Tanning Attitudes That Predict the Prevalence and Frequency of Tanning bed use in

Older Adolescents and Young Adults in Canada

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including the final revisions, as accepted by my examiners.

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ABSTRACT

Background: Tanning bed use is a modifiable risk factor in the development of melanoma skin cancer. Despite the increased risk of skin cancer, tanning bed use is most common among the adolescent and young adult population. Adolescents and young adults intentionally expose their skin to the artificial ultraviolet (UV) radiation emitted from tanning equipment. In Canada, the indoor tanning industry is largely unregulated and in need of a coordinated public health intervention.

Objectives: The objective of the study was to estimate the prevalence and frequency of tanning bed use in the past 12 months and to identify the tanning attitudes that predict the prevalence and higher frequency of tanning bed use in the past 12 months in the older adolescent and young adult population in Canada. The purpose of the study was to identify key points of intervention and to provide valuable information to help inform policy makers and health promotion workers when developing a strategy to reduce exposure to artificial UV radiation.

Methods: The study used the data collected in the 2006 Second National Sun Survey (NSS2), the most recent and comprehensive survey in Canada to examine exposure to UV radiation. A logistic regression and negative binomial regression model was used to predict the prevalence and higher frequency of tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) in the 2006 NSS2, respectively.

Results: Overall, 21.5% of females and 8.3% of males (aged 16 to 34) in Canada were found to have had used artificial tanning equipment at least once in the past 12 months in 2006. Among those who had used a tanning bed in the past 12 months, 7.0% of

females and 10.3% of males had used the equipment once, compared to 41.3% of females and 29.2% of males who had used the equipment more than 12 times.

The individual level determinants that predict any use of a tanning bed in the past 12 months include gender (female), ethnicity (white), the intent to suntan during the summer months (always or often), the belief that people look better with a tan, and the belief that you look more attractive with a tan. In addition, having skin that will freckle (no suntan) when repeatedly exposed to sunlight was negatively associated with any use of a tanning bed in the past 12 months. The belief that a tan gives a healthy outdoor look, on the other hand, did not predict any tanning bed use in the past 12 months. Among those who had used a tanning bed in the past 12 months, the individual level determinants that predict the higher frequency of tanning bed use include gender (female), skin that will moderately tan when repeatedly exposed to sunlight, the use of a tanning bed to look better (reported as 'very important'), and the use of a tanning bed to relax or feel better (reported as 'very important'). The use of a tanning bed to boost their immune system, to protect against cancer, and to get vitamin D did not predict the higher frequency of tanning bed use in the past 12 months.

Conclusion: Tanning bed use in the older adolescent and young adult population is a significant and growing public health concern both in Canada and worldwide. The appearance-related motivation to use a tanning bed, but not the health-related motivation to use a tanning bed, is predictive of tanning bed use and is a key point of intervention. The tobacco industry is similar to the indoor tanning industry; however, tobacco control efforts have led to the development of evidence-based policies, which may provide a framework to reduce tanning bed use.

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CHAPTER 1

Literature review

1.1 Tanning equipment and UV radiation

Tanning equipment (tanning bed, sun bed, or sun lamp) is designed to produce a rapid onset, deeply coloured tan; however, exposure to the artificial UV radiation emitted from the equipment is a risk factor in the development of skin cancer, photoaged skin, and eye damage.

1.1.1 UV radiation

UV radiation is classified according to wavelength, ranging from 100 to 400 nm. Solar (or natural) UV radiation is composed of UVA (320 to 400 nm) and UVB (290 to 320 nm) radiation. UVB radiation is more biologically active than UVA radiation, but can not penetrate into the deeper layer of the skin, called the dermis (World Health Organization, 2016). UVB radiation, however, can cause damage to the epidermis, the superficial layer of the skin, and is responsible for the reddening or burning of the skin (World Health Organization, 2016). Furthermore, UVB radiation can cause direct damage to the cellular DNA and as a result, can play an important role in the development of skin cancer (International Agency for Research on Cancer [IARC], 2006).

UVA radiation, on the other hand, can penetrate into the dermis and has long been known to cause premature skin aging and wrinkling of the skin, but has only recently been recognized for its role in the development of skin cancer (World Health

Organization, 2016). Unlike UVB radiation, UVA radiation can cause indirect damage to the cellular DNA, through the generation of reactive oxygen species and/or nitrogen species (IARC, 2006).

1.1.2 Artificial UV radiation

The artificial UV radiation emitted from tanning equipment is similar to solar UV radiation in that it contains both UVA and UVB radiation (IARC, 2006). Although the spectrum of wavelength that is emitted by the equipment is specific to each source and the equipment may vary by location, tanning equipment lamps have been manufactured to emit predominately UVA radiation (IARC, 2006). Since 1980, the move toward UVA radiation was driven by the increasing concerns about the carcinogenic nature of UVB radiation. The low-pressure fluorescent lamps, however, continue to emit low levels of UVB radiation in order to produce a deep coloured tan and speed the tanning process (described in section 2.2.1.2; Bizzozero, 2002). In the more recent high-pressure fluorescent lamps, the UVA radiation output has been reported up to ten times greater than the UVA radiation level in sunlight (Gerber *et al.*, 2002; Hornung *et al.*, 2003).

In Canada, under the Radiation Emitting Devices Act (C.R.C., c. 1370), tanning equipment may be equipped with one or more lamps and may produce a wavelength between 200 nm to 400 nm (Government of Canada, 2015). In addition, the equipment manufacturer must provide information on the first and maximum exposure times based on skin type (further discussed in section 2.2.1.6). The information that is provided is based on the original bulb; however, overexposure to UV radiation has occurred as a result of the original bulb being replaced by more powerful bulbs that do not comply with federal regulations (Health Canada, 2014).

1.2 Health risks

UV radiation can lead to the development of skin cancer (melanoma and non-melanoma skin cancer), photoaged skin, and eye damage. Theoretically, the reaction of the skin to solar or artificial UV radiation is the same.

1.2.1 Skin cancer

Skin cancer is the most common type of cancer in Canada with more than 80,000 cases diagnosed each year (Canadian Cancer Society, 2014). There are more cases of skin cancer diagnosed annually in Canada than the number of lung, breast, and colorectal cancers combined (Canadian Cancer Society, 2014). The age-standardized incidence of melanoma, the most deadly form of skin cancer, increased in the past 25 years with an average increase of 2% per year in males and 1.5% per year in females (Canadian Cancer Society, 2014). In females, however, the increase in incidence rate accelerated at 2.6% per year (Canadian Cancer Society, 2014). With the increasing incidence, the economic burden of skin cancer in Canada, estimated at $532 million per year in 2010, is expected to nearly double to $922 million per year by 2031 (Canadian Partnership Against Cancer, 2010a).

1.2.1.1 Anatomy and physiology of the skin

Skin is the largest organ of the human body, accounting for 15% of body weight (Marieb *et al.*, 2012). Shown in Figure 1, the epidermis is the thin outermost layer of the skin and consists of cells called keratinocytes. Keratinocytes are responsible for making keratin, a fibrous protein that gives skin its durability. Other cells of the epidermis include stem cells, melanocytes, tactile (Merkel) cells, and dendritic (Langerhans) cells. The deeper connective tissue layer of the skin, called the dermis, contains the collagen

and elastin that provide structure to the skin. Below the dermis lies another layer called the hypodermis (or subcutis), which is a subcutaneous tissue composed of adipose tissue (fat). The hypodermis is not part of the skin, but is typically studied in conjunction with it.

The epidermis contains no blood vessels and instead relies on the dermis for nutrients and waste removal (Marieb *et al.*, 2012). The basal cell layer of the epidermis contains stems cells that divide continuously to produce new cells that mature (undergo keratinization), in a process that pushes these cells toward the surface. The cells eventually become the flattened squamous cells that make up the squamous cell layer of the epidermis, replacing the older cells.
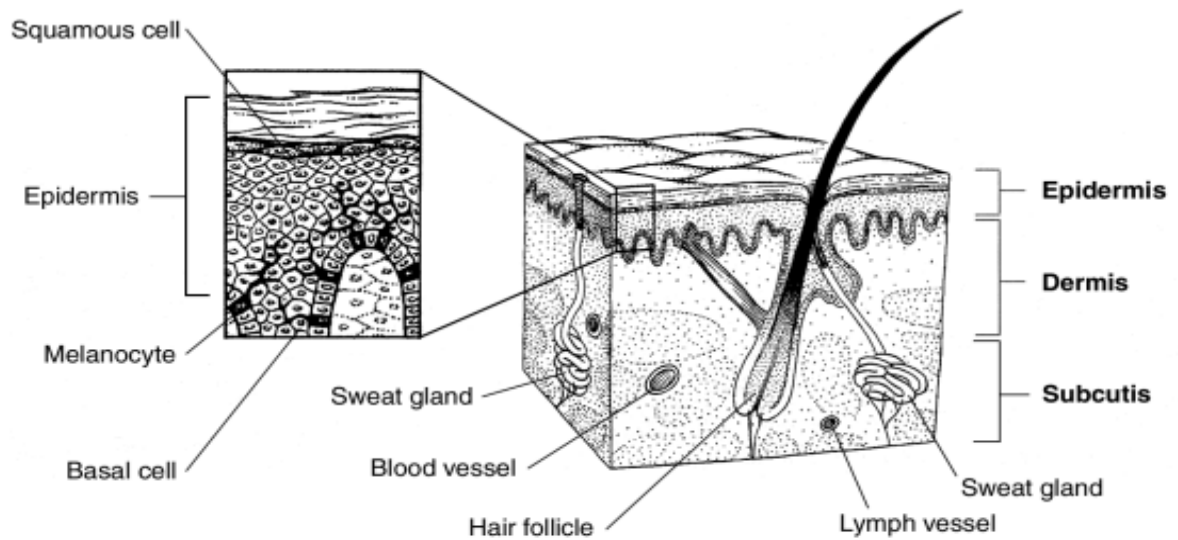
Figure 1. Anatomy of the skin (American Cancer Society, 2016)

1.2.1.2 Tanning process

Melanocytes are pigment-producing cells found predominantly in the basal cell layer of the epidermis (shown in Figure 1; Kolarsick *et al.*, 2011). The pigment that is

produced, called melanin, is synthesized by membrane-bound organelles, called melanosomes (Bandarchi *et al.*, 2010). Melanosomes are transferred to the keratinocytes and the melanin that is produced forms a melanin cap to protect the cellular DNA from damage due to UV radiation (Costin & Hearing, 2007). The heavily pigmented skin of some individuals (natural pigmentation or constitutive skin colour), compared to individuals with fair skin, may be attributed to greater melanosome production in melanocytes, greater melanin production in melanosomes, greater size of melanosomes, greater dispersion of melanosomes, and slower melanosome degradation (Kolarsick *et al.*, 2011).

When exposed to UV radiation, the melanin that is produced will give skin a tanned appearance (acquired tan). Immediate tanning is the result of the darkening of the pigment present in the epidermis, when UVA radiation is absorbed (Health Canada, 2014). The immediate tan will fade within three to 36 hours of exposure (Health Canada, 2014). Delayed tanning, on the other hand, is the result of UVB exposure. When skin is exposed to UV light there is an increase in melanogenesis, the production of melanin, and a corresponding increase in the amount of melanosomes being transferred to the keratinocytes (Kolarsick *et al.*, 2011). A delayed tan is observed after one day and can last up to months (Health Canada, 2014).

1.2.1.3 Non-melanoma skin cancer (NMSC)

In 2015, an estimated 78,300 cases of non-melanoma skin cancer (NMSC) would be diagnosed in Canada (Canadian Cancer Society, 2016a). In 2014, NMSC accounted for 28% of all new cancer cases; however, because most provincial/territorial cancer registries in Canada do not collect incidence data on NMSC, estimates are based on data

from the four provinces that do (Canadian Cancer Society, 2014). Incidence data on NMSC is not collected because the cancer is common, easily treated (by surgical excision), and often treated before the cancer has been confirmed (Canadian Cancer Society, 2014; Canadian Partnership Against Cancer, 2010a; Canadian Strategy for Cancer Control, 2006). Nevertheless, basal cell carcinoma is the cancer of the basal cell layer of the epidermis and is the most common type of NMSC, accounting for 77% of NMSC cases in Canada (Canadian Cancer Society, 2014). Squamous cell carcinoma, on the other hand, is the cancer of the squamous cells and is the second most common type of skin cancer, accounting for 23% of NMSC cases in Canada (Canadian Cancer Society, 2014).

1.2.1.4 Melanoma

Melanoma is the cancer of the melanocytes. It is the least common, but most deadly form of skin cancer (Canadian Cancer Society, 2014). Worldwide, melanoma represents 4% of all skin cancer cases, but up to 80% of all skin cancer deaths (Canadian Cancer Society, 2014). In 2015, an estimated 6,800 melanoma cases would be diagnosed and 1,150 melanoma deaths would occur, making melanoma one of the most common cancer types in Canada (Canadian Cancer Society, 2016b). In 2014, melanoma accounted for 3% of all new cancer cases and 1.4% of all cancer deaths (Canadian Cancer Society, 2014).

Relative survival for melanoma increased in Canada, increasing from 85% in 1992 to 1996 to 89% in 2004 to 2008 (Canadian Cancer Society, 2014). The stage of diagnosis, however, is related to survival: in the United States, it was found that the five-year relative survival of melanoma increased significantly if diagnosed at an earlier stage

(Howlader *et al.*, 2011). The U.S. Surveillance Epidemiology and End Results (SEER) program reported that the five-year relative survival of melanoma is 98.2% if the melanoma is localized and 15.1% if the melanoma is distant (Howlader *et al.*, 2011).

Overall melanoma is more common in males than in females in Canada; however, until the age of 50, melanoma is slightly more common in females. Based on estimates in 2010, one in 57 men and one in 74 women are expected to develop melanoma within their lifetime (Canadian Cancer Society, 2016b). Overall, the lifetime risk of developing melanoma increased from 0.9% to 1.7% for men and from 0.7% to 1.4% for women between 1993 and 2009 (Canadian Cancer Society, 2014). Based on estimates in 2010, one in 227 men and one in 456 women are expected to die from melanoma in 2015 (Canadian Cancer Society, 2016b). In Canada, the mortality from melanoma increased, with an average increase of 2.3% in men and 0.8% in women, between 1970 and 2007 (Kachuri *et al.*, 2013), representing the second greatest increase in mortality (after liver cancer in males and lung cancer in females) since 1970 (Canadian Cancer Society, 2014).

1.2.1.5 Tanning bed use and melanoma risk

In a meta-analysis study (of 19 epidemiological studies) that examined the ever-use, compared to the never-use of tanning equipment, it was found that the overall risk of melanoma had increased by 15% (IARC, 2006). Similar to the IARC report, in a more recent review of 27 cohort and population-based studies completed after 2007, it was found that the ever use of a tanning bed conferred an increased risk of melanoma of 20%, when compared to the never-use (Boniol *et al.*, 2012). The ever-use of a tanning bed, however, does not allow for the study of a dose-response relationship.

Although less consistent, evidence of a dose-response relationship has been found (Boniol *et al.*, 2012; Cust *et al.*, 2011; El Ghissassi *et al.*, 2009; Veierod *et al.*, 2010). Cust and colleagues (2011), for example, found that the risk of melanoma was 41% higher with the ever-use of a tanning bed, compared to the never-use, and the risk was approximately doubled if used more than ten times. Boniol and colleagues (2012), as another example, noted a 1.8% increase in the risk of melanoma skin cancer with each additional tanning session.

The use of a tanning bed at an early age might further increase the risk of melanoma. In the IARC report, the first use of a tanning bed, before the age of 35, was associated with a 75% increase in the risk of melanoma (2006). In the more recent meta-analysis, first exposure before the age of 35 was associated with a 59% increase in melanoma risk (Boniol *et al.*, 2012). Adolescents and young adults might be more susceptible to the damaging or carcinogenic effects of artificial UV radiation (Autier & Boyle, 2008; Autier & Dore, 1998; Whiteman *et al.*, 2001). The theory is based on the notion that melanocytes are more susceptible to the carcinogenic effects of UV radiation early in life, during peak melanocytic activity (Green *et al.*, 2011). This may, in part, explain why tanning bed use at an early age is associated with an increased melanoma risk. On the other hand, cumulative tanning bed use might be more important than when tanning bed use first began (Cust *et al.*, 2011; Lazovich *et al.*, 2010). For example, the study by Cust and colleagues (2011) found a weaker association between the later use of a tanning bed and melanoma risk, suggesting that the relative risk due to tanning bed use is decreased with increasing, accumulated sun exposure.

1.2.1.6 Risk factors in the development of melanoma

Exposure to UV radiation is the most important risk factor in the development of melanoma, accounting for up to 90% of melanoma cases in Canada (Armstrong & Kricker, 1993; Lucas *et al.*, 2008). It is the pattern of UV exposure, however, that can determine the type of skin cancer that might develop. Intermittent intense exposure to UV radiation, for example, is most important in the development of melanoma (National Cancer Institute, 2016). Therefore, the use of a tanning bed, due to its intermittent nature, is an important risk factor of melanoma in particular.

Phenotypic characteristics (blue or green eyes, light coloured hair, fair skin, and freckles) are other important risk factors in the development of melanoma (Gandini *et al.*, 2005a). As mentioned above, in Canada, the tanning equipment manufacturer must provide information on the maximum exposure time. The maximum exposure time is the "longest period for continuous exposure recommended by the manufacturer" (Government of Canada, 2015). The exposure schedule, on the other hand, is the "program of exposure recommended by the manufacturer of the equipment" and takes into account exposure times, intervals between exposures, and skin type (Government of Canada, 2015). The Fitzpatrick skin type classification is used to identify skin sensitivity, ranging from very fair (skin type I; always burns, never tans) to very dark (skin type VI; very rarely burns, tans well, very dark skin; Fitzpatrick, 1988). Individuals with skin type 1 and skin type 11 are most at risk of the damaging effects of UV radiation.

Other risk factors include the number of nevi (typical and atypical moles), history of melanoma (family and personal history), the presence of genetic conditions (e.g.

xeroderma pigmentosum), and a weakened immune system (Gandini *et al.*, 2005b; Thompson *et al.*, 2005)

1.2.2 Photoaged skin

Long-term exposure to UV radiation can cause premature skin aging and lead to the development of photoaged skin (leathery appearance). Photoaged skin is the result of accumulated damage from repeated exposure to UV radiation (World Health Organization, 2003). UVA radiation, in particular, is associated with the damage since it can penetrate the dermis and cause damage to collagen (protein fibers that provide strength to the skin), resulting in the production of abnormal elastin (protein that will provide elasticity to the skin) and enzymes that further break down collagen (IARC, 2006).

1.2.3 Eye damage

UVB radiation, in particular, can cause damage to the eye and can play an important role in the development of cortical cataracts, the clouding of the lens of the eyes (McCarty & Taylor, 2002; Taylor, 1989; West *et al.*, 2005). Worldwide, cataracts are a leading cause of permanent blindness, representing the most widespread serious eye condition related to exposure to UV radiation (IARC, 2006). Exposure to UV radiation can also cause photokeratitis (inflammation of the cornea and the iris), photoconjunctivitis (inflammation of the inner membrane of the eyelid and the white of the eye; conjunctiva), and cancer of the conjunctiva (squamous cell carcinoma; World Health Organization, 2003). Photokeratitis and photoconjunctivitis are temporary and often develop within six to 12 hours of exposure (Health Canada, 2014).

1.3 Tanning bed use

Tanning bed use in Canada represents a significant public health concern, among young people in particular. In the 2006 NSS2, it was found that 27% of females and 8% of males, aged 16 to 24, had used artificial tanning equipment at least once in the past 12 months, though this decreased with age where only 15% of females and 7% of males, aged 25 to 44, had used artificial tanning equipment in the past 12 months (Canadian Partnership Against Cancer, 2010b). In addition, among adults in the 2006 NSS2 who had used a tanning bed at least once in the past 12 months, 95% had used a tanning bed more than once: 15% had used a tanning bed two to three times, 19% had used a tanning bed four to six times, 25% had used a tanning bed seven to 12 times, and 36% of adults had used a tanning bed more than 12 times (Canadian Partnership Against Cancer, 2010b). Note that estimates of the prevalence and frequency of tanning bed use among older adolescents and young adults (aged 16 to 34), who are most at risk of melanoma, are not available.

More recent estimates of the prevalence and frequency of tanning bed use in Canada are also not available. However, in Ontario, between 2006 and 2012, among grade 11 and 12 students, any use of a tanning bed more than doubled, increasing from 7% to 16% (Ipsos Reid, 2012). International estimates of the prevalence of tanning bed use in the past 12 months also indicate that over time tanning bed use has increased in popularity and continues to represent a growing public health concern. Recent estimates (from 2007 to 2012) of the international prevalence of tanning bed use in the past year were 18% in adults (18 years and older), 45% in university students (college, university,

undergraduate, or graduate students), and 22% in adolescents (19 years old and under; Wehner *et al.*, 2014).

1.4 Perceived benefits and knowledge of the health risks

In adolescent and young adult populations, the evidence suggests that the perceived immediate benefits of using a tanning bed outweigh the potential health risks (Dennis *et al.*, 2009; Heckman *et al.*, 2008; Knight *et al.*, 2002; Mawn & Fleischer, 1993; Robinson *et al.*, 2008). Despite their knowledge of the health risks associated with exposure to UV radiation, adolescents and young adults continue to intentionally expose their skin to UV radiation (Dennis *et al.*, 2009; Heckman *et al.*, 2008; Knight *et al.*, 2002; Robinson *et al.*, 2008). Although knowledge was not examined in the current study (measures were not available), skin cancer prevention strategies have been primarily education-based with the goal of increasing knowledge; however, have had little success (further discussed below).

Among *adult* users, in the 2006 NSS2, the most common reason to use a tanning bed in the past 12 months was to look better; reported among 77% of adult users (Canadian Partnership Against Cancer, 2010b). Other reasons for tanning bed use among adult users included to tan without burning (74%), to relax or feel better (72%), to get vitamin D (41%), to treat a skin or medical condition or because a doctor recommended it (40%), to boost the immune system (34%), and to prevent cancer (22%; Canadian Partnership Against Cancer, 2010b). Because tanning bed use is most prevalent in older adolescent and young adult populations, a better understanding of the motivation to use a tanning bed among adolescents and young adults, in particular, could provide direction when developing a strategy to reduce exposure to artificial UV radiation.

1.5 Theoretical framework

The Theory of Reasoned Action (Fishbein & Ajzen, 1975) and Theory of Planned Behaviour (Ajzen, 1985) are theoretical models used to predict and explain behaviour (volitional and non-volitional behaviour, respectively). In both models, the attitude toward the behaviour is an important determinant of an individual's intention to perform the behaviour (behavioural intention) and is used to predict the behaviour. The current study used the Theory of Reasoned Action as a framework to identify the tanning attitudes that predict tanning bed use. In the future, however, the Theory of Planned Behaviour might prove to be more appropriate to predict tanning bed use, given the recent evidence to suggest that tanning bed use might be non-volitional (further discussed below); however, more research is needed.

1.5.1 The Theory of Reasoned Action

The Theory of Reasoned Action is a model widely used for the prediction of behaviour, when the behaviour is under voluntary control (e.g. condom use; Fishbein & Ajzen, 1975). Fishbein and Ajzen (1975) stated that behavioural intentions drive individual behaviour and are a function of the beliefs (normative and behavioural beliefs) that performing the behaviour will lead to a specific outcome. Behavioural intentions are an indication of "how hard people are willing to try; of how much of an effort they are planning to exert, in order to perform the behaviour" (Ajzen, 1991). Fishbein and Ajzen (1975) assumed that a variable outside of the model could influence the behavioural intention only to the extent that it can affect either the behavioural (attitude toward the behaviour) or normative belief (subjective norm). Generally speaking, if the behaviour is

evaluated as positive (attitude) and believed to be important to others (subjective norm), the behaviour is more likely to be performed (Ajzen, 1991; Madden *et al.*, 1992).

1.5.2 The Theory of Planned Behaviour

The Theory of Planned Behaviour is an extension of the Theory of Reasoned Action and is used to model behaviour not under volitional control (e.g. tobacco use; Ajzen, 1985). In addition to behavioural and normative beliefs, the model accounts for perceived behavioural control (Ajzen, 1985). The perception of behavioural control is the perception that the individual can perform the behaviour—the importance of the actual behavioural controls (e.g. opportunities and resources, including time and money) and this can impact both the intention and the behaviour (Ajzen, 1985).

An increasing amount of evidence has emerged to show that tanning behaviour might be an addictive behaviour, where tanning behaviour is motivated in part by UV light substance-related-disorder (Nolan *et al.*, 2009). The frequent use of a tanning bed is a behaviour pattern characteristic of other substance use disorders (Nolan *et al.*, 2009), and those who use a tanning bed have shown evidence of psychological and physical dependence (Fisher & James, 2010; Harrington *et al.*, 2010; Nolan *et al.*, 2009) and withdrawal, not present with the non-frequent use of a tanning bed or non-UV light exposure (Kaur *et al.*, 2006). Although more research is needed, perceived behavioural control might prove to be an important determinant of tanning bed use.

1.5.3 Predicting tanning bed use

The Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (Ajzen, 1985) have both been previously used to predict and explain tanning-related behaviours (both indoor and outdoor tanning; Hillhouse *et al.*, 1997;

Hillhouse *et al.*, 2000; Prislin & Kovrlija, 1992). Hillhouse and colleagues (2000), for example, found that the Theory of Planned Behavior variables (attitudes, subjective norms, and perceived behavioural control) were effective at predicting both indoor tanning behavioural intentions and tendencies. The previous studies, however, are limited in that they have examined tanning-related behaviours in only a subset of the adolescent and young adult population (e.g. college students, beachgoers, etc.), limiting the generalizability of the results.

The current study, on the other hand, identified the tanning attitudes that predict the prevalence and frequency of tanning bed use in a sample of respondents that is representative of older adolescents and young adults in Canada. The study used the Theory of Reasoned Action as a framework to identify the tanning attitudes that predict tanning bed use (measures of subjective norms and perceived behavioural control were not available). Although the Theory of Planned Behaviour may be an important area of inquiry and could help inform behavioural interventions, more research is needed to support the use of a tanning bed as a non-volitional behaviour. In either case, the study provides a better understanding of the motivational basis of tanning bed use and, to my knowledge, is the first study to examine tanning attitudes that predict the greater frequency of tanning bed use (number of times a tanning bed was used in the past 12 months).

1.6 The role of the indoor tanning industry and legislation

Using the Theory of Reasoned Action the current study examined the tanning attitudes (the proximal influences on tanning bed use); however, in order to better identify the strategies that could reduce tanning bed use, policy makers and health

promotion workers should take into account the broader context—the role of the indoor tanning industry and legislation. A better understanding of the multiple levels of influence on tanning bed use is critical to understand and redress tanning bed use in a population at increased risk of melanoma due to the high prevalence of tanning bed use.

1.6.1 Indoor tanning industry in Canada

In Canada and worldwide, the desire for tanned skin has led to the development of a large indoor tanning industry. In 2009, the indoor tanning industry in Canada was estimated to be a $500 million industry (Indoor Tanning Working Group, 2011). In Canada, however, tanning equipment operators are not required to register as a premise that offers tanning services. As a result, there is a lack of current information on the number of tanning equipment operators in Canada. Yet, it is well known that the presence of tanning equipment is extensive, where tanning facilities are now widely available in health and fitness clubs, beauty salons, etc.

The indoor tanning industry, to this point, has remained largely unregulated in Canada. Tanning equipment operators, for example, often do not maintain the design safety features of tanning equipment (Health Canada, 2014). In addition, the indoor tanning industry has dismissed the health risks and promoted the use of tanning beds for the production of vitamin D (Schulman & Fisher, 2010). Although artificial UV radiation can result in the production of vitamin D, the use of tanning equipment is not recommended for vitamin D production. In 2006, the Competition Bureau and Fabutan Corporation (a large company operating province-wide in Ontario) reached an agreement in which Fabutan would stop promoting the 'health benefits' of tanning bed use (Canadian Cancer Society, Ontario Division, 2009). The company had, in the past, made

unproven claims about the role of vitamin D in the prevention of cancer. In addition, indoor tanning had been promoted in the treatment of seasonal affective disorder, which requires visible (not UV) light.

1.6.2 Promotion of tanning bed use for the production of vitamin D

When developing a strategy to reduce tanning bed use, understanding the influence of the industry is important as it can influence the motivational basis for tanning bed use. In Canada, the indoor tanning industry is represented by the Joint Canadian Tanning Association (JCTA), a national, non-profit organization that was "created to increase understanding of the professional tanning industry's scientifically supported position that regular moderate UV exposure from sunshine or sunbed in a non-burning fashion is part of a responsible lifestyle that recognizes both the inherent benefits and the manageable risks associated with UV light exposure" (Joint Canadian Tanning Association, 2016). In the 2006 NSS2, it was found that 41% of adults who had used a tanning bed in the past 12 months had used a tanning bed to get vitamin D and 22% had used a tanning bed to prevent cancer (Canadian Partnership Against Cancer, 2010b). In recent years, an increasing amount of evidence has emerged to suggest that inadequate levels of vitamin D may be associated with other, non-bone related health outcomes, including increased cancer risk, multiple sclerosis, etc. (Zhang *et al.*, 2013). The current study examined whether the health-related concerns (namely, to get vitamin D, to boost the immune system, and to prevent cancer) are important reasons that older adolescents and young adults, in particular, use tanning beds.

1.6.2.1 Vitamin D and bone related outcomes

Vitamin D (25-hydroxyvitamin D) is a fat-soluble vitamin obtained through the diet (e.g. milk and margarine) and is synthesized by the skin, in response to UVB radiation (Health Canada, 2012; Wallingford *et al.*, 2014). Vitamin D is responsible for the maintenance of bone by regulating the absorption of calcium (Health Canada, 2012). When blood calcium levels drop, parathyroid hormone (PTH) is released and will act to increase blood calcium. PTH will act on the kidney to decrease calcium excretion, promote the conversion of vitamin D into the active form (calcium is absorbed from the diet), and will lead to the breakdown of bone to mobilize calcium and increase blood calcium. The breakdown of bone overtime can lead to bone loss and increase osteoporotic risk (Health Canada, 2012).

1.6.2.2 Vitamin D and non-bone health related outcomes

The role of vitamin D, outside of bone health, is newly recognized and is currently under investigation. Inadequate levels of vitamin D may be associated with increased cancer risk, including cancer of the colon, breast, ovarian, and prostate (Zhang *et al.*, 2013). In addition, vitamin D may play a role in autoimmune disease, mental health problems, and cardiovascular disease (Munger *et al.*, 2006; Zhang *et al.*, 2013). However, the research to this date has been inconsistent, with some research showing no association (Theodoratou *et al.*, 2014). In either case, the current evidence is insufficient for the role of vitamin D in non-bone related health outcomes (Institute of Medicine, 2011).

1.6.2.3 Vitamin D levels in Canada

Although debate about the optimal level of vitamin D continues, exposure to UVB radiation is not recommended for the production of vitamin D (Health Canada,

2012). The 2004 Canadian Community Health Survey (CCHS) collected data on the dietary intake of vitamin D and found a high prevalence of inadequate vitamin D intake (not including supplementation), ranging from 75 to 96% in Canada (Health Canada, 2012). However, the results do not account for the vitamin D that is obtained through exposure to UVB radiation. The 2007 to 2009 Canadian Health Measure Survey (CHMS), on the other hand, collected blood (serum) samples to measure vitamin D levels, which accounts for both vitamin D dietary intake and vitamin D obtained from exposure to UVB radiation. The CHMS found that over two-thirds over Canadians (68%) had sufficient levels of vitamin D (Health Canada, 2012).

1.6.2.4 Tanning bed use for the production of vitamin D

The JCTA reported that "Canadians specifically are affected by [the vitamin D issue] with estimates of more than 97% of Canadians being deficient at some point in the year" and that "given controlled nature of the UVB emitted by indoor tanning equipment, tanning beds are the most effective source of vitamin D available to Canadians" (Joint Canadian Tanning Association, 2016). Dismissing the health risks associated with exposure to UVB radiation, the indoor tanning industry continues to promote the use of tanning beds for the production of vitamin D. In Canada, however, most individuals have adequate levels of vitamin D (Health Canada, 2012).

Up until this point, the indoor tanning industry in Canada has remained largely unregulated and could influence attitudes, leading to negative health consequences. In Canada, tanning beds are not recommended for the production of vitamin D: Incidental exposure to solar UV radiation and normal dietary intake of vitamin D can provide adequate levels of vitamin D. In Canada, during the winter months, solar UVB radiation

is weak, and for those at increased risk of vitamin D deficiency, vitamin D supplements are available (Health Canada, 2014).

1.6.3 Policy and regulation in Canada

In the 2006 IARC report on *Exposure to Artificial UV radiation and Skin Cancer* it was noted that "although the available findings are therefore not conclusive, the strength of the existing evidence suggests that policymakers should consider enacting measures, such as prohibiting minors and discouraging young adults from using indoor tanning facilities" (IARC, 2006). In 2009, with further evidence of the carcinogenic nature of artificial UV radiation, the World Health Organization classified the radiation emitted from tanning equipment as carcinogenic (World Health Organization, 2009). Provinces in Canada, with a few exceptions, have since introduced legislation to prohibit minors (under 18 or 19 years of age) from the use of a tanning bed (further discussed below). Still, those under the age of 35 would benefit from a coordinated public health intervention to promote behaviour change and reduce intentional exposure to UV radiation.

CHAPTER 2

Study rationale and research questions

2.1 Study rationale

In 2009, the World Health Organization classified the artificial UV radiation emitted from tanning equipment as a known carcinogen (Class I: Carcinogenic to human), ranked equal to asbestos and tobacco (World Health Organization, 2009). Results of the 2006 NSS2 found that older adolescents (aged 16 to 24) had the highest prevalence of tanning bed use in the past 12 months in Canada (Canadian Partnership Against Cancer, 2010b); however, it is those under the age of 35 who would benefit from a public health intervention to reduce tanning bed use (IARC, 2006). Furthermore, among adult users, most (36%) had used a tanning bed more than 12 times in the past 12 months, further increasing their risk of melanoma (Canadian Partnership Against Cancer, 2010b). Estimates of the prevalence and frequency of tanning bed use among older adolescents and young adults (aged 16 to 34), however, are not available.

The current study examined the prevalence and frequency of tanning bed use and the individual level determinants (including demographic characteristics, sun sensitivity characteristics, and tanning attitudes) that predict tanning bed use in the past 12 months among older adolescent and young adult populations (aged 16 to 34) in Canada. Although previous research examined the relationship between tanning attitudes and tanning behaviour, the research examined behaviour in only a subset of the older adolescent and young adult population (among college students, beachgoers, etc.). The current study used data collected in the 2006 NSS2, which provided the unique opportunity to examine exposure to artificial UV radiation in a population that is representative of older

adolescents and young adults in Canada (Marrett *et al.*, 2010). Although the data was collected in 2006, tanning bed use has since increased in popularity and now represents an even larger public health concern (based on international trends). The 2006 NSS2 provides the most recent estimates of the prevalence and frequency of tanning bed use in Canada and is worth examining.

Melanoma is largely preventable with up to 90% of melanoma cases caused by exposure to UV radiation (Armstrong & Kricker, 1993; Lucas *et al.*, 2008). Exposure to artificial UV radiation is a modifiable risk factor in the development of melanoma. In Canada there is a need to reduce tanning bed use among older adolescents and young adults (aged 16 to 34), who are most likely to use artificial tanning equipment and at greater risk of melanoma from artificial exposure to UV radiation. The current study provides valuable information that could be used to help inform a coordinated public health intervention to reduce tanning bed use and prevent against melanoma (and other health risks).

2.2 Research Questions

The thesis answered the following Research Questions (RQ) using the 2006 NSS2:

RQ 1: What is the prevalence of any tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) in Canada?

RQ 2: What tanning attitudes predict any tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) in the 2006 NSS2?

RQ 3: What is the frequency of tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) who had used a tanning bed in Canada?

RQ 4: What tanning attitudes predict the frequency of tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) who had used a tanning bed in the 2006 NSS2?

2.3 Hypotheses

RQ 1: Approximately 30% of females and 10% of males, aged 16 to 34, in Canada were expected to have had used a tanning bed in the past 12 months. The hypothesis is consistent with the available estimates of the prevalence of tanning bed use in the past 12 months (estimates for those aged 16 to 24 and 25 to 44 from the 2006 NSS2 and international estimates of tanning bed use in the past 12 months).

RQ 2: Consistent with the Theory of Reasoned Action, a positive tanning attitude was expected to predict a higher probability of use of a tanning bed in the past 12 months. The belief that a tan is attractive (*people* look better with a tan and *you* look more attractive with a tan) and that a tan gives a healthy outdoor look were taken as evidence of a positive tanning attitude (consistent with previous research). Tanning attitudes, however, might be highly correlated, potentially giving rise to the problem of collinearity (in which case, only one attitude would be kept). In addition, I expected that the interaction terms between the tanning attitudes would be significant, where those who agreed with all three beliefs (demonstrating a more positive tanning attitude), for example, would better predict the use of tanning bed than those who agreed with only one belief.

RQ 3: Among older adolescents and young adults, who had used a tanning bed in the past 12 months, 35% were expected to have had used a tanning bed more than 12 times, consistent with the results of the 2006 NSS2 for *all* adult users.

RQ 4: Consistent with the Theory of Reasoned Action, the more positive tanning attitude was expected to predict the more frequent use of a tanning bed in the past 12 months. In addition to the belief that people look better with a tan, that you look more attractive with a tan, and that a tan gives a healthy outdoor look, it was expected that the use of a tanning to look better and to relax/feel better would also predict the more frequent use of a tanning bed. Respondents who reported using a tanning bed to look better and/or to relax or feel better as 'very important' to why they had used a tanning bed were expected to have had used a tanning bed more frequently than those who reported it as being 'not important.' Similar to in RQ 2, tanning attitudes might be highly correlated, potentially giving rise to the problem of collinearity. In addition, I expected that the interaction terms between the tanning attitudes would be significant, where those who had more than one positive tanning attitude, for example, would better predict the higher frequency of tanning bed use than those who had only one positive tanning attitude. Other reasons for tanning bed use, that might predict the higher frequency of tanning bed use, include to boost your immune system, to prevent cancer, and to get vitamin D; however, these are more exploratory in nature.

CHAPTER 3

Methods

3.1 Data source

3.1.1 2006 Second National Sun Survey

The current study used data collected in the 2006 NSS2 (Marrett *et al.*, 2010). The objectives of the project, as described by Marrett and colleagues (2010), were to estimate levels of UV radiation exposure and related indicators among Canadians during the summer of 2006, building upon the first national sun survey (NSS1) conducted in 1996. The final NSS2 consisted of two questionnaires administered independently to two distinct samples of adult respondents: the base sample questionnaire used to estimate UV exposure, sun protection, and related knowledge, attitudes, and beliefs among Canadians and the comparison questionnaire which allows for direct comparison to the NSS1. The study used the data collected from the base sample questionnaire, a copy of which is included in Appendix A. Further information, related to survey methods, is available online (http://www.ncbi.nlm.nih.gov/pubmed/21033539).

3.1.1.1 Sample selection

The NSS2 target population consisted of all persons 16 years or older living in Canada, with the following exceptions: residents of the Canadian territories, full-time residents of institutions (nursing homes, penal institutions, group homes, etc.: 1.7% of Canadians living in the provinces), residents not fluent in one of Canada's official languages (1.7% of Canadians living in the provinces) and residents without telephone service (1.2% of Canadian households in the provinces; Marrett *et al.*, 2010).

3.1.1.2 Participant selection and recruitment

A two-stage probability selection process was used, which consisted of household selection followed by participant or respondent selection (Marrett *et al.*, 2010). In household selection, residential telephone numbers were used as a surrogate for households, and a modified form of random digit dialing was used to select numbers. An introductory letter was mailed to selected households, followed by the first call attempt in order to assess household eligibility. Eligible households contained at least one adult who fit the definition of the target population and in households that contained more than one eligible adult; the adult whose birthday was next was selected to participate in the survey.

3.1.1.3 Survey protocols

The data for the NSS2 was collected using computer-assisted telephone interviewing (Marrett *et al.*, 2010). A total of 7,121 adults (response rate of 63%) were interviewed for the base sample. The telephone interviews were conducted from August 2 to November 22, 2006 and took, on average, 13 to 19 minutes to complete. Data editing included ensuring that the data were consistent with skip patterns, re-coding open-ended responses and imputing values for variables essential for survey weighting, such as age group, household size, and number of telephones per household.

3.2 Measures

The following section describes the response and explanatory variables of interest, as well as the coding.

3.2.1 Response variables

3.2.1.1 Tanning bed use

On the NSS2 base sample questionnaire, the use of a tanning bed in the past 12 months was measured in the following question: "During the past 12 months, have you used any artificial tanning equipment such as a tanning bed, sunlamp or tanning light for any reason including medical reasons?" Respondents who answered "yes" were coded as "1" and respondents who answered "no" were coded as "0". All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the model. The number of respondents excluded for each variable is provided in Appendix B.

3.2.1.2 Frequency of tanning bed use

Respondents who had used artificial tanning equipment within the past 12 months were further asked how frequently they had used tanning equipment in the following question: "In the past 12 months, how many times have you used artificial tanning equipment?" In the descriptive statistics, respondents who reported using tanning equipment once were coded as "0", two to three times as "1", four to six times as "2", seven to 12 times as "3", and more than 12 times as "4" for comparison purposes (consistent with how the number of times a tanning bed was used in the past 12 months in adults was presented in the original report on the results of the 2006 NSS2).

In the predictive models, respondents who reported using artificial tanning equipment between one and 48 times were coded by the number of times that they had used tanning equipment (count variable) and respondents who reported using tanning equipment 49 or more times were coded as "49" (consistent with how the number of

times a tanning bed was used in the past 12 months was coded in the original dataset). The distribution of the response variable is provided in Appendix B. All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the models.

3.2.2 Explanatory variables

3.2.2.1 Tanning attitudes

On the NSS2 base sample questionnaire, tanning attitudes were measured using the following questions: (1) "Most people look better if they have at least a little bit of a tan. Do you strongly agree, somewhat agree, somewhat disagree, or strongly disagree?" (2) "You look more attractive when you have a tan. Do you strongly agree, somewhat agree, somewhat disagree, or strongly disagree?" and (3) Having a tan gives you a healthy outdoor look. Do you strongly agree, somewhat agree, somewhat disagree, or strongly disagree?" Respondents who "strongly agree" or "somewhat agree" were coded as "1" and respondents who "strongly disagree" or "somewhat disagree" were coded as "0". The data demonstrated a flooring/ceiling effect and could be collapsed into the two categories (agree and disagree) without loss of information. All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the models.

On the NSS2 base sample questionnaire, tanning attitude was also measured using the following questions that asked respondents, who had used artificial tanning equipment in the past 12 months, if the following reasons for using artificial tanning equipment were very important, somewhat important, or not important to why they had used artificial tanning equipment: (1) "To look better?" and (2) "To relax or feel better?"

In the predictive models, simple coding for categorical variables was used where each level ("very important" and "somewhat important") was compared to the reference group ("not important"). The reference group was coded as "0" and each other level was coded as "1". Respondents who answered "not applicable", "don't know", "refused", or "not stated" were excluded from the models.

Other motivators used in the predictive models were measured using the following questions that asked respondents, who had used artificial tanning equipment in the past 12 months, if the following reasons for using artificial tanning equipment were very important, somewhat important, or not important to why they had used artificial tanning equipment: (1) "To boost your immune system?" (2) "To prevent cancer?" and (3) "To get vitamin D?" Similar to above, simple coding was used where each level ("very important" and "somewhat important" coded as "1") was compared to the reference group ("not important" coded as "0"). Respondents who answered "not applicable", "don't know", "refused", or "not stated" were excluded from the models.

4.2.2.2 Intent to tan

On the NSS2 base sample questionnaire, tanning intention was assessed in the following question: "during the summer do you always, often, sometimes, rarely or never get a tan?" Similar to above, the data demonstrated a flooring/ceiling effect and could be collapsed into three categories (always/often, sometimes, and rarely/never) without the loss of information. Again, simple coding for categorical variables was used where each level ("always/often" sometimes coded as "1") was compared to the reference group ("rarely or never" coded as "0"). All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the models.

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3.2.2.3 Sun sensitivity and demographic characteristics

Region: The NSS2 collected data that were representative of each province. The six geographic regions included: Atlantic Canada (Newfoundland/Labrador, Prince Edward Island, Nova Scotia, and New Brunswick), Quebec, Ontario, Manitoba/ Saskatchewan, Alberta, and British Columbia. Simple coding was used where each level of the variable (coded as "1") was compared to the reference group ("Quebec" coded as "0"). Note, sample sizes are provided in Appendix B.

Gender: The NSS2 collected data on gender. Respondents who were "female" were coded as "1" and respondents who were "male" were coded as "0".

Background: On the NSS2 base sample questionnaire, data on background was collected in the following question: "People with different backgrounds react differently to sun exposure. It will help in our study to know if you are Caucasian or white, Black, or something else?" Respondents who answered "Caucasian/white" were coded as "1" and respondents who answered "Black" or "something else" were coded as "0" and are referred to as the "other" group. All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the models.

Natural hair colour: One question on the NSS2 base sample questionnaire asked about natural hair colour: "What is your natural hair colour?" Respondents who answered "black", "dark brown", "light brown", "red", and "blonde" were kept in the models. All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the models. Simple coding for categorical variables was used where each level was compared to the reference group ("black" coded as "0").

Sensitivity of skin: On the NSS2 base sample questionnaire, two questions asked about skin sensitivity to UV radiation: (1) "What would happen to your skin if it were exposed to bright sunlight for the first time in summer, for one hour in the middle of the day, without any protection?" The question was followed by a list of reactions ("severe sunburn with blistering", "painful sunburn for a few days followed by peeling", "mildly burnt followed by some tanning" and "go darker/brown without any sunburn"). Simple coding for categorical variables was used where each level was compared to the reference group ("go darker/brown without any sunburn" coded as "0"). All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the models.

(2) "Now, what would happen to your skin if it was repeatedly exposed to bright sunlight in summer without any protection?" The question was followed by a list of reactions ("go very brown and deeply tanned", "get moderately tanned", "get mildly or occasionally tanned", and "get no suntan at all or only get freckled (includes repeated burns or skin rash)"). Simple coding for categorical variables was used where each level was compared to the reference group ("go very brown and deeply tanned" coded as "0"). All other respondents (who answered "not applicable", "don't know", "refused", or "not stated") were excluded from the models.

Personal history with skin cancer: One question on the NSS2 base sample questionnaire asked about the respondent's personal history with skin cancer: "Do you have, or have you ever had, skin cancer?" Respondents who responded with yes were coded as "1" and no were coded as "0". Descriptive statistics are provided; however, this variable was not used in the predictive models.

CHAPTER 4

Statistical Analyses

4.1 Survey data weighting

The 2006 NSS2 provided the weighted data that was used in the descriptive statistics (Marrett *et al.*, 2010). Sample weights were computed for all survey respondents based on the probability of household selection within sampling strata, proportion of non-responding households, number of telephone lines per household and number of adults/children per household. Weights were also post-stratified to match the regional, sex and age distribution of the target populations according to the 2006 census estimates (post 2001 census adjusted). Compared to select other characteristics of the sample, after weighting, with the target population revealed that adults with the following characteristics were over-represented in the NSS2 base sample: Caucasians/whites (88% of NSS2 base sample versus 85% according to the 2006 census); Canadian-born (83% of sample versus 76% of population); and having a university degree (27% of sample versus 18% of population). Residents relying on cellphone use only are also typically underrepresented in telephone surveys; however, approximately 5.3% of NSS2 base sample respondents reported living in a cellphone-only household, and it is believed that approximately 5% of Canadian households had cellphone service only in 2006. Further information is available online (http://www.ncbi.nlm.nih.gov/pubmed/21033539).

The weighted 2006 NSS2 data was used to describe the explanatory and response variables (descriptive statistics), followed by a chi-squared test (using unweighted data) to test for significant differences in explanatory and response variables (when weighted data was used, all variables were highly significant). Significant differences in the

variables likely reflect actual differences at the population level.

4.2 Research Question 1

The results of the descriptive statistics were used to answer Research Question 1, regarding the prevalence of any tanning bed use in the past 12 months in male and female older adolescents and young adults (aged 16 to 34) in Canada. Research Question one was answered using weighted 2006 NSS2 data.

4.3 Research Question 2

To answer Research Question 2, a logistic regression model was used to identify the tanning attitudes that predict any tanning bed use in the past 12 months in older adolescents and young adults (aged 16 to 34) in the 2006 NSS2 (using unweighted data). The dependent variable was any use of a tanning bed in the past 12 months (a binary variable). The association between any use of a tanning bed in the past 12 months and sun sensitivity and demographic characteristics, the intent to tan, the belief that people look better with a tan, the belief that having a tan makes you more attractive, and the belief that having a tan gives you a healthy outdoor look were investigated. Respondents with missing data were excluded from the model, since only a small percentage of the data was missing (see Appendix B for missing data). Although significant, tanning attitudes were only moderately correlated (correlations are provided in Appendix B) and as a result, all attitudes were kept in the model. The interaction between the attitudes was also examined; however, found to be non-significant and removed from the model. All other associations (significant and non-significant) were retained in the model (to increase the predictive ability of the model).

To assess the fit of the model, a log-likelihood statistic was used. In addition, the c-statistic was used to compare the goodness of fit, where a value of 0.5 would indicate that the model is no better than chance at making the prediction of whether an individual had used a tanning bed in the past 12 months (Hosmer & Lemeshow, 1989).

4.4 Research Question 3

The results of the descriptive statistics were used to answer Research Question 3, regarding the frequency of tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) in Canada who had used a tanning bed in the past 12 months. Research Question 3 was answered using weighted 2006 NSS2 data.

4.5 Research Question 4

To answer Research Question 4 a negative binomial regression (a generalization of the Poisson regression) model was used where the dependent variable was the number of times a tanning bed was used in the past 12 months (a count variable; coded between one and 49 times used) among older adolescents and young adults who had used a tanning bed in the past 12 months from the NSS2 (using unweighted data). The distribution of the response variable is found in Appendix B. The negative binomial regression model is used for overdispersed count data of the Poisson distribution and had been used because the dispersion was significantly greater than one.

Similar to above, the association between the number of times a tanning bed was used in the past 12 months and the independent variables was examined. Independent variables included: sun sensitivity and demographic characteristics, the intent to tan, the belief that people look better with a tan, the belief that having a tan makes you more attractive, the belief that having a tan gives you a healthy outdoor look, and the use of a

tanning bed to look better, to relax/feel better, to boost your immune system, to prevent cancer, and to get vitamin D. Respondents with missing data were excluded from the model, since only a small percentage of the data was missing (see Appendix B for missing data). To assess model fit, the p-value of the deviance statistic and degree of freedom was used.

CHAPTER 5

Results

5.1 Sample size

A total of 7,121 adults were interviewed for the base sample of the 2006 Second National Sun Survey; 1,785 were between the age of 16 and 34. The sample is representative of older adolescents and young adults in Canada with a weighted sample size of 8,331,600.

5.2 Descriptive statistics

Descriptive statistics for older adolescents and young adults (aged 16 to 34) are provided in Table 1. Significantly more males had a positive tanning attitude: 73.41% of females and 84.76% of males, aged 16 to 34 in Canada, agreed (somewhat or strongly) that most people look better with a tan, 58.29% of females and 73.39% of males agreed that they look more attractive with a tan, and 68.01% of females and 77.85% of males agreed that a tan gives a healthy outdoor look. However, significantly more females had used a tanning bed in the past 12 months: 21.53% of females and 8.32% of males, aged 16 to 34 in Canada, had used artificial tanning equipment at least once in the past 12 months. Interestingly, both females and males were more likely to agree that people look better with a tan than that they look more attractive with a tan.

Among females (aged 16 to 34) who had used a tanning bed, reasons for tanning bed use (somewhat important and very important) include to look better (80.15%), to relax or feel better (74.04%), to tan without burning (66.31%), to treat a skin condition or other medical condition (41.78%), to get vitamin D (41.73%), because a doctor

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recommended it (31.28%), to boost their immune system (30.29%), and/or to prevent cancer (25.00%). Among males (aged 16 to 34) who had used a tanning bed, reasons for tanning bed use (somewhat important and very important) include to look better (79.47%), to relax or feel better (74.47%), to tan without burning (72.96%), to treat a skin condition or other medical condition (44.14%), to get vitamin D (38.76%), to boost their immune system (35.92%), because a doctor recommended it (31.35%), and/or to prevent cancer (17.17%).

Overall, 78.70% of females and 72.48% of males, who had used a tanning bed in the past 12 months, had "always" used eye protection when using a tanning bed; however, 10.15% of females and 13.84% of males had "never" used eye protection. In addition, 22.86% of females, aged 16 to 34 in Canada, had used creams, lotions, or sprays to tan in the past 12 months, with 32.36% using creams, lotions or sprays to get a better tan, 29.65% because it is perceived to be faster and or more convenient, and 23.78% because it is perceived to be safer. Only 5.13% of males, on the other hand, had used creams, lotions, or sprays to tan in the past 12 months.

Table 1. Weighted descriptive statistics for older adolescents and young adults (aged 16 to 34) in Canada from the 2006 Second National Sun Survey, by gender [a]

Characteristics	Male (n = 766)[b] %	Female (n = 1019)[c] %	Chi-square (Unweighted)	P-value
Tanning attitude				
Most people look better if they have at least a little bit of a tan [d]				
Agree	84.76	73.41	$X^2 (3) = 34.54$	**p < .0001**
Disagree	13.54	26.04		
Don't know	1.63	0.55		
Refused	0.08*	0.00*		
You look more attractive when you have a tan [d]				
Agree	73.39	58.29	$X^2 (4) = 56.22$	**p < .0001**
Disagree	21.25	38.59		
Don't know	2.15	1.51		
Refused	0.68*	0.81		
Not stated	2.52	0.81		
Having a tan gives you a healthy outdoor look [d]				
Agree	77.85	68.01	$X^2 (4) = 26.93$	**p < .0001**
Disagree	17.76	29.39		
Don't know	1.27	1.06		
Refused	0.04*	0.24*		
Not stated	3.09	1.30		
Tanning intention				
Intent to tan during summer months				
Always/often	42.38	37.38	$X^2 (4) = 25.07$	**p < .0001**
Sometimes	21.83	27.93		
Rarely/never	35.36	34.58		
Don't know	0.14*	0.11*		
Refused	0.29*	0.00*		
Tanning bed use				
Used any artificial tanning equipment in the past 12 months				
Yes	8.32	21.53	$X^2 (2) = 62.55$	**p < .0001**
No	91.68	78.34		
Don't know	0.00*	0.13*		
Number of times used artificial tanning equipment in the past 12 months [e]				
Once	10.28	6.97	$X^2 (5) = 17.55$	p = 0.0036
Two to three	21.85	13.11		
Four to six	15.15	16.42		
Seven to 12	22.42	19.03		
More than 12	29.34	41.27		
Don't know	0.97*	3.20		
Why used artificial tanning equipment: 1. To treat skin condition or other medical condition [e]				
Very important	12.22	14.07	$X^2 (3) = 0.66$	p = 0.8819
Somewhat important	31.92	27.71		
Not important	55.86	57.52		

Don't know	0.00*	0.70*		
2. To tan without burning [e]				
Very important	15.27	24.24	$X^2 (3) = 12.18$	p = 0.0068
Somewhat important	57.69	42.07		
Not important	26.34	33.69		
Don't know	0.69*	0.00*		
3. To look better [e]				
Very important	18.28	24.83	$X^2 (2) = 0.91$	p = 0.6327
Somewhat important	61.19	55.32		
Not important	20.54	19.85		
4. Because a doctor recommended it [e]				
Very important	21.65	17.50		p = 0.9047
Somewhat important	9.70	13.78		
Not important	68.00	67.44	$X^2 (3) = 0.56$	
Don't know	0.66*	1.28*		
5. To relax or feel better [e]				
Very important	23.16	18.91	$X^2 (2) = 0.21$	p = 0.8997
Somewhat important	51.31	55.13		
Not important	25.53	25.97		
6. To boost your immune system [e]				
Very important	10.80	7.21	$X^2 (3) = 9.31$	p = 0.0255
Somewhat important	25.12	23.08		
Not important	58.50	68.71		
Don't know	5.58*	1.00*		
7. To prevent cancer [e]				
Very important	15.60	13.28	$X^2 (3) = 1.09$	p = 0.7804
Somewhat important	1.57*	11.72		
Not important	82.23	72.85		
Don't know	0.60*	2.15*		
8. To get vitamin D [e]				
Very important	14.99	11.50	$X^2 (3) = 0.16$	p = 0.9830
Somewhat important	23.77	30.23		
Not important	60.58	57.28		
Don't know	0.66*	0.98*		
Tanning behaviour				
Used eye protection [f]				
Always	72.48	78.70	$X^2 (4) = 1.58$	p = 0.8128
Often	6.23*	3.87		
Sometimes	5.92*	6.24		
Rarely	1.54*	1.03*		
Never	13.84	10.15		
Used creams, lotions, or sprays [g]				
Yes	5.13	22.86	$X^2 (2) = 130.63$	**p < .0001**
No	94.87	77.01		
Don't know	0.00*	0.13*		
Why used creams, lotions, or sprays [g]				
Faster or convenience	18.32	29.65	$X^2 (5) = 11.65$	p = 0.0399
Safer	6.74*	23.78		
Better tan	65.67	32.36		
To get a tan or to look better	2.25*	7.47		
Other	7.02*	6.54		
Don't know	0.00*	0.19*		
Demographic and sun sensitivity characteristics				
Region				
Atlantic Canada	6.78	6.91	$X^2 (5) = 3.51$	p = 0.6213

Quebec	23.05	22.66		
Ontario	39.22	39.57		
Manitoba & Saskatchewan	6.81	6.68		
Alberta	11.95	11.50		
British Columbia	12.19	12.69		
Background				
Caucasian/white	76.83	81.06	$X^2 (3) = 6.14$	p = 0.1050
Other	22.51	18.00		
Don't know	0.54*	0.94		
Refused	0.12*	0.00*		
Natural hair colour				
Blonde	14.32	16.77	$X^2 (6) = 54.56$	**p < .0001**
Red	2.29	5.06		
Light brown	21.62	29.53		
Dark brown	35.43	34.53		
Black	25.89	12.93		
Other	0.46	1.04		
Don't know	0.00*	0.14*		
Skin exposed to sunlight for first time [h]				
Severe sunburn	18.83	30.02	$X^2 (5) = 62.59$	**p < .0001**
Mild sunburn	33.17	35.91		
Brown without any sunburn	37.22	25.67		
Don't know	2.35	1.87		
Refused	0.56*	0.30*		
Not stated	7.87	6.23		
Skin repeatedly exposed to sunlight [i]				
Very brown/deeply tanned	33.17	25.07	$X^2 (5) = 32.10$	**p < .0001**
Moderately tanned	30.35	35.56		
Mildly/occasionally tanned	18.65	19.65		
No suntan/freckled	7.57	11.11		
Don't know	2.40	2.37		
Not stated	7.87	6.23		
History of skin cancer [j]				
Yes	0.34*	0.36	$X^2 (1) = 0.34$	p = 0.5605
No	99.66	99.64		

[*] Have expected counts (unweighted) less than 5; Interpret with caution
[a] Bolded values are significant (p < .0001)
[b] Males: n = 4,217,300 (Weighted)
[c] Females: n = 4,114,400 (Weighted)
[d] Agree = somewhat or strongly agree, Disagree = somewhat or strongly disagree
[e] Among those who had used a tanning bed in the past 12 months
[f] When used a tanning bed in the past 12 months
[g] Used creams, lotions, sprays to look tanned in the past 12 months
[h] Skin reaction when exposed to bright sunlight for the first time in summer, for one hour in the middle of the day, without any protection
[i] Skin reaction when repeatedly exposed to bright sunlight in the summer without any protection
[j] Personal history of skin cancer, including melanoma, basal cell carcinoma, and squamous cell carcinoma

Shown in the Table 2, 92.89% of those who had used a tanning bed in the past 12 months agreed that people look better with a tan, 85.06% agreed that they look more attractive with a tan, and 87.94% agreed that a tan gives a healthy outdoor look. Those

who had used a tanning bed in the past 12 months were more likely to agree that people look better with a tan than they look more attractive with a tan (92.89% vs. 85.06%).

Compared to those who did not use a tanning bed in the past 12 months, those who did use a tanning bed were significantly more likely to agree that people look better with a tan (94.44% vs. 76.48%), they look more attractive with a tan (84.23% vs. 62.73%), and a tan gives a healthy outdoor look (88.17% vs. 70.33%). Similarly, those who did use a tanning bed in the past 12 months were significantly more likely to have the intent to suntan during the summer months (59.57% vs. 36.45%) and to have had used creams, lotions, or sprays to tan in the past 12 months (46.17% vs. 8.17%).

Table 2. Weighted descriptive statistics for tanning attitudes, intention, and behaviours among older adolescents and young adults (aged 16 to 34) in Canada from the 2006 Second National Sun Survey, by tanning bed use in the past 12 months [a]

Characteristics	Tanning bed use in past 12 months		Chi-square (Unweighted)	P - value
	No (n = 1485)[b] %	Yes (n = 299)[c] %		
Tanning attitude				
Most people look better if they have at least a little bit of a tan [d]				
Agree	76.48	94.44	$X^2 (3) = 50.62$	**p < .0001**
Disagree	22.18	5.56		
Don't know	1.29	0.00*		
Refused	0.05*	0.00*		
You look more attractive when you have a tan [d]				
Agree	62.73	84.23	$X^2 (4) = 63.46$	**p < .0001**
Disagree	32.42	14.89		
Don't know	2.04	0.69*		
Refused	0.87	0.00*		
Not stated	1.94	0.19*		
Having a tan gives you a healthy outdoor look [d]				
Agree	70.33	88.17	$X^2 (4) = 34.81$	**p < .0001**
Disagree	25.68	11.08		
Don't know	1.27	0.56*		
Refused	0.16*	0.00*		
Not stated	2.56	0.19*		
Tanning intention				
Intent to tan during summer months				
Always/often	36.45	59.57	$X^2 (4) = 68.68$	**p < .0001**
Sometimes	24.54	15.91		
Rarely/never	38.69	13.80		
Don't know	0.14*	0.00*		
Refused	0.17*	0.00*		
Tanning behaviour				
Used creams, lotions, or sprays [e]				
Yes	8.17	46.17	$X^2 (2) = 224.84$	**p < .0001**
No	91.75	53.83		
Don't know	0.08*	0.00*		
Why used creams, lotions, or sprays [e]				
Faster or convenience	21.70	33.69	$X^2 (5) = 4.08$	p = 0.5373
Safer	25.20	16.10		
Better tan	38.26	38.38		
To get a tan or to look better	7.05	5.99		
Other	7.79	5.52		
Don't know	0.00*	0.31*		

*Have expected counts (unweighted) less than 5; Interpret with caution
[a] Bolded values are significant (p < .0001)
[b] No: n = 7,109,500 (Weighted)

Table 3 shows the percentage of respondents who had used a tanning bed in the past 12 months for each sun sensitivity and demographic characteristic. The results show that the rate of tanning bed use is significantly different for gender and background. The rate of use in the past 12 months is highest for the female (21.56% vs. 8.32%) and Caucasian/white (17.88% vs. 3.25%) population. As noted prior, the data is weighted by sex and likely reflects actual differences at the population level.

Table 3. Weighted descriptive statistics for sun sensitivity and demographic characteristics among older adolescents and young adults (aged 16 to 34) in Canada from the 2006 Second National Sun Survey, by tanning bed use in the past 12 months [a]

Characteristics	Tanning bed use in past 12 months		Chi square (Unweighted)	P - value
	No (n = 1485)[b] %	**Yes** (n = 299)[c] %		
Demographic and sun sensitivity characteristics				
Gender				
Male	91.68	8.32	$X^2 (1) = 61.79$	**p < .0001**
Female	78.44	21.56		
Region				
Atlantic	78.30	21.70	$X^2 (5) = 11.85$	p = 0.0368
Quebec	83.22	16.78		
Ontario	87.20	12.80		
Manitoba & Saskatchewan	82.62	17.38		
Alberta	83.56	16.44		
British Columbia	88.88	11.12		
Background				
Caucasian/white	82.12	17.88	$X^2 (3) = 26.70$	**p < .0001**
Other	96.75	3.25		
Don't know	90.48	9.52*		
Refused	100.00*	0.00*		
Natural hair colour				
Blonde	80.71	19.29	$X^2 (6) = 25.02$	p = 0.0003
Red	90.73	9.27		
Light brown	83.35	16.65		
Dark brown	83.20	16.80		
Black	94.55	5.45		
Other	56.20	43.80		
Don't know	100.00	0.00*		
Refused	100.00*	0.00*		
Skin exposed to sunlight for first time [d]				
Severe sunburn	85.55	14.45	$X^2 (5) = 17.43$	p = 0.0037
Mild sunburn	81.35	18.65		
Brown without any sunburn	86.22	13.78		
Don't know	95.50	4.50*		
Refused	100.00	0.00*		
Not stated	93.70	6.30		
Skin repeatedly exposed to sunlight [e]				
Very brown/deeply tanned	85.91	14.09	$X^2 (5) = 18.31$	p = 0.0026
Moderately tanned	81.15	18.85		
Mildly/occasionally tanned	83.34	16.66		
No suntan/freckled	92.92	7.08		
Don't know	90.27	9.73		
Refused	93.70	6.30		

History of skin cancer [f]				
Yes	77.80	22.20*	$X^2 (1) = 1.78$	$p = 0.1820$
No	85.18	14.82		

[*] Have expected counts (unweighted) less than 5; Interpret with caution
[a] Bolded values are significant (p < .0001)
[b] No: n = 7,109,500 (Weighted)
[c] Yes: n = 1,239,600 (Weighted)
[d] Skin reaction when exposed to bright sunlight for the first time in summer, for one hour in the middle of the day, without any protection
[e] Skin reaction when repeatedly exposed to bright sunlight in the summer without any protection
[f] Personal history of skin cancer, including melanoma, basal cell carcinoma, and squamous cell carcinoma

Shown in Table 4, among respondents who had used a tanning bed more than 12 times within the past 12 months, 96.33% agreed that most people look better with a tan, 90.11% agreed that they look more attractive with a tan, and 91.29% agreed that a tan gives a healthy outdoor look. Similarly, among respondents who had used a tanning bed more than 12 times within the past 12 months, 64.62% had the intention to suntan during the summer months. No significant differences were found; however, note the number of table cells with expected counts of less than five. The low sample size can make the results difficult to interpret.

Table 4. Weighted descriptive statistics for tanning attitudes, intention, and behaviours among older adolescents and young adults (aged 16 to 34) in Canada among those who had used a tanning bed in the past 12 months from the 2006 Second National Sun Survey, by frequency of tanning bed use [a]

Characteristics	Tanning Bed Use (Number of times used in the past 12 months)					Chi-square (Unweighted)	P-value
	Once (n = 22)[b] %	2-3 (n = 40)[c] %	4-6 (n = 50)[d] %	7-12 (n = 63)[e] %	>12 (n = 116)[f] %		
Tanning attitude							
Most people look better if they have at least a little bit of a tan [g]							
Agree	89.57	94.26	92.71	94.02	96.33	$X^2 (4) = 1.67$	p =
Disagree	10.43*	5.74*	7.29*	5.98*	3.67		0.7955
You look more attractive when you have a tan [g]							
Agree	96.54	74.10	75.24	81.77	90.11	$X^2 (12) =$	p =
Disagree	2.64*	25.90	19.71	18.23	9.89	17.48	0.1324
Don't know	0.82*	0.00*	3.90*	0.00*	0.00*		
Not stated	0.00*	0.00*	1.16*	0.00*	0.00*		
Having a tan gives you a healthy outdoor look [g]							
Agree	88.40	95.95	75.66	85.09	91.29	$X^2 (12) =$	p =
Disagree	5.87*	4.05*	23.18	14.91	8.42	14.69	0.2587
Don't know	5.73*	0.00*	0.00*	0.00*	0.29*		
Not stated	0.00*	0.00*	1.16*	0.00*	0.00*		
Tanning intention							
Intent to tan							
Always/often	61.10	53.84	48.09	61.43	64.62	$X^2 (8) = 7.96$	p =
Sometimes	29.71	24.04	25.46	26.58	28.26		0.4376
Rarely/never	9.19*	22.12	26.45	11.99	7.12		
Tanning bed use							
Why used artificial tanning equipment: [h] 1. To treat skin condition or other medical condition							
Very important	32.49	13.50	12.85	15.49	9.74	$X^2 (12) =$	p =
Somewhat important	19.70*	30.02	26.78	22.58	35.24	9.56	0.6540
Not important	47.80	54.46	60.37	61.93	54.53		
Don't know	0.00*	2.02*	0.00*	0.00*	0.49*		
2. To tan without burning							
Very important	29.51	19.97	19.18	19.83	22.29	$X^2 (12) =$ 12.10	p = 0.4374

Somewhat important	37.89	31.52	54.62	54.94	48.65		
Not important	32.60	48.51	24.99	25.23	29.05		
Don't know	0.00*	0.00*	1.22*	0.00*	0.00*		

3. To look better

Very important	24.74	13.51	16.10	13.00	33.04	$X^2 (8) = 24.07$	p = 0.0022
Somewhat important	50.07	59.78	65.30	51.15	58.07		
Not important	25.20	26.70	18.60	35.84	8.90		

4. Because a doctor recommended it

Very important	11.19	22.84	17.70	18.76	20.17	$X^2 (12) = 12.32$	p = 0.4203
Somewhat important	32.06	14.68	10.71	10.36	9.84		
Not important	47.01	62.48	70.70	69.95	69.99		
Don't know	9.74*	0.00*	0.90*	0.93*	0.00*		

5. To relax or feel better

Very important	24.06	5.80*	16.51	14.17	30.26	$X^2 (8) = 10.71$	p = 0.2188
Somewhat important	44.73	52.48	55.61	63.10	49.02		
Not important	31.21	41.72	27.88	22.73	20.71		

6. To boost your immune system

Very important	13.29*	1.49*	7.03*	14.30	7.82	$X^2 (12) = 2.08$	p = 0.9993
Somewhat important	21.18	23.35	16.12	27.40	26.17		
Not important	65.53	71.15	75.63	57.63	63.33		
Don't know	0.00*	4.01*	1.22*	0.93*	2.68*		

7. To prevent cancer

Very important	11.19*	9.30	11.43	20.26	14.38	$X^2 (12) = 12.96$	p = 0.3722
Somewhat important	14.50*	10.58*	5.49	5.66*	6.70		
Not important	64.56	76.11	83.08	73.22	78.55		
Don't know	9.74*	4.01*	0.00*	0.86*	0.38*		

8. To get vitamin D

Very important	13.29*	10.18	16.99	15.10	10.12	$X^2 (12) = 8.26$	p = 0.7648
Somewhat important	35.08	20.78	20.95	29.75	32.55		
Not important	51.63	67.35	62.06	54.22	56.16		
Don't know	0.00*	1.69*	0.00*	0.93*	1.16*		

Tanning behaviour

Used eye protection [i]							
Always	53.12	81.88	84.37	83.29	73.08	X² (16) = 19.90	p =
Often	5.73*	0.00*	1.34*	6.29*	6.91		0.2247
Sometimes	7.64*	1.13*	7.41*	5.39*	7.62		
Rarely	0.00*	0.00*	1.00*	0.00*	1.95*		
Never	33.50	16.99	5.88*	5.02*	10.44		
Used creams, lotions, or sprays [j]							
Yes	31.36	57.31	30.28	37.72	53.57	X² (4) = 7.23	p =
No	68.64	42.69	69.72	62.28	46.43		0.1240
Why used creams, lotions, or sprays [j]							
Faster or convenience	38.16*	28.01	21.19	17.72	41.76	X² (20) = 16.17	p = 0.7061
Safer	11.62*	21.00*	16.35*	19.22	11.71		
Better tan	13.61*	39.56	57.93	48.20	36.44		
To get a tan or to look better	13.21*	9.29*	2.66*	14.86*	1.06*		
Other	23.39*	2.14*	1.86*	0.00*	8.31		
Don't know	0.00*	0.00*	0.00*	0.00*	0.71*		

[*] Have expected counts (unweighted) less than 5; Interpret with caution
[a] Bolded values are significant (p < .0001)
[b] Used a tanning bed once in the past 12 months: n = 22 (Unweighted)
[c] Used a tanning bed two to three times in the past 12 months: n = 40 (Unweighted)
[d] Used a tanning bed four to six times in the past 12 months: n = 50 (Unweighted)
[e] Used a tanning bed seven to 12 times in the past 12 months: n = 63 (Unweighted)
[f] Used a tanning bed more than 12 in the past 12 months: n = 116 (Unweighted)
[g] Agree = somewhat or strongly agree, Disagree = somewhat or strongly disagree
[h] Among those who had used a tanning bed in the past 12 months
[i] When used a tanning bed in the past 12 months
[j] Used creams, lotions, sprays to look tanned in the past 12 months

Shown in Table 5 is the percentage of respondents who had used a tanning bed in the past 12 months for each sun sensitivity and demographic characteristics. The results show that the rate of tanning bed use did not significantly differ for any of the characteristics. Also note the number of table cells low sample sizes, making the results difficult to interpret.

Table 5. Weighted descriptive statistics for sun sensitivity and demographic characteristics among older adolescents and young adults (aged 16 to 34) in Canada among those who had used a tanning bed in the past 12 months from the 2006 Second National Sun Survey, by frequency of tanning bed use [a]

Characteristics	Tanning Bed Use (Number of times used in the past 12 months)					Chi square (Unweighted)	P-value
	Once (n = 22)[b] %	2-3 (n = 40)[c] %	4-6 (n = 50)[d] %	7-12 (n = 63)[e] %	>12 (n = 116)[f] %		
Demographic and sun sensitivity characteristics							
Gender							
Male	10.38	22.07	15.30	22.64	29.62	X^2 (4) =	p =
Female	7.20	13.55	16.96	19.66	42.63	6.55	0.1615
Region							
Atlantic	11.50*	13.00	14.75	14.55	46.21	X^2 (20) =	p =
Quebec	11.62	16.08	9.29	21.39	41.62	16.91	0.6586
Ontario	2.83*	19.61	21.88	22.23	33.45		
Manitoba & Saskatchewan	12.23*	17.26	20.15	15.82	34.55		
Alberta	6.10*	15.13	6.32	26.55	45.89		
British Columbia	13.37*	5.17*	31.10	13.50*	36.85		
Background							
Caucasian/ White	7.46	16.78	16.40	20.83	38.54	X^2 (8) =	p =
Other	24.16*	0.00*	20.16*	15.70*	39.98	9.13	0.6917
Don't know	0.00*	0.00*	0.00*	0.00*	100.0*		
Natural hair colour							
Blonde	3.25*	12.32	17.29	20.20	46.93	X^2 (20) =	p =
Red	16.29*	13.24*	18.21*	0.00*	52.27*	27.27	0.1279
Light brown	10.80	11.15	12.54	19.05	46.46		
Dark brown	6.22	18.12	20.83	23.55	31.28		
Black	10.50*	28.00*	9.94*	23.39*	28.17*		
Other	33.79*	36.45*	0.00*	0.00*	29.77*		
Skin exposed to sunlight for first time [g]							
Severe sunburn	9.16	9.15	12.19	31.47	38.03	X^2 (16) =	p =
Mild sunburn	6.71	19.57	18.79	16.36	38.57	11.72	0.7628
Brown without any sunburn	10.26	17.81	16.47	18.15	37.31		
Don't know	0.00*	0.00*	100.00*	0.00*	0.00*		
Not stated	0.00*	6.22*	0.00*	18.92*	74.85		
Skin repeatedly exposed to sunlight [h]							
Very brown/ Deeply tanned	14.26	19.96	18.71	15.88	31.18	X^2 (20) =	p =
Moderately tanned	6.35	18.44	14.84	19.89	40.48	23.32	0.2731
Mildly/ Occasionally tanned	2.95*	10.37	14.24	26.32	46.12		
No suntan/	10.62*	6.58*	44.43	32.15	6.23*		

Freckled							
Don't know	37.82*	5.40*	0.00*	0.00*	56.78*		
Not stated	0.00*	6.22*	0.00*	18.92*	74.85		
History of skin cancer [i]							
Yes	0.00	0.00	0.00	72.84	27.16	$X^2 (4) =$	p =
No	8.16*	16.10*	16.57*	20.24*	38.83*	0.64	0.9588

[*] Have expected counts (unweighted) less than 5; Interpret with caution
[a] Bolded values are significant (p < .0001)
[b] Used a tanning bed once in the past 12 months: n = 22 (Unweighted)
[c] Used a tanning bed two to three times in the past 12 months: n = 40 (Unweighted)
[d] Used a tanning bed four to six times in the past 12 months: n = 50 (Unweighted)
[e] Used a tanning bed seven to 12 times in the past 12 months: n = 63 (Unweighted)
[f] Used a tanning bed more than 12 in the past 12 months: n = 116 (Unweighted)
[g] Skin reaction when exposed to bright sunlight for the first time in summer, for one hour in the middle of the day, without any protection
[h] Skin reaction when repeatedly exposed to bright sunlight in the summer without any protection
[i] Personal history of skin cancer, including melanoma, basal cell carcinoma, and squamous cell carcinoma

5.3 Regression models

5.3.1 Logistic model to predict prevalence

As presented in Table 6, the use of a tanning bed in the past 12 months was directly associated with being female ([estimated adjusted] OR 3.99, 95%CI 2.91 - 5.47), white (OR 2.56, 95%CI 1.28 - 5.12), having the intent to tan (always or often) during the summer months (OR 1.94, 95%CI 1.38 - 2.72), having the belief that people look better if they have at least a little bit of a tan (OR 2.98, 95%CI 1.64 – 5.42), and the belief that you look more attractive with a tan (OR 2.27, 95%CI 1.46 - 3.52) in older adolescents and young adults in the 2006 NSS2. The use of a tanning bed in the past 12 months was negatively associated with having skin that will freckle (no suntan) when repeatedly exposed to sunlight (OR 0.52, 95%CI 0.28 – 0.96). The model with both significant and non-significant variables accurately predicts the outcome (any use of a tanning bed) 76.2% of the time (based on the c-statistic).

Table 6. Logistic regression model for predicting any tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) from the 2006 Second National Sun Survey [a, b]

Characteristics	OR	95% CI	
Tanning attitude			
Most people look better if they have at least a little bit of a tan [c]			
Disagree	1.00		
Agree	**2.98**	**1.64**	**5.42**
You look more attractive when you have a tan [c]			
Disagree	1.00		
Agree	**2.27**	**1.46**	**3.52**
Having a tan gives you a healthy outdoor look [c]			
Disagree	1.00		
Agree	1.26	0.80	1.98
Tanning intention			
Intent to tan during summer months			
Never	1.00		
Sometimes	1.33	0.95	1.85
Always/often	**1.94**	**1.38**	**2.72**
Demographic and sun sensitivity characteristics			
Gender			
Male	1.00		
Female	**3.99**	**2.91**	**5.47**
Region			
Quebec	1.00		
Atlantic	1.16	0.72	1.85
Ontario	0.81	0.51	1.28
Manitoba & Saskatchewan	0.95	0.59	1.52
Alberta	0.97	0.61	1.53
British Columbia	0.62	0.37	1.06
Background			
Other	1.00		
White	**2.56**	**1.28**	**5.12**
Natural hair colour			
Black	1.00		
Dark brown	1.18	0.61	2.26
Light brown	1.10	0.55	2.17
Red	0.88	0.31	2.49
Blonde	1.22	0.60	2.48
Other	1.70	0.44	6.60
Skin exposed to sunlight for first time [d]			
Brown without any sunburn	1.00		
Mild sunburn	1.06	0.76	1.48
Severe sunburn	0.83	0.56	1.25

Skin repeatedly exposed to sunlight [e]			
Very brown/deeply tanned	1.00		
Moderately tanned	0.99	0.71	1.38
Mildly/occasionally tanned	0.80	0.53	1.21
No suntan/freckled	**0.52**	**0.28**	**0.96**

[a] c-statistic = 0.762; Bolded values are significant at a 5% level of significance
[b] 1 = yes (n = 293), 0 = no (n = 1,401), 91 missing values for the response or explanatory variables
[c] Agree = somewhat or strongly agree, Disagree = somewhat or strongly disagree
[d] Skin reaction when exposed to bright sunlight for the first time in summer, for one hour in the middle of the day, without any protection
[e] Skin reaction when repeatedly exposed to bright sunlight in summer without any protection

5.3.2 Negative binomial regression model to predict higher frequency

Shown in Table 7, gender (female), having skin that will moderately tan when repeatedly exposed to sunlight, the use of a tanning to look better ("very important"), and the use of a tanning bed to relax or feel better ("very important") were found significant at a 1% level of significance and found to predict the higher frequency of tanning bed use among those who had used a tanning bed in the past 12 months. Note, "other" hair colour was also found to be significant, resulting in a decrease in the logs of expected counts of the response variable; however, "other" hair colour is difficult to interpret and is likely the result of the small sample size. At a 5% level of significance, the model is significant ($p < 0.05$).

Compared to males, the difference in the logs of expected counts is expected to be 0.61 units higher for females (the estimated negative binomial regression coefficient comparing females to males, given that the other variables in the model are held constant). The estimated rate ratio for females, compared to males, is 1.84 (anti-log of 0.61). In other words, females (aged 16 to 34) who had used a tanning bed in the past 12 months had used a tanning bed 84% more often than males in the past 12 months. Compared to those with skin that will go very brown and deeply tanned, the difference in

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the logs of expected counts is expected to be 0.49 units higher for those with skin that will moderately tan when repeatedly exposed to sunlight. Those with skin that will moderately tan when repeatedly exposed to sunlight had used a tanning bed 63% more often (anti-log of 0.49 is 1.63) in the past 12 months.

Compared to those who reported the use of a tanning bed to look better as "not important," the difference in the logs of expected counts is expected to be 0.56 units higher for those who reported it as "very important." Those who used a tanning bed to look better had used a tanning bed 75% more often (anti-log of 0.56 is 1.75) in the past 12 months. Similarly, compared to those reported the use of a tanning bed to relax or feel better as "not important," the difference in the logs of expected counts is expected to be 0.53 units higher for those who reported it as "very important." Those who used a tanning bed to relax or feel better had used a tanning bed 70% more often (anti-log of 0.53 is 1.70) in the past 12 months.

Table 7. Negative binomial regression model for predicting frequency of tanning bed use in the past 12 months among older adolescents and young adults (aged 16 to 34) who had used a tanning bed in the past 12 months in the 2006 Second National Sun Survey * [a]

Characteristics	Frequency of tanning bed use in the past 12 months [b]		
	n = 285		
	Estimate	**95% CI**	**Anti-log**
Tanning attitude			
Most people look better if they have at least a little bit of a tan [c]			
Disagree	0.00		
Agree	-0.15	-0.68 0.38	0.86
You look more attractive when you have a tan [c]			
Disagree	0.00		
Agree	0.15	-0.25 0.54	1.16
Having a tan gives you a healthy outdoor look [c]			
Disagree	0.00		
Agree	0.14	-0.25 0.53	1.15
Tanning intention			
Intent to tan during summer months	0.00		
Rarely/never	-0.30	-0.58 -0.01	0.74
Sometimes	-0.33	-0.60 -0.05	0.72
Always/often			
Tanning bed use			
Why used artificial tanning equipment: [d]			
To tan without burning			
Not important	0.00		
Somewhat important	-0.13	-0.40 0.14	0.88
Very important	-0.16	-0.47 0.15	0.85
To look better			
Not important	0.00		
Somewhat important	0.30	-0.02 0.63	1.35
Very important	**0.56**	**0.17 0.95**	**1.75**
To relax or feel better			
Not important	0.00		
Somewhat important	0.21	-0.07 0.48	1.23
Very important	**0.53**	**0.18 0.87**	**1.70**
To boost your immune system			
Not important	0.00		
Somewhat important	0.04	-0.26 0.35	1.04
Very important	-0.10	-0.66 0.45	0.90
To prevent cancer			
Not important	0.00		
Somewhat important	-0.31	-0.73 0.11	0.73
Very important	0.35	-0.09 0.79	1.41
To get vitamin D			
Not important	0.00		
Somewhat important	0.07	-0.19 0.33	1.07
Very important	-0.38	-0.91 0.16	0.68
Demographic and sun sensitivity characteristics			

Gender				
Male	0.00			
Female	**0.61**	**0.33**	**0.88**	**1.84**
Region				
Quebec	0.00			
Atlantic	0.03	-0.34	0.39	1.03
Ontario	0.04	-0.33	0.41	1.04
Manitoba &	0.02	-0.34	0.39	1.02
Saskatchewan	0.20	-0.15	0.55	1.22
Alberta	0.11	-0.33	0.54	1.12
British Columbia				
Background				
Other	0.00			
Caucasian/White	-0.05	-0.59	0.48	0.95
Natural hair colour				
Black	0.00			
Dark brown	-0.50	-1.02	0.02	0.61
Light brown	-0.19	-0.72	0.34	0.83
Red	-0.50	-1.35	0.34	0.61
Blonde	-0.22	-0.79	0.35	0.80
Other	**-1.39**	**-2.43**	**-0.36**	**0.25**
Skin exposed to sunlight for first time [e]				
Brown without any sunburn	0.00			
	-0.28	-0.54	-0.01	0.75
Mild sunburn	-0.22	-0.56	0.12	0.80
Severe sunburn				
Skin repeatedly exposed to sunlight [f]				
	0.00			
Very brown/deeply tanned	**0.49**	**0.14**	**0.83**	**1.63**
	-0.42	-0.95	0.10	0.66
Moderately tanned				
Mildly/ Occasionally tanned	0.30	0.03	0.57	1.34
No suntan/ Freckled				

*df = 250, Value/DF = 1.1597, p = 0.04

[a] Bolded values are significant at a 1% level of significance

[b] 1 – 48 = number of times a tanning bed was used in the past 12 months (n = 286), 14 missing values

[c] Agree = somewhat or strongly agree, Disagree = somewhat or strongly disagree

[d] Used in the past 12 months

[e] Skin reaction when exposed to bright sunlight for the first time in summer, for one hour in the middle of the day, without any protection

[f] Skin reaction when repeatedly exposed to bright sunlight in the summer without any protection

CHAPTER 6

Discussion

6.1 Prevalence of tanning bed use in the past 12 months

6.1.1 Prevalence of tanning bed use

In the study, 17.3% of older adolescents and young adults (aged 16 to 34) in Canada (21.5% of females and 8.3% of males) were found to have had used a tanning bed in the past 12 months in 2006. The results are as expected and consistent with the meta-analysis that examined the international prevalence of tanning bed use (reported data from 1986 to 2012), where 14.0% of adults (18 years and older) and 18.3% of adolescents (19 years old and under) were found to have had used a tanning bed in the past 12 months (Wehner *et al.*, 2014). In Canada, 17.3% of the older adolescent and young adult population represents over 1.2 million individuals (aged 16 to 34) who have had used a tanning bed in the past 12 months and are now at increased risk of melanoma (and other health concerns). Tanning bed use, however, likely increased in popularity in Canada since the 2006 NSS2 and might represent an even greater public health concern today (based on international trends; Wehner *et al.*, 2014).

6.1.2 Sun sensitivity and demographic characteristics

Gender was found to be the strongest predictor of the prevalence of tanning bed use in the past 12 months in the older adolescent and young adult population. In the 2006 NSS2, females (aged 16 to 34) were 3.99 times more likely to have had used a tanning bed in the past 12 months. The results are consistent with previous research, where females are more likely to use tanning equipment (Heckman *et al.*, 2008; Hoerster *et al.*, 2007; Mayer *et al.*, 2011; Miyamoto *et al.*, 2012; Stryker *et al.*, 2007). The gender

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difference may be due to differences in the appearance-related concerns; however, in the current study, male respondents were significantly more likely to agree with the belief that people look better with a tan, they look more attractive with a tan, and a tan gives a healthy outdoor look (further discussed below). Nevertheless, females were significantly more likely to have had used a tanning bed at least once in the past 12 months.

Background was also found to be a significant predictor of the prevalence of tanning bed use in the past 12 months, where respondents who reported being Caucasian/white were 2.56 times more likely to have had used a tanning bed in the past 12 months, compared to the 'other' group. The results are consistent with previous research, which also found that tanning bed use is highest among those who are Caucasian/white (Heckman *et al.*, 2008; Hoerster *et al.*, 2007; Mayer *et al.*, 2011; Miyamoto *et al.*, 2012; Stryker *et al.*, 2007). The ethnicity difference may be due to differences in social pressures, where it is more socially acceptable for those who are white to tan for cosmetic purposes (Heckman *et al.*, 2008). Dark-skinned individuals may not perceive indoor tanning as culturally appropriate or may not need to make the effort to tan (Heckman *et al.*, 2008). In addition, having skin that will freckle (no suntan) when repeatedly exposed to sunlight negatively predicted the use of a tanning bed in the past 12 months, where those with skin that will freckle (no suntan) when repeatedly exposed to sunlight were less likely to use a tanning bed in the past twelve months, presumably because they do not tan (Heckman *et al.*, 2008).

6.1.3 Intent to suntan during summer months

Despite the fact that intent to tan was not specific to tanning bed use, intent to tan was a significant predictor of tanning bed use, where respondents who had a strong desire

to suntan (reported intent to tan as 'always' or 'often' during the summer months) were 1.94 times more likely to have had used a tanning bed in the past 12 months. The result is consistent with previous research (Hillhouse *et al.*, 2000) and consistent with the theoretical approach. In relation to the Theory of Reasoned Action, intent to tan is an immediate determinant of tanning bed use and, as shown in the current study, can be used to predict the prevalence of tanning bed use in the past 12 months in older adolescents and young adults in Canada.

6.1.4 Tanning attitudes

As expected, the tanning attitudes that predict any tanning bed use in the past 12 months in older adolescents and young adults (aged 16 to 34) in the 2006 NSS2 include the belief that people look better with a tan and the belief that you look more attractive with a tan, where those who agreed were 2.98 and 2.27 times more likely to have had used a tanning bed in the past 12 months, respectively. Interestingly, the belief that a tan gives a healthy outdoor look was not found to be a significant predictor of tanning bed use. The current study found that appearance-related attitude, but not health-related attitude, could predict any use of a tanning bed in the past 12 months in older adolescents and young adults in the 2006 NSS2.

In relation to the health-related attitude, a further look into the research found some supporting evidence; however, the research has been inconsistent (Dennis *et al.*, 2009; Hillhouse *et al.*, 2000). Consistent with the current study, however, Hillhouse and colleagues (2000) found that appearance-related attitude was more predictive of tanning bed use than health-related attitude, suggesting that in an effort to modify tanning bed use, the focus should be on the appearance-related concerns (e.g. the motivation to

maintain an attractive appearance) rather than on the health-related concerns (e.g. the belief that a tan can give a healthy outdoor look).

Interestingly, the current study found that both females and males (aged 16 to 34) were more likely to agree that people look better with a tan than that they look more attractive with a tan. The result lends support for tanning bed use being, in part, socially motivated. Although subjective norms were not examined in the current study, the social influence on tanning behaviour had been previously noted. In a survey of youth (aged 15 to 17) in Saskatchewan, for example, parental influence was found to have a significant influence on tanning behaviour, where those who had used a tanning bed were more likely to have a parent of guardian who had also used a tanning bed (Sun Smart Saskatchewan, 2013).

Interestingly, the study also found that male respondents were significantly more likely to agree with the belief that people look better with a tan, they look more attractive with a tan, and a tan gives a healthy outdoor look. Although more research is needed, tanning bed use among females might be, in part, motivated by the male preference for tanned skin. The result might suggest an intervention to target the male attitude toward tanned skin.

6.2 Frequency of tanning bed use in the past 12 months
6.2.1 Frequency of tanning bed use

In Canada, the majority of older adolescents and young adults (aged 16 to 34) who had used a tanning bed in the past 12 months had used a tanning bed more than 12 times: 7.0% of females and 10.3% had used a tanning bed once; 13.1% of females and 21.8% of males two to three times; 16.4% of females and 15.1% of males four to six

times; 19.0% of females and 22.4% of males seven to 12 times; and, 41.3% of females and 29.3% of males more than 12 times. The frequent use of tanning bed is a concern given the increased risk of melanoma with each use. As noted above, Boniol and colleagues (2012) found a 1.8% increase in the risk of melanoma skin cancer with each additional tanning session. A limited amount of previous research examined the frequency of tanning bed use (Börner *et al.*, 2009; Cust *et al.*, 2011; Dennis *et al.*, 2009) and fewer have examined the frequency of tanning bed use in the past 12 months (Börner *et al.*, 2009). Nevertheless, the results are consistent with previous research to show that the majority of users have used a tanning bed more than once.

6.2.2 Sun sensitivity and demographic characteristics

In the 2006 NSS2, females aged 16 to 34 who had used a tanning bed in the past 12 months were found to have had used a tanning bed 84% more often than males in the past 12 months. The result further suggests that an intervention targeted toward females would be most effective. Similarly, those who had used a tanning bed in the past 12 months with skin that will moderately tan when repeatedly exposed to sunlight were found to have had used a tanning bed 63% more often in the past 12 months than those with skin that will deeply tan when repeatedly exposed to sunlight.

6.1.3 Tanning attitudes

In the 2006 NSS2, those who had used a tanning bed to look better and to relax or feel better (reported as "very important") in the past 12 months had used a tanning bed 75% and 70% more often in the past 12 months than those who did not, respectively. The frequent use of a tanning bed to relax or feel better may be due to the physiological effect of UV radiation or due to the act itself of lying in a warm, quiet place (Holman, 2015). In

either case, promoting the use of alternative behaviours to reduce stress (or to relax and feel better) might be an effective strategy to reduce tanning bed use in older adolescent and young adult populations in Canada; however, further research into this area is needed.

The frequent use of a tanning bed to look better may lend support for the role of sunless tanning products (e.g. creams, lotions, and sprays to tan) in harm reduction—promoted as a safer alternative to indoor tanning. Given the appearance-related motivation to use a tanning bed, it was initially thought that sunless tanning products (used to tan) might play a role in reducing tanning bed use. However, based on the results of the current study and consistent with previous research, the promotion of sunless tanning products may not reduce UV exposure as was initially thought. The current study found that the majority (37.21%) of those who had used a tanning bed in the past 12 months had also used cream, lotions, or sprays to tan, compared to only 7.95% who had not used a tanning bed in the past 12 months. The use of creams, lotions, or sprays, in addition to tanning bed use, is consistent with previous research (Brooks *et al.*, 2006; Cokkinides *et al.*, 2010; Mahoney *et al.*, 2012; Paul *et al.*, 2011; Stryker *et al.*, 2007).

6.3 General discussion

The current study further found that the motivation for the initiation of tanning bed use might be different from the motivation for the continued or frequent use of a tanning bed; however, more research into this area is needed. Intent to tan, for example, was found to predict any use of a tanning bed in the past 12 months, but not found to predict the higher frequency of tanning bed use. Recent research indicated that individuals, motivated by the dependence to tan, have a weaker relationship between

intent to tan and tanning behaviour (Baker *et al.*, 2011; Robinson *et al.*, 2012). If this is the case, different strategies may be needed to 1) prevent the initiation of tanning bed use and 2) to help current users to quit or reduce the frequency of use (Holman, 2015). The current study, however, used a cross-sectional design, which does not allow for the differentiation of the experimental use of a tanning bed (or initiation of tanning bed use, common among adolescents) from the well-established use of a tanning bed (when examining the prevalence of tanning bed use), limiting the results.

In the past, a limited number of interventions to reduce tanning bed use in adolescents and young adults have had the goal of increasing their knowledge of the carcinogenic effects of UV radiation and have had limited (Arthey & Clarke, 1995). In the United States, in a comparison survey of indoor tanning knowledge among young adults (aged 18 to 30 years) from 1988 to 2007, knowledge of the risk of skin cancer from tanning increased from 42% to 87% (Robinson *et al.*, 2008). In the survey, media was identified as the main source of information. Media campaigns at this time had emphasized the harmful effects of tanning and it is likely that the shift in knowledge represented the change in the skin cancer prevention message. In addition, the study examined indoor tanning attitude and noted the limited influence of knowledge on tanning attitude, reflected in the increase in tanning bed use.

In Canada, general tanning knowledge has been examined at a provincial level. In a survey of youth in Saskatchewan, overall 77.0% and 74.2% believed that tanning could cause damage to their skin and cause premature skin aging, respectively (Sun Smart Saskatchewan, 2013). Interestingly, compared to non-indoor tanners, indoor tanners (defined as having ever used a tanning bed) were more than twice as likely to agree that,

"as long as you don't burn, indoor tanning does not damage your skin," identifying a gap in their knowledge.

Although the current study did not examine knowledge or the influence on attitude, the study did examine the belief that tanned skin gives a healthy outdoor look and although most adolescents and young adults agreed, the belief was not found to significantly predict tanning bed use in the past 12 months. It is, however, possible that knowledge of the appearance-related risks of tanning bed use (i.e. that *any* exposure to UV radiation can cause damage to the skin) can influence appearance-related attitude and motivational basis for tanning bed use, especially if adolescents and young adults use a tanning bed to tan without burning. Future research should examine the influence of knowledge of the appearance-related risks, in particular, on tanning attitude and behaviour.

Consistent with the current study, the focus of the intervention should be on the appearance-related motivation to use a tanning bed, including the belief that people look better with a tan and that you look more attractive with a tan and on the use of a tanning bed, specifically, to look better or to relax and feel better. Although more research is needed, interventions should have the goal of increasing knowledge of the appearance-related risks with any exposure to UV radiation, rather than health-related risks (i.e. skin cancer). In addition to an intervention targeted at the high-risk population (young white females), an intervention focused on the appearance of photodamaged and premature aged skin would be most effective.

6.4 The role of the industry and legislation

In order to better identify the strategies that could reduce tanning bed use, policy makers and health promotion workers should take into account the broader contextual factors—the role of the indoor tanning industry and legislation. Although the study focused on the individual level determinants that predict tanning bed use, the following section will provide a brief overview of the use of tanning beds for the production of vitamin D and comparisons to the tobacco industry and opportunities for further regulation.

6.4.1 Tanning bed use for the production of vitamin D

As mentioned above, the JCTA has promoted the use of a tanning bed for the production of vitamin D. The study examined whether vitamin D and cancer prevention could predict the higher frequency of tanning bed use. In the current study, 41.73% of female and 38.76% of male older adolescents and young adults (aged 16 to 34) in Canada, who had used a tanning bed in the 12 months, had used a tanning bed to get vitamin D (reported as either 'somewhat' or 'very important') and a further 25.00% of female and 17.70% of male older adolescents and young adults had used a tanning bed in the past 12 months to prevent cancer. The current study, however, found that the use of a tanning bed to get vitamin D and to prevent cancer were not significant predictors of the higher frequency of tanning bed use in the past 12 months. The results lend additional support for the health-related concerns not being a significant motivator for tanning bed use in older adolescents and young adults in Canada.

6.4.2 Lessons from tobacco control

Parallels can be made to the tobacco industry, which has similarly dismissed the health risks of tobacco use and targeted adolescents and young adults (Seidenberg *et al.*,

2014; Sinclair & Makin, 2013). Like tobacco (or cigarette) use, tanning bed use is associated with a number of significant health risks (when used as intended) and might (to some degree) be addictive (Kourosh *et al.*, 2010; Trochim *et al.*, 2003). Unlike tobacco products, tanning beds are used predominately by one group—white females. In addition, tanning beds do not produce toxic emissions and are not the only source of UV radiation (Seidenberg *et al.*, 2014). Nevertheless, in an effort to reduce tanning bed use, tobacco control policies may provide a framework (Seidenberg *et al.*, 2014; Sinclair & Makin, 2013). The following section will provide a brief overview of current regulations in Canada:

6.4.2.1 Legislation

In Canada, the Tobacco Act (passed in 1997) outlines the federal level tobacco regulations and provides the framework "to protect the health of Canadians from the health risks associated with tobacco use; to protect young persons and others from inducements to use tobacco products and the consequent dependence on them; to protect the health of young persons by restricting access to tobacco products; and to enhance public awareness of the health hazards of using tobacco products" (Government of Canada, 2016).

Similar to tobacco, the sale, lease, and import of tanning equipment is regulated at the Federal level (the Radiation Emitting Devices Act). Tanning bed use (in commercial establishments), however, is regulated at the provincial level (Government of Canada, 2015). Provinces (and territories) in Canada either regulate or intend to regulate the access of minors to tanning equipment (discussed below). At the Federal level, the Radiation Emitting Devices Act sets, for example, the labelling requirements; however,

the application and scope of the Act are limited and do not apply to tanning equipment operators (Health Canada, 2014). In addition, the Act does cover the mechanism for monitoring and enforcement (Health Canada, 2014). Health Canada has also prepared the Guidelines for Tanning Salon Owners, Operators, and Users; however adherence to the guidelines is voluntary (Health Canada, 2014). Although currently under revision by the Federal Provincial Territorial Radiation Protection Committee, the document provides "a fundamental understanding of ultraviolet radiation and its effects" (Health Canada, 2014).

6.4.2.2 Price regulation

Taxation is a widely used approach, used to decrease tobacco use. It is justified by the economic health burden caused by tobacco use. Taxation is among the most effective methods to target youth, in particular, and reduce tobacco use (IARC, 2011). In Canada, tobacco taxes are implemented at both, the federal and provincial level (Azagba and Sharaf, 2011; Reid & Hammond, 2015). A tanning bed taxation could, similarly, be justified by the economic burden caused by tanning bed use and could help to reduce the demand for tanning equipment among youth (Seidenberg *et al.*, 2014). Furthermore, the funded money could be directed toward other efforts to reduce tanning bed use, including both education and research (Seidenberg *et al.*, 2014).

6.4.2.3 Regulating access to minors

In Canada, the sale of tobacco is prohibited to young persons (18 years of age or less) and retailers of tobacco products are required to inform the public the sale of tobacco products to young persons is prohibited by the law (Government of Canada, 2016). Regulating access to tanning bed use, under provincial jurisdiction, has led to what

Seidenberg and colleagues (2014) described as "a patchwork quilt of governing restriction (or lack thereof)."

The inclusion of parental consent, is unique to indoor tanning and not seen in either alcohol or tobacco control. In the United States, neither the inclusion of parental consent (Mayer *et al.*, 2011) or age-restriction (Forster *et al.*, 2006; Mayer *et al.*, 2008) have shown to be effective. The inclusion of parental consent is difficult to enforce and parents may choose to expose their children to the carcinogenic effects of tanning bed use. In addition, a challenge to regulating access of tanning beds to minors is the unsupervised tanning beds in apartment complexes, student residences, gyms etc. (Holman *et al.*, 2013).

Prince Edward Island, Quebec, Ontario, Manitoba, and British Columbia have recently introduced legislation to prohibit the use of tanning beds by individuals under the age of 18. Similarly, Newfoundland/Labrador, Nova Scotia, and New Brunswick have introduced legislation to prohibit the use of tanning beds by individuals under the age of 19. Saskatchewan and Alberta currently do not regulate the use of tanning beds, but both provinces intend to introduce legislation. In March 2015, the Government of Saskatchewan released a statement that outlined Saskatchewan's plan to develop regulation to prohibit the use of tanning beds by those under the age of 18 (Government of Saskatchewan, 2015). Although Alberta intends to introduce legislation, the details have not yet been released (Canadian Press, 2012). Few studies, however, have assessed the association between legislative action (tanning law restriction on youth assess) and those that have, did not find an association.

6.4.2.4 Advertising and marketing

The Tobacco Act prohibits the promotion of tobacco products, specifically "a representation about a product of service by any means, whether directly or indirectly, including any communication of information about a product or services and its price or distribution, that is likely to influence and shape attitudes, beliefs, and behaviours about the products or service with exception" (Government of Canada, 2016); however, provinces in Canada can further restrict advertising and promotion. In the tobacco industry, marketing targeted toward youth has led to youth initiation of tobacco use (Cummings *et al.*, 2002; DiFranza *et al.*, 2006).

Similar to the tobacco industry, the indoor tanning industry is known to market to young people (Canadian Cancer Society, Ontario Division, 2009). Current practices, however, have allowed the industry to be largely successful in promoting indoor tanning too young people. The industry, for example, is allowed to directly market to young people, and have done so through schoolyard flyer drops and in yearbooks (Canadian Cancer Society, Ontario Division, 2009). The practice has been to promote indoor tanning as a normal, save product. In Canada, several provincial regulations have begun to prohibit advertising or marketing of tanning services to minors. However, to my knowledge, there are no further regulations. In fact, most tanning facilities offer promotional packages, including unlimited tanning, and will recommend tanning every second day (Sun Safe Nova Scotia coalition, 2005).

6.4.2.4 Health warnings

In June 2001, Canada was the first country to implement health-warning labels on cigarettes, where 50% of the front (English) and back (French) of the cigarette package is required to include a health warning label (Government of Canada, 2016). In March

2017, 75% of the cigarette and little cigar packaging are required to have health warning covering (Government of Canada, 2016). In addition, a prescribed health information message containing information to quit is required to appear in rotation, on the inside of each package (Government of Canada, 2016). Finally, a toxic emission message about the constituents of cigarette smoke is required to appear on packages (Government of Canada, 2016).

The Radiation Emitting Devices Act, similarly, requires information and labelling of tanning equipment, including instructions for safe use (e.g. the "minimum interval between consecutive exposures recommended by the manufacturer") and ultraviolet radiation warning labels. The Minister provides the warning labels, shown in Figure 4 and 5 (Government of Canada, 2015).

Figure 4. Ultraviolet radiation warning label shown in French, black and white (Government of Canada, 2015).
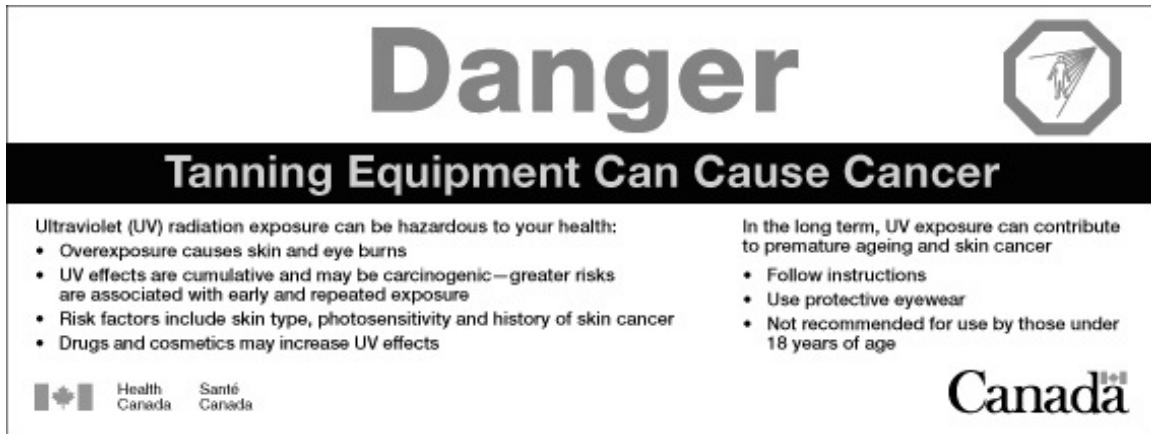
Figure 5. Ultraviolet radiation warning label shown in English, black and white (Government of Canada, 2015).

6.5 Strengths and limitations of the study

6.5.1 Strengths

The study focused on tanning bed use in Canada; this is an important public health issue that needs to be addressed. The study used data collected in the 2006 NSS2, the most recent and comprehensive survey in Canada to allow for the study of exposure to artificial UV radiation in a population that was representative of the older adolescent and young adult (general) population in Canada. In the past, research examined tanning behaviour in only a subset of the young adult population (e.g. among college students), limiting the generalizability of the results. In addition, the study had a large sample of adolescents and young adults (a limitation noted in previous research). Although the study used data that had already been collected, a number of tanning attitudes were examined. The tanning attitudes were not significantly correlated and could be compared and contrasted (e.g. the appearance-related belief vs. health-related belief), providing a better understanding of the motivational basis for tanning bed use.

6.5.2 Weaknesses

The study did, however, use data collected in 2006. As noted prior, the prevalence of tanning bed use in the past 12 months is likely underestimated (based on international trends, tanning bed use has since increased in popularity). The frequency of tanning bed use may, similarly, be underestimated. There is, however, no reason to believe, to my knowledge, that tanning attitudes have changed overtime. In Canada, since 2006, there have been no interventions, to my knowledge, to change tanning attitudes. If anything, the attitudes likely became more prominent (with tanning equipment now widely available in Canada). Nevertheless, this is the most recent estimate of the prevalence and frequency of tanning bed use in Canada. Second, the study examined intent to suntan during the summer months and a number of attitudes that were not specific to tanning bed use. Nevertheless, significant predictors were found that could be used to help inform a public health intervention. Third, the use of a secondary data set did not allow for the study of other predictors (e.g. subjective norms, perceived behavioural control, social influence, etc.). The study was limited to tanning attitudes, when tanning bed use is likely to have multiple determinants, even at the individual level. Fourth, although the study included a large sample of adolescents and young adults, only a handful had used a tanning bed in the past 12 months and were included in the model to predict the higher frequency of tanning bed use. Despite several of the cells (with the frequency of tanning bed use) having low cell counts, the characteristics were included in the model—a limitation of the study. Fifth, the study used a cross-sectional design and relied on self-report measures. The use of self-report data is subject to bias (reporting or recall bias) and

the use of a cross-sectional study design, as noted, does not allow for the differentiation of the experimental use of tanning beds from the well-established use of tanning beds.

6.5.3 Research implications

Future research should examine tanning knowledge related to the appearance-related concerns, including adolescent and young adult knowledge of whether any exposure to artificial UV radiation can lead to premature skin aging or damage to the skin (appearance-related risks of exposure to UV radiation). In addition, future research should examine knowledge related to vitamin D production (including immune system function and cancer prevention). The knowledge might reflect the influence of the indoor tanning industry, which has been known to promote the use of tanning beds for the production of vitamin D. Furthermore, research should examine adolescent and young adult knowledge of the indoor tanning industry, including an understanding of the industry tactics. Measures of perceived behavioural control are another important area of research, given the evidence to suggest that tanning bed use might be an addictive behaviour. In addition to measures of perceived behavioural control, surveys should include measures of subjective norms. Research has shown that tanning behaviour is, in part, socially determined. A better understanding of the social motivation to use a tanning bed is an important area of research.

CHAPTER 7

Conclusion

Despite the limitations, the study provides valuable insight into the use of tanning beds among older adolescents and young adults (aged 16 to 34) in Canada. The study adds to the growing body of literature to document the belief that tanned skin is attractive and the concerning prevalence and frequency of tanning bed use. The study examined the individual-level determinants of tanning bed use among older adolescents and young adults (aged 16 to 34) in the 2006 NSS2 and found that the appearance-related motivation for the use of a tanning bed may be more important than the health-related motivation for the prevalence and higher frequency of tanning bed use. This is a key point of intervention that should be addressed in an effort to reduce tanning bed use.

In Canada, there is a need for a coordinated public health approach to reduce tanning bed use. The individual-level determinants of tanning bed use, identified in the current study, provide valuable information to help inform policy and other decision makers, but must be understood in terms of the broader context. The indoor tanning industry, as stated above is known to dismiss health risks and propagate misinformation related to the benefits of tanning bed use in Canada. Tobacco control initiatives, on the other hand, have developed a set of evidence-based policies and may provide a conceptual framework, in order that tanning attitudes are consistent with the carcinogenic nature of UV radiation and industry products.

APPENDIX A

The Second National Sun Survey (NSS2) Base Sample Questionnaire (English), 2006

(Not included)

APPENDIX B

Sample size of demographic and sun sensitivity characteristics from the 2006 NSS2:

Gender	
Male	766
Female	1019
Region	
Atlantic	251
Quebec	324
Ontario	371
Manitoba & Saskatchewan	259
Alberta	317
British Columbia	263
Background	
Caucasian/white	1516
Other	260
Don't know	8
Refused	1
Natural hair colour	
Blonde	326
Red	75
Light brown	479
Dark brown	639
Black	248
Other	16
Don't know	2
Skin exposed to sunlight for first time	
Severe sunburn	473
Mild sunburn	662
Brown without any sunburn	515
Refused	6
Not stated	92
Skin repeatedly exposed to sunlight	
Very brown/deeply tanned	503
Moderately tanned	633
Mildly/occasionally tanned	332
No suntan/freckled	183
Don't know	42
Not stated	92
History of skin cancer	
Yes	1776
No	9

Frequency distribution of the number of times a tanning bed was used in the past 12 months, among older adolescent and young adult who had used a tanning bed in the past 12 months in Canada from the 2006 NSS2:

Distribution of freq

Number of times a tanning bed was used in the past 12 months
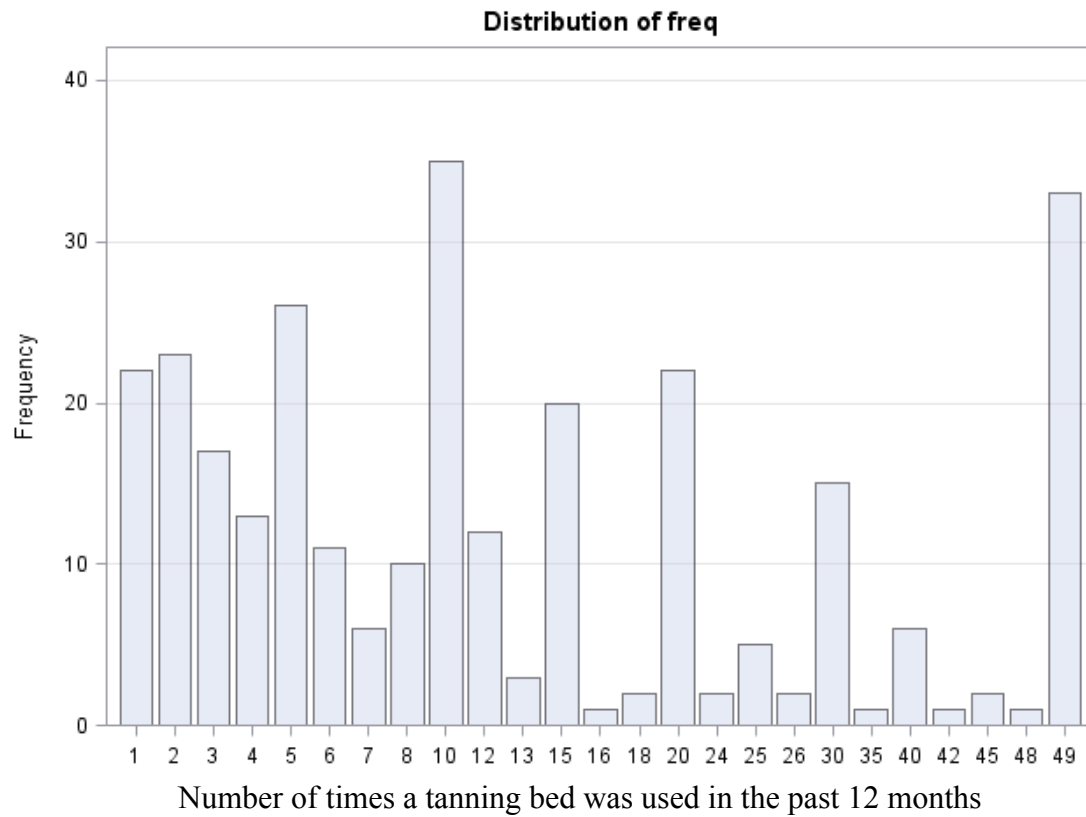
Spearman correlation between tanning attitudes:

		Spearman correlation	P-value
People look better with a tan	You look better with a tan	0.61	<.0001
People look better with a tan	A tan gives a healthy outdoor	0.53	<.0001
You look better with a tan	A tan gives a healthy outdoor	0.55	<.0001

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