing that tanning facilities are located close to schools. One study found that 74% of high schools in New Hampshire have at least one tanning facility within 3.2 km (2 miles) of the school (Olson et al. 2013). Moreover, a recent study conducted in Worcester County, Massachusetts, found that tanning facilities were concentrated around schools, especially colleges and universities, and that 39% of middle schools, high schools, and colleges and universities were within 1.6 km (one mile) of a tanning salon (Nahar et al. 2018). This study also found that tanning salons were located more closely to schools than McDonald’s restaurants (Nahar et al. 2018). This ease of access to indoor tanning may increase indoor tanning use by youth. The many indoor tanning facilities and their availability may increase youth awareness of them, the normalization of the behaviour, and the extent to which they are easily accessible (i.e. within walking distance from school).

Indoor tanning is likely a common practice due, in part, to the proximity of tanning facilities and schools. Indoor tanning remains a popular activity worldwide, especially among youth and young adults. An international systematic review of 16 countries found approximately 18% of adolescents had participated in indoor tanning in 2014 (Wehner et al. 2014). In the US, the 2017 American Youth Risk Behaviour Survey indicated that 5.6% of high school students used an indoor tanning device at least once over the
previous year (Kann et al. 2018). Across 7 provinces in Canada, the 2015 Cancer Risk Assessment in Youth (CRAYS) survey indicated that 4.4% of grade 10 and 11 high school students had ever used an ultraviolet (UV) tanning device (Nadalin et al. 2018).

Results from this study indicate the mean distances between large urban and medium communities were shorter, compared to those found for small and rural communities. The mean distance between indoor tanning facilities and high schools was 1.0 km and 1.1 km in large urban and medium communities, respectively, compared to 1.1 km and 2.6 km in small and rural communities, respectively. Approximately 78% of Ontario’s population is located within large urban and medium population size communities (Statistics Canada 2017). Previous research has also determined the mean distance between indoor tanning facilities and high schools was smaller in urban communities (Nahar et al. 2018). Since most individuals, including children, live in urban communities, from a population perspective, the potential exposure risk of youth tanning is highest in urban communities. Therefore, it is especially important to prevent youth in these communities from accessing indoor tanning facilities.

The clustering observed in this study between indoor tanning facilities and schools in Toronto, Ontario further suggests that indoor tanning facilities are located more closely to schools than if they were randomly distributed. This suggests that youth in Toronto are at a particular risk of indoor tanning, given the clustering observed and thus the high likelihood of exposure to these facilities. We suspect this is likely the case in other similarly densely populated, large urban centres in Ontario. Hence, it is
especially important that PHUs in urban communities are regularly inspecting and enforcing indoor tanning legislation, including youth access, and employing methods to prevent youth from gaining access to indoor tanning facilities.

Since 2014, youth under 18 have been banned from using indoor tanning beds in Ontario (Ontario Ministry of Health and Long-Term Care 2014). While previous research indicates nearly 8% of youth under 18 were indoor tanning in Ontario in both commercial and private locations after the legislation was enacted (Nadalin et al. 2018), few PHUs have recorded instances of indoor tanning by minors during inspections of indoor tanning facilities (Reimann et al. 2019). Inspection and enforcement are important to ensuring youth are not accessing indoor tanning. In areas where indoor tanning facilities are common and in close proximity to schools, this may be particularly difficult to ensure. Specifically, the proximity of indoor tanning facilities and high schools is concerning, given previous US research suggests the average age indoor tanning behaviour initiation is 15 years (Zeller et al. 2006). Postponing tanning bed initiation may lower skin cancer risk by reducing indoor tanning behaviour, cumulative UV exposure, and number of burns (Seidenberg et al. 2017). This indicates an important area for policy development around zoning and distance of tanning facilities from schools.

Regulating indoor tanning facilities can go a long way towards protecting health, especially of youth. Considering previous research has shown that youth living within 3.2 km (2 miles) of an indoor tanning facility are 40% more likely to have participated in indoor tanning than those youth located further away (Mayer et al. 2011), it is important
to use policy initiatives to restrict the locations of indoor tanning facilities, especially relative to schools. The current research shows that 95% of indoor tanning facilities are located within 3 km of high schools, and 78% are within 1.5 km of high schools. This proximity is concerning. Collaboration between public health and policy makers to develop policy further restricting access and decreasing proximity to indoor tanning facilities for youth is needed. Creating zoning by-laws would limit the location and density of indoor tanning facilities around schools (ChangeLab Solutions 2012). Research around tobacco use by youth has similarly suggested that reducing the density of tobacco sales outlets, especially near schools, may lower youth smoking behaviour (Larsen et al. 2017). Limiting the ease of walking distance from indoor tanning facilities to schools may make them more difficult to access. Ensuring tanning facilities are not within walking distance of schools will make tanning facilities further out of range of access, and could result in preventing indoor tanning at a young age, and therefore future cancers (Pagoto et al. 2015).

5.5.1 Limitations

Although this study focuses on one Canadian province, it does provide a model which can be applied to other jurisdictions. We relied on a straight-line method to estimate distances between indoor tanning facilities and schools rather than using road networks, which may have underestimated walking distance. However, straight-line methods have been used by other similar studies (Kwate and Loh 2010; McCarthy et al. 2009; Olson et al. 2013; Patel et al. 2007; Simon et al. 2008), and are thus an acceptable estimate. This was a cross-sectional study, and temporality of the schools
and tanning facilities was not included in this data. Therefore, there is no information about whether schools or indoor tanning facilities settled first.

5.6 Conclusions

The findings from this study suggest youth are potentially at greater risk as a result of having indoor tanning facilities located near their schools. Indoor tanning facilities are located especially close to high schools and are located closest to schools in urban and medium sized communities. Additionally, youth in Toronto are at a particular risk of indoor tanning, given the clustering observed between the locations of schools and locations of indoor tanning facilities. There is a need for greater education of youth and their parents on the risks of indoor tanning, especially within a high school setting. However, these efforts will likely fall short without policy intervention. Public health should work with policy makers to create policy addressing the zoning of indoor tanning businesses to restrict the locations of indoor tanning facilities relative to schools, especially high schools.
5.7 References


Nadalin, Victoria, Marrett, L. D., Cawley, C., Atkinson, J., Tenkate, T., McWhirter, J. E.,


Toronto District School Board. (2014). Eligibility for Student Transportation. https://www.tdsb.on.ca/EarlyYears/Kindergarten/Transportation/Eligibility


5.8 Figures

Figure 5.1 - High Schools and Colleges/Universities Across Ontario
Figure 5.2 - High Schools and Colleges/Universities in Central, Eastern, and Southern Ontario
Figure 5.3 - Indoor Tanning Facilities Across Ontario
Figure 5.4 - Indoor Tanning Facilities in Central, Eastern, and Southern Ontario
Figure 5.5 - Schools and Indoor Tanning Facilities Across Ontario

Legend

- Tanning Facilities
- Colleges and Universities
- High Schools
Figure 5.6 - Schools and Indoor Tanning Facilities in Central, Eastern, and Southern Ontario
Figure 5.7 - Population Density Across Ontario Measured as People per KM$^2$
Figure 5.8 - Population Density in Central and Southern Ontario Measured as People per KM$^2$
Figure 5.9 - Point map of school and salon location within the Toronto Public Health Unit area. (axis scales in km)
### 5.9 Tables

**Table 5.1 - Community Type based on Population Size and Population Density**

<table>
<thead>
<tr>
<th>Community Type</th>
<th>Population Size</th>
<th>Population Density (persons per square km)</th>
<th>Numbers of Communities</th>
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<td>Large Urban</td>
<td>100,000 or more</td>
<td>200 persons or more</td>
<td>24</td>
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<tr>
<td>Medium</td>
<td>30,000 - 99,999</td>
<td>200 persons or more</td>
<td>18</td>
</tr>
<tr>
<td>Small</td>
<td>1,000 - 29,999</td>
<td>200 persons or more</td>
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<td>Any Population Size</td>
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Table 5.2 - Indoor Tanning Facility Type and School Type by Population Type

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<thead>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural</td>
<td>Small</td>
<td>Medium</td>
<td>Large Urban</td>
<td></td>
</tr>
<tr>
<td>All facilities (n=688)</td>
<td>128 (19%)</td>
<td>49 (7%)</td>
<td>81 (12%)</td>
<td>430 (62%)</td>
<td></td>
</tr>
<tr>
<td>Tanning facilities (n=420)</td>
<td>101 (24%)</td>
<td>38 (9%)</td>
<td>48 (11%)</td>
<td>233 (55%)</td>
<td></td>
</tr>
<tr>
<td>Gyms with tanning (n=268)</td>
<td>27 (10%)</td>
<td>11 (4%)</td>
<td>33 (12%)</td>
<td>197 (74%)</td>
<td></td>
</tr>
<tr>
<td><strong>School Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Schools (n=1497)</td>
<td>425 (28%)</td>
<td>82 (5%)</td>
<td>108 (7%)</td>
<td>880 (59%)</td>
<td></td>
</tr>
<tr>
<td>College/University (n=195)</td>
<td>43 (22%)</td>
<td>15 (8%)</td>
<td>22 (11%)</td>
<td>115 (59%)</td>
<td></td>
</tr>
</tbody>
</table>
Table 5.3 - Number and percent of tanning facilities within 1.5, 2.0, or 3.0 km to the nearest school, by tanning facility type

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>1.5 km</th>
<th>2.0 km</th>
<th>3.0 km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Schools</td>
<td>Colleges/Universities</td>
<td>High Schools</td>
</tr>
<tr>
<td>All Facilities (n=688)</td>
<td>536 (78%)</td>
<td>122 (18%)</td>
<td>605 (88%)</td>
</tr>
<tr>
<td>Tanning Salons (n=420)</td>
<td>332 (79%)</td>
<td>73 (17%)</td>
<td>372 (88%)</td>
</tr>
<tr>
<td>Gyms (n=268)</td>
<td>204 (76%)</td>
<td>49 (18%)</td>
<td>233 (87%)</td>
</tr>
<tr>
<td>School Type</td>
<td>All Facilities</td>
<td>Salon</td>
<td>Gym</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td>1.5 km</td>
<td>2.0 km</td>
<td>3.0 km</td>
</tr>
<tr>
<td>High School</td>
<td>747 (50%)</td>
<td>580 (39%)</td>
<td>437 (29%)</td>
</tr>
<tr>
<td>College/University</td>
<td>96 (49%)</td>
<td>82 (42%)</td>
<td>68 (35%)</td>
</tr>
</tbody>
</table>

Table 5.4 - Number and percent of schools within 1.5, 2.0, or 3.0 km to the nearest tanning salon and gym with tanning, by school type
Table 5.5 - Mean distance between Tanning Facilities and Schools

<table>
<thead>
<tr>
<th>Community Type</th>
<th>Mean Distance in KM (Standard Error [95% CI])</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Facilities</td>
</tr>
<tr>
<td>All of Ontario</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>1.32 (0.08 [1.16,1.47])</td>
</tr>
<tr>
<td>College / University</td>
<td>7.97 (0.50 [6.99,8.95])</td>
</tr>
<tr>
<td>Rural</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>2.63 (0.39 [1.87,3.40])</td>
</tr>
<tr>
<td>College / University</td>
<td>19.30 (1.63 [16.06,22.53])</td>
</tr>
<tr>
<td>Small</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>1.10 (0.14 [0.81,1.39])</td>
</tr>
<tr>
<td>College / University</td>
<td>18.11 (4.06 [9.94,26.27])</td>
</tr>
<tr>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>1.07 (0.07 [0.93,1.21])</td>
</tr>
<tr>
<td>College / University</td>
<td>4.46 (0.52 [3.43,5.49])</td>
</tr>
<tr>
<td>Large Urban</td>
<td></td>
</tr>
<tr>
<td>High Schools</td>
<td>1.00 (0.39 [0.92,1.08])</td>
</tr>
<tr>
<td>College/University</td>
<td>4.10 (0.15 [3.80,4.40])</td>
</tr>
</tbody>
</table>
6 CHAPTER 6 | General Discussion and Conclusions

6.1 Overview of the Thesis

The body of work comprising this doctoral research provides a synthesis of previous worldwide research conducted on indoor tanning compliance and its impact on youth tanning. Additionally, using Ontario, Canada as a focus, this research provides a greater understanding of how legislation is functioning and the ease of access to indoor tanning for youth as determined by the proximity of indoor tanning facilities relative to schools. This research was conducted through a series of studies including using methodologies of systematic reviews, a cross-sectional study using an online survey, and geo-spatial analyses. This approach helped to better understand the current landscape of indoor tanning legislation and future directions, especially with a focus on youth access and restrictions.

The focus of Chapter 2 was a synthesis of the existing literature on compliance with indoor tanning legislation with the purpose of making recommendations on improving compliance, especially through legislative amendments. Chapter 3 synthesized the impact of indoor tanning legislations on the prevalence and frequency of youth indoor tanning and characterized these changes. The research in Chapter 4 evaluated how indoor tanning legislation in Ontario has been implemented, enforced, and complied with, and to uncover barriers and facilitators to inspection and enforcement. Finally, Chapter 5 evaluated the proximity between indoor tanning facilities and schools in Ontario and offers suggestions for future legislative directions.
The results of these studies offer new research in the Ontario context, situated within the broader global research on indoor tanning legislation, as well as resulting recommendations for legislative amendments and new directions to help prevent indoor tanning behaviour. The summation of this work provides information for public health practitioners, policymakers, researchers, and the public around mitigating the risks of indoor tanning, especially for youth, towards the broader public health goal of preventing skin cancer.

6.1.1 Key Findings and Implications

Overall, the key findings show 1) compliance with many aspects of indoor tanning legislation is low, 2) indoor tanning legislation has been associated with lower tanning prevalence among youth, 3) the protective effects of indoor tanning legislation cannot be fully realized without better enforcement strategies, and 4) indoor tanning facilities are located in close proximity with schools which likely impacts prevalence of indoor tanning behaviour, especially by youth. This work has strengthened the scientific literature related to the current and evolving indoor tanning legislations.

Commercial tanning was first introduced in the 1970s, and since then its popularity has increased substantially (Pawlak et al. 2012). However, results from this thesis and other research suggest this trend may be changing. As of 2017, there were 688 indoor tanning salons and gyms with indoor tanning in Ontario. The number of tanning salons listed in Ontario decreased by 63.2% from 2006 to 2017 (McWhirter et al. 2018). This is a promising trend, as fewer tanning salons suggest a decrease in indoor tanning access, demand and potentially use. Additionally, results from the 2014
Canadian Community Health Survey suggest that the percentage of Canadians participating in indoor tanning has decreased by 50% since 2006 (Qutob et al. 2017; The Ontario Sun Safety Working Group 2006).

There is also a lower trend in the prevalence of youth indoor tanning in the US. This is likely a result of indoor tanning legislation banning youth from indoor tanning. This decline was true for comparisons of youth tanning before and after legislation was introduced in some jurisdictions (n=3, mean=3% decrease, range=1%–6% decrease), and also when comparing states with and without legislation (n=4, mean=5% lower, range=1%–18% lower), and when comparing states with complete age restrictions (no parental permission exemptions) to those with legislation allowing youth access with parental consent (n=2, mean(females)=11% lower, mean(males)=2% lower, range=2%–13% lower). The decline appeared to increase as time passed from when legislation was enacted because the decline was larger for states with longer standing compared to newly implemented legislation (n=2, mean=9% lower, range=2%–20% lower). The percent decreases in youth indoor tanning prevalence were, on average, small (ranging from 1% to 20%); however, this equates to millions of youth not participating in indoor tanning at the population level. While the general trend of lower indoor tanning prevalence is encouraging, the results also indicate youth are still indoor tanning across the US, despite policy banning youth use. Hence, though indoor tanning legislation is having some positive impact, it may not be reaching its full intended effect.

Although the prevalence of indoor tanning appears to be declining, results from this research suggest youth are still gaining access to indoor tanning facilities.
regardless of legislation restricting their access and use. Compliance with indoor tanning legislations regarding youth access are varied (mean=65%, range=0 to 100%), but often quite low, especially when evaluated using in-person compliance checks (mean=34%, range=20%-62%), which are most like real-world access scenarios. In comparison, compliance with indoor tanning legislation estimated by telephone methods are likely overestimated (mean=65%, range=0%-100%), because of prompting used when asking questions about indoor tanning legislations, as well as social acceptability bias impacts on this methodology. Asking direct questions to the owner/operators about their businesses age compliance is likely not an accurate proxy for true age compliance. For example, a question may have asked “I am 14, can I indoor tan at your facility?” In contrast, in-person methods often rely on “secret shoppers”, which has been used for tobacco control, and has led to improved compliance with youth access restrictions (Krevor et al. 2011). The “secret shopper” method has a youth pose as a consumer and attempt to make a purchase (Krevor et al. 2011). In-person checks provide the most accurate reflection of true compliance with indoor tanning legislation. This method should be implemented worldwide as one way to reduce the rates of youth indoor tanning when coupled with restrictive legislation. Further, 20 Public Health Units (PHUs) in Ontario responsible for inspecting indoor tanning facilities only reported one infraction related to underage sales over a four-year period. This is clearly an underestimation of youth tanning in Ontario, as research conducted after the implementation of the Skin Cancer Prevention Act (SCPA) found that nearly 8% of youth were still indoor tanning (Nadalin et al. 2018). This implies youth are gaining access to indoor tanning facilities,
and PHUs are not finding these infractions to be able to stop them. Improved methods for ensuring youth are not gaining access to indoor tanning facilities are needed in Ontario, and more broadly in all jurisdictions with indoor tanning legislation.

Proximity to indoor tanning facilities also plays a role in youth indoor tanning. A study conducted in the US found adolescents living closer to indoor tanning facilities were significantly more likely to have participated in indoor tanning than those living farther away (Mayer et al. 2011). Additionally, research has found that indoor tanning salons are located near schools, especially high schools (Nahar et al. 2018; Olson et al. 2013; Patel et al. 2007). In much of Ontario, the close proximity between indoor tanning facilities and schools creates a pattern of easy access for youth. The average distance between indoor tanning facilities and schools is 1.3 km for all high schools (1.0 km for urban high schools), and 8.0 km for colleges and universities. Additionally, there is a significant clustering between the locations of tanning facilities and the locations of schools in Toronto. This indicates high schools and tanning facilities are clustered within Toronto. Assuming this is similar for other large, urban cities in Ontario, youth in densely populated cities are at a particular risk of indoor tanning. Public health should work with policy makers to create more stringent legislation, improve enforcement around youth access, and create policy addressing the zoning of indoor tanning businesses.

Signage is another important component of indoor tanning legislation. Warning signs raise awareness of avoidable health issues and influence health behaviours (Stockwell 2006; Wettlaufer et al. 2009). They also increase conversations about risky health behaviours and can shift social norms (Martin-Moreno et al. 2013). Compliance
with posting warning signs in the literature was 44% on average across studies included in the systematic review (range=8%-97%). This is concerning, as the communicative role of warning signs is important. However, previous research suggests inspections of warning signs are being conducted to ensure consumers are being provided with appropriate health risk information (Hickle et al. 2005). In Ontario, PHUs reported SCPA complaints, infractions, and enforcement responses were most often related to signage (83% of all infractions). Together with previous findings, these results suggest the indoor tanning industry may be resistant to posting warning signs. Speculatively, this may be because warning signs have the potential to deter indoor tanning use by communicating risk information to consumers.

Effective enforcement is imperative to ensure indoor tanning legislation is being properly followed. To have effective enforcement, public health needs appropriate resources. Previous research found that across the most populous cities in 28 US states, a median of two staff were available to conduct enforcement activities (Mayer et al. 2008). Only six of these cities reported conducting annual inspections of indoor tanning facilities. It is likely that cities not conducting annual inspections need more resources to do so (Mayer et al. 2008). Similarly, Ontario’s PHU staff reported a lack of resources as a significant barrier to inspection and enforcement related to the SCPA. Most infractions were uncovered during routine inspections (97%), rather than complaint-based inspections. Research has found that routine inspections are associated with increased compliance with indoor tanning legislation (Hickle et al. 2005; Pichon et al. 2009). To conduct routine inspections, greater resources are needed for
inspections of indoor tanning facilities for compliance with legislation. It is especially important that PHUs in urban communities, where indoor tanning facilities are located the closest to schools are regularly inspecting and enforcing indoor tanning legislation, including youth access, and employing methods to prevent youth from gaining access to indoor tanning facilities. Possible ways to increase funds available for inspection and enforcement could include applying charges to indoor tanning facilities for noncompliance, as outlined by the Schedule of Fines in Ontario (Ontario Court of Justice 2014), an indoor tanning business registration fee, or an indoor tanning tax, as has been implemented in the US (Internal Revenue Service 2012). Both methods will likely aid in deterring indoor tanning behavior because it will result in a more expensive service as the cost is passed on to the consumer. Greater resource allocation towards indoor tanning facility inspection should lead to better enforcement and, in-turn, greater compliance with legislation.

Overall, results show imperfect compliance with all aspects of indoor tanning legislation. Indoor tanning legislation is clearly not meeting its intended outcome of total compliance. Consistent with these findings, Ontario’s SCPA is not fully complied with, as PHUs in Ontario have found 242 infractions related to all aspects of the SCPA between 2014 and 2017. Amendments must be made for the SCPA, and all other indoor tanning legislations worldwide to maximize their effectiveness. Future indoor tanning policy research and practice should consider successful strategies used by other public health initiatives, including alcohol and tobacco control. These strategies
should include secret shopper inspections, and routine, unannounced inspections of indoor tanning facilities.

The results from the research presented in the chapters of this thesis provide: 1) a synthesis of the environment around compliance and enforcement of indoor tanning legislations worldwide; 2) a first look at how the SCPA is being inspected, enforced, and complied with in Ontario; and 3) support for further policy tools to regulate the proximity between indoor tanning facilities and schools in Ontario. The lack of compliance with indoor tanning legislations, especially related to youth access and signage requirements, the lack of resources to support enforcement, and the close proximity between indoor tanning facilities and schools are issues which need to be addressed by future collaborations between public health practitioners and policy makers. However, the noted decrease in the prevalence of youth indoor tanning behaviour is a promising step towards protection from all health risks associated with indoor tanning, especially for youth.

### 6.2 Strengths of the Research

Different methodological approaches were applied throughout this research. The systematic reviews presented in Chapters 2 and 3 follow PRISMA guidelines and provide a synthesis of the available peer-reviewed literature. These chapters were a necessary first step, providing current compliance levels with indoor tanning legislations in the US, and the impact of these legislations on youth indoor tanning behaviour. This research is helpful for researchers, public health practitioners, and policymakers,
providing a comprehensive overview of the available literature, while acknowledging existing gaps.

Next, a cross-sectional study was conducted utilizing an electronic survey sent to all PHUs in Ontario (Chapter 4). The questions were created based on the SCPA legislation itself, the Ontario government-issued Tanning Facility Inspection Report form used by PHU staff to record inspection details, the inspection protocol document issued by the Ontario Ministry of Health and Long-Term Care about the implementation and enforcement of the SCPA (Ontario Ministry of Health and Long-Term Care 2018), and through discussions with public health personnel conducting inspections related to the SCPA. This created a comprehensive, relevant, and robust set of questions. Both closed- and open-ended questions were included in the questionnaire, and the latter helped to gain an understanding of the respondents’ opinions and perceptions of the SCPA. Our moderate response rate (56%) was likely due to recruitment through a hardcopy letter sent by mail introducing the questionnaire and inviting their PHU’s participation, followed by an email that included the questionnaire link. A notable strength of Chapter 4 is that it was conducted as a process evaluation, which is unique to indoor tanning legislation evaluations, since most are outcome evaluations. Importantly, the results of Chapter 4 help to explain previous findings showing that youth still participate in indoor tanning despite legislation prohibiting this (Nadalin et al. 2018).

All known tanning salons and gyms with tanning beds were included in the geo-spatial analysis of indoor tanning facilities relative to the high schools, universities, and
colleges in Ontario (Chapter 5), creating a comprehensive provincial data set. This data set can be used for future research on the quantity and locations of indoor tanning facilities. As well, this study provides a model which can be applied to other jurisdictions to determine if indoor tanning facilities are similarly located in close proximity to schools in other areas. The methodology used was rigorous, with two researchers ensuring all indoor tanning facilities were captured for analysis. The results, when considered in the context of previous findings indicating that proximity is associated with increased use (Mayer et al. 2011), provide strong evidence for future policy addressing the zoning of indoor tanning businesses to restrict the locations of indoor tanning facilities relative to schools, especially high schools.

The evidence from the Ontario analyses make important contributions to the Canadian context for indoor tanning legislation research. This research contributes to a growing body of evidence around Ontario's legislation and the Ontario context, which can be used to inform research in other provinces and provide evidence around what may be happening in other provinces. This research provides information around the number of indoor tanning facilities in Ontario, and highlights that many gyms also offer indoor tanning. All research results presented have real-world applications. For example, evidence from the survey of Ontario PHUs highlight the need for mandatory, routine inspections, more resource allocation toward inspection and enforcement of the SCPA, and overall imperfect compliance with the SCPA. Findings are useful for both public health professionals and policymakers, as they provide evidence needed to
strengthen current policy, and support the further regulation of the indoor tanning industry.

6.3 Limitations of the Research

For the systematic reviews, only English-language, peer-reviewed studies were included, meaning studies in other languages, and those in the grey literature were excluded. These studies may have provided further evidence which were not included in these analyses. The broad heterogeneity of studies including methodologies, temporal and geographical differences, different study sites or study participants (facilities, websites, beds, public health inspectors), and different populations of interest made comparisons across studies challenging. A quantitative meta-analysis was not possible. Additionally, legislation content and stringency varied across jurisdictions, which made comparisons between differing jurisdictions difficult. Further, some manuscripts did not describe which jurisdictions, corresponding legislations, and legislative elements were examined in their evaluations. These factors created challenges when synthesizing the available evidence.

In the study of PHUs in Ontario with respect to inspection and enforcement of the SCPA, we did not assess whether certain types of tanning facilities (e.g., tanning salons vs gyms with tanning) differed regarding complaints or infraction type or quantity. The data did not enable linkages between facility type and complaints or infractions. Our data did not allow us to address whether complaints and infractions were clustered within certain jurisdictions in Ontario. Further, our data may underestimate the number
of infractions related to business registration, since the tanning facility inspection report form used by PHUs to record infractions does not include this type of infraction, which may influence how PHUs track this and reported it on the questionnaire.

The geo-spatial examination of proximity of indoor tanning facilities to schools focused on one Canadian province only, hence findings from other provinces remain unknown. Straight-line methods were used to estimate distances between indoor tanning facilities and schools rather than using road networks. Therefore, we potentially underestimated walking distances. However, straight-line methods have been used previously (Kwate and Loh 2010; McCarthy et al. 2009; Olson et al. 2013; Patel et al. 2007; Simon et al. 2008), and are considered acceptable estimate. Definitions of community sizes were limited by those classifications given by Statistics Canada (Statistics Canada 2018). These classifications may not be completely accurate, as some of the communities included both the population centres, and the surrounding rural areas. Therefore, urban communities may also include areas of the province more similar to rural communities.

Overall limitations of this body of work should also be recognized. Legislative differences between jurisdictions included in this research should be taken into consideration when making inferences beyond those jurisdictions included in the analyses. This may make extrapolating these results beyond these jurisdictions difficult. Additionally, the indoor tanning industry is constantly changing, with facilities frequently opening and closing. Although correct at the time of the studies, the exact number of indoor tanning facilities may have changed since this research was conducted.
6.4 Next Steps for Research

Given the lower compliance with in-person inquiries compared to telephone inquiries, we encourage researchers to use in-person data collection techniques when evaluating compliance with indoor tanning legislations as these may more accurately reflect day-to-day business practices. Moreover, the variability in compliance noted in one of the systematic reviews in this work suggests that high compliance for key aspects of indoor tanning legislation is possible. Hence, the variables contributing to high compliance with indoor tanning legislation should be more carefully determined as a priority area for future research, as such findings could inform best practices. Future research should strive to explicitly define compliance, to allow for clearer understanding of research findings.

Future research should also consider the temporal relationship between the implementation of indoor tanning legislation, and the timing of both compliance and impact research. Researchers may wish to explore how compliance with legislation in a jurisdiction changes over time to further describe temporal trends, which should clarify some of the differences in compliance, and shed some light on how long it takes for a legislation to become impactful. Further, the factors associated with higher versus lower compliance, such as public health messaging to youth and/or parents, could be researched across jurisdictions. Most studies on compliance and impact were conducted in the US, suggesting a need for studies from more countries with different indoor tanning legislation experiences. Research is also needed to evaluate why
regional differences exist. Future research should also explore which aspects of legislative stringency are most impactful with respect to indoor tanning legislation.

The intention to understand the frequency of indoor tanning by youth relative to legislation in the context of one of the systematic reviews was restricted by the inclusion of only one study on the topic. Typically, in most survey research conducted on indoor tanning behaviour, youth are only asked if they have participated in indoor tanning in the previous 12 months. To gain a greater understanding of the frequency of indoor tanning by youth, more research is needed to determine how often youth are participating in indoor tanning.

Future research should assess whether certain types of tanning facilities (e.g., tanning salons vs gyms with tanning) differ regarding complaints or infraction type or quantity. This may shed some light on whether indoor tanning is more easily accessible in one type of facility over another. Additionally, research is needed to determine whether significant clustering between indoor tanning facilities and schools exist outside of large urban centres in Ontario. Comparisons could be made between students attending schools in close proximity to indoor tanning facilities to students in schools with a larger distance between school and an indoor tanning facility. Additionally, if by-laws are passed restricting the locations of indoor tanning facilities relative to high schools, future research should determine whether indoor tanning facilities relocate closer to colleges and universities in Ontario.
6.5 Conclusion

This thesis provides an overview of compliance, inspection, impact, and enforcement of indoor tanning legislation, with a focus on youth access. Worldwide, compliance was varied for most aspects of indoor tanning legislation, and compliance with youth access was particularly low. Though compliance was low, there were still small decreases in prevalence of youth indoor tanning with legislation restricting youth access equating to millions of youth potentially avoiding a risky exposure. In Ontario, PHUs are inspecting and enforcing the SCPA legislation, but there has been only one infraction relative to youth access, which, based on previous research, is likely an underestimate of youth indoor tanning prevalence. Indoor tanning facilities are located in close proximity to schools, especially high schools, which may increase the prevalence of indoor tanning behaviour by youth. Findings from these studies highlight the need for collaboration between public health and policymakers. There is a need for policy amendments and new policy initiatives, especially addressing youth access to indoor tanning facilities.
6.6 References


APPENDICES

Appendix 1: PRISMA Checklists (Chapters 2 and 3)

Table A1.1 Prisma Checklist Chapter 2

<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist item</th>
<th>Reported on page #</th>
</tr>
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<tbody>
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<td>TITLE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
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<td>Identify the report as a systematic review, meta-analysis, or both.</td>
<td>71</td>
</tr>
<tr>
<td>ABSTRACT</td>
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<td></td>
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</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
<td>71-72</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known.</td>
<td>73-74</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
<td>75</td>
</tr>
<tr>
<td>METHODS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</td>
<td>No published protocol</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
<td>76</td>
</tr>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
<td>75-76</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
<td>75-76</td>
</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).</td>
<td>76-77</td>
</tr>
<tr>
<td>-----------------</td>
<td>---</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
<td>77</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
<td>78-79</td>
</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>12</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
<td>Table A2.1</td>
</tr>
<tr>
<td>Summary measures</td>
<td>13</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
<td>78-79</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>14</td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$) for each meta-analysis.</td>
<td>79</td>
</tr>
<tr>
<td>Risk of bias across studies</td>
<td>15</td>
<td>Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).</td>
<td>89</td>
</tr>
<tr>
<td>Additional analyses</td>
<td>16</td>
<td>Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</td>
<td>19</td>
</tr>
<tr>
<td><strong>RESULTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study selection</td>
<td>17</td>
<td>Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.</td>
<td>Figure 2.1</td>
</tr>
<tr>
<td>Study characteristics</td>
<td>18</td>
<td>For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.</td>
<td>Table 2.3</td>
</tr>
<tr>
<td>Risk of bias within studies</td>
<td>19</td>
<td>Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).</td>
<td>Table A2.1</td>
</tr>
<tr>
<td>Results of individual studies</td>
<td>20</td>
<td>For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.</td>
<td>79-87</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>21</td>
<td>Present the main results of the review. If meta-analyses are done, include for each, confidence intervals and measures of consistency</td>
<td>9-18</td>
</tr>
<tr>
<td>Table 2.3</td>
<td>89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Risk of bias across studies</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present results of any assessment of risk of bias across studies (see Item 15).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional analysis</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).</td>
<td></td>
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**DISCUSSION**

<table>
<thead>
<tr>
<th>Table 2.3</th>
<th>87-95</th>
</tr>
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<tr>
<td>Summary of evidence</td>
<td>24</td>
</tr>
<tr>
<td>Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).</td>
<td></td>
</tr>
<tr>
<td>Limitations</td>
<td>25</td>
</tr>
<tr>
<td>Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).</td>
<td></td>
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<tr>
<td>Conclusions</td>
<td>26</td>
</tr>
<tr>
<td>Provide a general interpretation of the results in the context of other evidence, and implications for future research.</td>
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**FUNDING**

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<td>Funding</td>
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<tr>
<td>Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.</td>
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Table A1.2 Prisma Checklist Chapter 3

<table>
<thead>
<tr>
<th>Section/topic</th>
<th>#</th>
<th>Checklist item</th>
<th>Reported on page #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TITLE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Identify the report as a systematic review, meta-analysis, or both.</td>
<td>121</td>
</tr>
<tr>
<td><strong>ABSTRACT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.</td>
<td>121-122</td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known.</td>
<td>123-124</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).</td>
<td>123-124</td>
</tr>
<tr>
<td><strong>METHODS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.</td>
<td>No published protocol</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.</td>
<td>124-125</td>
</tr>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.</td>
<td>124</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.</td>
<td>124</td>
</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)</td>
<td>124-125</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.</td>
<td>125</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.</td>
<td>126</td>
</tr>
<tr>
<td>---------------------</td>
<td>----</td>
<td>--------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Risk of bias in individual studies</td>
<td>12</td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
<td>126</td>
</tr>
<tr>
<td>Summary measures</td>
<td>13</td>
<td>State the principal summary measures (e.g., risk ratio, difference in means).</td>
<td>126 (prevalence)</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>14</td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$) for each meta-analysis.</td>
<td>NA</td>
</tr>
<tr>
<td>Risk of bias across studies</td>
<td>15</td>
<td>Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).</td>
<td>Table A2.1 Table A2.3</td>
</tr>
<tr>
<td>Additional analyses</td>
<td>16</td>
<td>Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</td>
<td>126</td>
</tr>
</tbody>
</table>

**RESULTS**

| Study selection     | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | Figure 3.1 |
| Study characteristics| 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | Table 3.1 |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see Item 12). | Table A2.1 Table A2.3 |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | 126-131 Table 3.1 |
| Synthesis of results | 21 | Present the main results of the review. If meta-analyses are done, include for each, confidence intervals and measures of consistency | 126-131 Table 3.1 Table A2.3 |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | Table 3.1 Table A2.1 |
| Additional analysis  | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | Table 3.2 |

**DISCUSSION**
<table>
<thead>
<tr>
<th><strong>Summary of evidence</strong></th>
<th>24</th>
<th>Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).</th>
<th>131-137</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Limitations</strong></td>
<td>25</td>
<td>Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).</td>
<td>137-138</td>
</tr>
<tr>
<td><strong>Conclusions</strong></td>
<td>26</td>
<td>Provide a general interpretation of the results in the context of other evidence, and implications for future research.</td>
<td>138</td>
</tr>
</tbody>
</table>

**FUNDING**

| **Funding**            | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | NA     |
Appendix 2: Information for Critical Appraisals (Chapters 2 and 3)

Table A2.1 Critical Appraisal Criteria

<table>
<thead>
<tr>
<th>Question</th>
<th>Explanation</th>
<th>Score Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hypothesis</td>
<td>Is the hypothesis/aim/objective of the study clearly described?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes=1</td>
</tr>
<tr>
<td>2. Literature Review</td>
<td>Is the literature review current and complete?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partially=0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes=1</td>
</tr>
<tr>
<td>3. Research Design Identified</td>
<td>Has the research design been clearly identified?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partially=0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes=1</td>
</tr>
<tr>
<td>4. Appropriate Research Design</td>
<td>Is the research design appropriate for the study hypothesis?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes=1</td>
</tr>
<tr>
<td>5. Participants</td>
<td>Is it clear how participants were:</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>a. Initially identified or selected</td>
<td>Partially=0.5</td>
</tr>
<tr>
<td></td>
<td>b. Approached for entry into the study</td>
<td>Yes=1</td>
</tr>
<tr>
<td></td>
<td>c. Included or excluded</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Assessed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. Confirmed in their assessment</td>
<td></td>
</tr>
<tr>
<td>6. Tabulation of Participants</td>
<td>For each stage of the study, has the number of subjects included or excluded been tabulated?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes=1</td>
</tr>
<tr>
<td>7. Sample Size Calculation</td>
<td>Was the sample size calculation described? Was it appropriate for the methods?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>Was it adequate for what the researchers were aiming to do?</td>
<td>Yes=1</td>
</tr>
<tr>
<td></td>
<td><strong>NA:</strong> assigned if the study was a census; <strong>NR:</strong> assigned if the sample size calculation was not given</td>
<td></td>
</tr>
<tr>
<td>8. Ethics</td>
<td>Was the study conducted in an ethical matter?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes=1</td>
</tr>
<tr>
<td>9. Interviewer/Coder Training</td>
<td>Were interviewers/coders trained in collecting data, were they aware of the hypothesis? Were steps taken to reduce interviewer bias?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td><strong>NR:</strong> assigned if there was no description of how interviewers were trained</td>
<td>Partially = 0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes=1</td>
</tr>
<tr>
<td>Question</td>
<td>Description</td>
<td>Score</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>10. Structured Data Collection Form</td>
<td>Was a structured data form or survey used, and was the data collected in a similar environment?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>Yes=1</td>
<td></td>
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<tr>
<td>11. Questions Asked</td>
<td>Have the precise questions asked been reported?</td>
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<td>Partially=0.5</td>
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<tr>
<td></td>
<td>Yes=1</td>
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</tr>
<tr>
<td>12. Graded Results</td>
<td>Have the authors described how they graded a result? I.e. Did they explain how or why they coded a result the way they did (especially with interview type questions)?</td>
<td>No=0</td>
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<tr>
<td></td>
<td>Partially=0.5</td>
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</tr>
<tr>
<td></td>
<td>Yes=1</td>
<td></td>
</tr>
<tr>
<td>13. Confounders</td>
<td>Have confounding or effect-modifying variables been discussed so the reader can judge how they’ve been controlled?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>Partially=0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes=1</td>
<td></td>
</tr>
<tr>
<td>14. Follow-up</td>
<td>When follow-up occurred, have measurements been described, and adequate to ascertain results aren’t biased? Have all participants been accounted for at follow-up?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>Partially=0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes=1</td>
<td></td>
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<tr>
<td>15. Measures of Association</td>
<td>Have correct measures of association been reported?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
<td>Partially=0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes=1</td>
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<tr>
<td>16. Confidence Intervals</td>
<td>Do measures of association have confidence intervals reported? Are mean values accompanied by a measure of variance?</td>
<td>No=0</td>
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<tr>
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<td>Partially=0.5</td>
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<tr>
<td></td>
<td>Yes=1</td>
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</tr>
<tr>
<td>17. Conclusion Based on Analysis</td>
<td>Is the conclusion based on the analysis? Are the conclusions strongly suggestive when the data more properly suggests a chance finding? Have important observations been ignored?</td>
<td>No=0</td>
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<tr>
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<td>Partially=0.5</td>
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<td></td>
<td>Yes=1</td>
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<tr>
<td>18. Explanations for Outcomes</td>
<td>Have competing explanations for the outcomes been discussed?</td>
<td>No=0</td>
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<tr>
<td>19. Statistics</td>
<td>Were all necessary statistics conducted?</td>
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</tr>
<tr>
<td></td>
<td>Yes=1</td>
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</tr>
<tr>
<td>20. Clinical/Practical Significance</td>
<td>Is clinical/practical significance discussed separately from statistical significance? Are the differences found significant enough to change practices and policies?</td>
<td>No=0</td>
</tr>
<tr>
<td></td>
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<tr>
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<tr>
<td>21. Power</td>
<td>Has the power of the study to detect differences been discussed?</td>
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<tr>
<td>Question</td>
<td>Description</td>
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<td>--------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>22. Results in the Context of Existing Research</td>
<td>Have study results been placed in the context of existing findings? Have differences with previous work been discussed? Have directions been given for future research?</td>
<td></td>
</tr>
<tr>
<td>23. Policy Implications</td>
<td>If policy implications have been drawn from the data, have they been justified?</td>
<td></td>
</tr>
<tr>
<td>24. Main Findings</td>
<td>Are the main findings of the study clearly described?</td>
<td></td>
</tr>
<tr>
<td>25. P-values</td>
<td>Have actual probability values been reported (i.e. specific p value rather than &lt;0.05) <strong>NA</strong>: assigned if the study didn’t have statistics to report p-values for</td>
<td></td>
</tr>
<tr>
<td>26. Representative Participants</td>
<td>Were participants representative of the entire population from which they were recruited? (Whether it be actual individual participants or facilities or websites included)</td>
<td></td>
</tr>
<tr>
<td>27. Were current policies discussed?</td>
<td>Did the study include comments on the policies in effect at the time of the study?</td>
<td></td>
</tr>
<tr>
<td>28. Was it clear which policy was being evaluated?</td>
<td>Did the authors make it clear which policies were being evaluated for enforcement or compliance?</td>
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<tr>
<td>First Author (year)</td>
<td>Bracken</td>
<td>Downs and Black</td>
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<td>Brouse (2011)</td>
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<td>26/27</td>
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<td>Choy (2017)</td>
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<td>23/24</td>
</tr>
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<td>25/26</td>
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<td>Pichon (2009)</td>
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<tr>
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<td>21/25</td>
</tr>
</tbody>
</table>

Y – yes; N – no; P – partially; NR - not reported; NA – not applicable

¹ Denominator was reduced if questions were NA or NR
### Table A2.3 Critical Appraisal of Studies (Chapter 3)

<table>
<thead>
<tr>
<th>First Author (year)</th>
<th>Bracken</th>
<th>Downs and Black</th>
<th>Other</th>
<th>Score¹</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blashill (2017)</td>
<td>Y Y Y P N NR Y NR Y Y Y Y NA Y Y Y Y Y N Y Y Y N Y N Y Y</td>
<td>21.5/25</td>
<td>86%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cokkinides (2009)</td>
<td>Y Y Y Y N NA Y NR Y Y Y Y NA Y Y Y N Y Y Y Y Y N Y Y Y Y</td>
<td>22/25</td>
<td>88%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coups (2016)</td>
<td>Y N Y Y P N NR Y NR Y Y N Y Y NA Y Y Y N Y Y N Y Y Y Y Y Y Y</td>
<td>19.5/25</td>
<td>78%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guy Jr. (2014)</td>
<td>Y Y Y Y P N NR Y NR Y Y Y Y Y Y NA Y Y Y Y Y Y Y N Y Y P Y N Y Y</td>
<td>21/25</td>
<td>84%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mayer (2011)</td>
<td>Y Y Y Y Y Y NR Y Y Y Y Y Y N Y NA Y Y Y Y Y Y Y N Y Y Y Y Y Y</td>
<td>24/26</td>
<td>92%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simmons (2014)</td>
<td>Y Y Y Y Y N NR Y NR Y Y P Y Y NA Y Y Y Y Y Y N Y Y Y Y Y Y Y</td>
<td>22.5/25</td>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qin (2018)</td>
<td>Y Y Y Y Y Y NR Y NR Y Y Y Y NA Y Y Y Y Y Y Y Y Y Y Y Y Y Y</td>
<td>25/25</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Y – yes; N – no; p – partially; NR - not reported; NA – not applicable

¹ Denominator was reduced if questions were NA or NR
Appendix 3: Survey Questions

Online Survey Questions to Ontario Public Health Units: 
*The Skin Cancer Prevention Act (Tanning Beds)*

On May 1, 2014 Bill 30 the *Skin Cancer Prevention Act: Tanning Beds* came into force. The goals of this legislation are to restrict access and advertising to youth under the age of 18 and to warn people of all ages about the dangers of indoor tanning.

The purpose of this survey is to collect information from Ontario public health units to: understand how this legislation has been implemented; assess any available evidence around compliance, inspection, and enforcement; and note the barriers and facilitators to inspection and enforcement.

Part A: Demographic Information

1. **From which public health unit are you responding?**
   (Research results will only be presented in aggregate form; no health units will be named. This information is being collected for administrative purposes only.)
   (enter answer)

2. Does your health unit conduct *complaint-based* and/or *education/routine inspection and enforcement* activities related to the Act? (select all that apply)
   a. Education/Routine
   b. Complaint-based

   [If education/routine, respondent will be asked the next question. If complaint-based, respondent will skip forward]

3. What is the **minimum number of education/routine inspections conducted** related to the Act by your health unit per year?
   (enter answer)

Part B: Indoor Tanning Facilities in Your Jurisdiction

According to the Act, a Notice of Operation must be given to the Medical Officer of Health by those offering tanning services or ultraviolet light treatments for tanning.
4. Does your health unit have a **record of the businesses** (name, address, telephone number) **that offer tanning services** or ultraviolet light treatments for tanning in your jurisdiction?
   a. Yes
   b. No
   c. Prefer Not to Answer

   [If yes, respondent will be asked the next 3 questions. If no, respondent will skip forward to complaints]

5. According to your health unit’s current records, how many facilities sell/offer tanning services or ultraviolet light treatments for tanning in your health unit’s jurisdiction?

   (enter number or unknown)

6. When was this record last **updated**? (month, year)

7. How is this list **maintained**? Please describe.

   (enter answer)

8. According to your health unit’s current records, how many of each type of tanning business is there in your health unit’s jurisdiction (enter 0 if none)?

<table>
<thead>
<tr>
<th>Type of Tanning Business</th>
<th>Number of facilities (enter number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanning Salon</td>
<td></td>
</tr>
<tr>
<td>Gym or Fitness Facility</td>
<td></td>
</tr>
<tr>
<td>Salon/Spa</td>
<td></td>
</tr>
<tr>
<td>Other (describe)</td>
<td></td>
</tr>
<tr>
<td>Other (describe)</td>
<td></td>
</tr>
<tr>
<td>Other (describe)</td>
<td></td>
</tr>
</tbody>
</table>

**Part C: Complaints**
We are interested in learning about what has happened since the Act came into force on May 1, 2014, including information related to complaints about possible or actual infractions. We would like to know how many complaints there have been, who made the complaints, and what the complaints were about.

9. Has your health unit ever received any complaints about possible or actual infractions regarding the Skin Cancer Prevention Act (Tanning Beds)? (yes or no)
   a. Yes
   b. No

10. Has your health unit kept track of the number of complaints?
    a. Yes
    b. No
    c. Prefer Not to Answer

   [ if yes, answer next question; if no, skip ahead]

11. How many of each type of complaint has your health unit received within each of the following time frames (enter 0 if none):

<table>
<thead>
<tr>
<th></th>
<th>In 2014?</th>
<th>In 2015?</th>
<th>In 2016?</th>
<th>In 2017?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Underage sale</strong>: Selling, offering for sale, or providing tanning services or UV light treatments to individuals less than 18 years old?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age verification</strong>: Failing to request identification for individuals who appear less than 25 years old before providing tanning services/UV light treatments?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Self-tanning</strong>: Permitting self-tanning (i.e., services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
or treatments without requiring the presence of an attendant)?
3(1) of the Ontario Regulation 99/14

**Underage marketing:**
Advertising or marketing tanning services/UV light treatments to persons who are less than 18 years old?
4(1) of the Ontario Regulation 99/14

**Signage:** Failure to post signage in accordance with regulations:

*Point of sale warning sign?*
5(2) of the Ontario Regulation 99/14

*Health warning sign?*
5(3) of the Ontario Regulation 99/14

*Age restriction and identification decal?*
5(4) of the Ontario Regulation 99/14

*Employee reminder decal?*
5(5) of the Ontario Regulation 99/14

*Signage in general (type not specified)?*
12. In general, when a complaint is reported to the health unit, what action is taken?
   a. No action
   b. Recorded but no inspection/visit
   c. Recorded and inspection/visit
   d. Other (enter text)
   e. Unknown
   f. Prefer not to answer

13. Are there any other types of information that your health unit collects about complaints and/or responses to complaints related to the Act not covered by our questions? If yes, please list/describe. (open-ended)

14. Is there anything else you would like to share with us about complaints related to the Act? If yes, please list/describe. (open-ended)
<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Infractions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Underage sale</strong>: Selling, offering for sale, or providing tanning services/UV light treatments to individuals less than 18 years old?</td>
<td>2(1)</td>
<td></td>
</tr>
<tr>
<td><strong>Age verification</strong>: Failing to request identification for individuals who appear less than 25 years old before providing tanning services/UV light treatments?</td>
<td>2(2)</td>
<td></td>
</tr>
<tr>
<td><strong>Self-tanning:</strong> Permitting self-tanning (i.e., services or treatments without requiring the presence of an attendant?) 3(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Underage marketing:</strong> Advertising or marketing tanning services/UV light treatments to persons who are less than 18 years old? 4(1)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Signage:</strong> Failure to post signage in accordance with regulations:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Point of sale warning sign?</strong> 5(2)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Health warning sign?</strong> 5(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age restriction and identification decal? 5(4)</strong></td>
</tr>
<tr>
<td><strong>Employee reminder decal? 5(5)</strong></td>
</tr>
<tr>
<td><strong>Signage in general (type not specified)? 5(1)</strong></td>
</tr>
<tr>
<td><strong>Eyewear:</strong> Failure to provide protective eyewear, and instructions, to individuals using the tanning services/UV light treatments? 6(2), 6(3)</td>
</tr>
<tr>
<td><strong>Business registration:</strong> Failure to provide Medical Officer of Health with notice of operation including business name, address, and telephone number? 7(1)</td>
</tr>
</tbody>
</table>
Part D: Inspection and Enforcement

The Ontario Public Health Standards indicate that the board of health shall implement and enforce the *Skin Cancer Prevention Act*. We are interested in how the Act is enforced in your health unit’s jurisdiction. In this section, we ask questions about enforcement, inspections conducted, and offences and responses to offences that have been identified.

15. Who at your health unit is primarily responsible for inspecting/enforcing the Act’s requirements? (select all that apply)
   a. Public health inspector
   b. Public health nurse
   c. Public health promoter
   d. Other (enter text)
   e. Unknown
   f. No one
   g. Prefer Not to Answer

16. Has any training been provided to the health unit employee(s) responsible for inspection and enforcement of the Act?
   a. Yes
   b. No
   c. Unknown
   d. Prefer Not to Answer

17. During inspections conducted due to complaints, how many of each type of infraction/offence have been committed by a tanning bed owner/operator since 2014, and how many of the following actions have been taken (Note: each infraction may have more than one response; enter 0 if none):

18. During education/routine inspections, how many of each type of infraction/offence have been committed by a tanning bed owner/operator since 2014, and how many of the following actions have been taken (Note: each infraction may have more than one response; enter 0 if none):
<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Number of Infractions</strong></td>
<td>No action</td>
</tr>
<tr>
<td><strong>Underage sale:</strong> Selling, offering for sale, or providing tanning services/UV light treatments to individuals less than 18 years old?</td>
<td>2(1)</td>
<td></td>
</tr>
<tr>
<td><strong>Age verification:</strong> Failing to request identification for individuals who appear less than 25 years old before providing tanning services/UV light treatments?</td>
<td>2(2)</td>
<td></td>
</tr>
<tr>
<td><strong>Self-tanning:</strong> Permitting self-tanning (i.e., services or treatments without requiring the presence of an attendant)?</td>
<td>3(1)</td>
<td></td>
</tr>
<tr>
<td><strong>Underage marketing:</strong></td>
<td>Advertising or marketing tanning services/UV light treatments to persons who are less than 18 years old? 4(1)</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Signage:</strong></td>
<td>Failure to post signage in accordance with regulations:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Point of sale warning sign? 5(2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Health warning sign? 5(3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age restriction and identification decal? 5(4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Employee reminder decal? 5(5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Signage in general (type not specified)? 5(1)</td>
<td></td>
</tr>
</tbody>
</table>
19. Are there any other types of information that your health unit collects about inspections, offence/infractions, enforcement and/or other actions taken related to the Act? (open-ended)

20. Is there anything else you would like to share with us about inspection and enforcement related to the Act? If yes, please list/describe. (open-ended)

**Part E: Additional Information and Follow-up**

You’ve reached the final section of the survey!

21. Is there anything else you would like to add or share on this topic?
22. We would like to build a **comprehensive list of all tanning facilities in Ontario**. Having a list from each health unit in Ontario will allow us to do so. Is your health unit able/willing to share with us the list of businesses offering tanning services or ultraviolet light treatments for tanning? If so, please upload below:

**Note:** you may upload a single file, or to upload multiple files, please compress them into a ZIP file before uploading

23. If you would like a **copy of the compiled list**, please click on the link below to provide your email address. To ensure anonymity, the email address provided will not be linked to your health unit's survey responses. If yes, please click on the link to open the new survey window.

24. May we contact you again in the future for **follow-up**? To ensure anonymity, the email address provided will not be linked to your health unit's survey responses. If yes, please click on the link to open the new survey window (different from the one above).

This is the end of the survey! Once you click submit, you will **not** be able to go back and make any changes.

**If you would like a copy of the research findings**, please provide your email address in the window that pops up once you click the next button. This will not be linked to your health unit's survey responses.

**Thank you for your participation!**