ASSOCIATION BETWEEN GAMBLING ACCESSIBILITY AND PROBLEM GAMBLING IN THE GENERAL POPULATION

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DEDICATION

To my late father, **Emmanuel Mantey**, who sacrificed everything within his reach for my education. Papa, your investment in my education was never a waste. It has paid off as you anticipated. You will forever be remembered, appreciated, and adored.

ABSTRACT

Accessibility to gambling is one of the important modifiable determinants of problem gambling behaviour. Studies presented in this dissertation attempted to provide a comprehensive analysis and explanation of the association between accessibility and problem gambling prevalence using different measures of accessibility with quantitative and qualitative data. The first study examined the association between perceived accessibility and problem gambling severity and the moderating role of demographic characteristics, substance use, and psychosocial variables using a perceptual measure of accessibility. The second study examined the relative importance of availability, proximity, and a composite measure of accessibility in explaining the prevalence of problem gambling risk and severity. The third study examined the relative and interactive influence of actual and perceived accessibility on problem gambling risk and severity. The final study used a mixed-methods design to determine differences between non-problem, low-risk, moderate-risk, and problem gamblers in their accessibility to casinos in both Alberta and Tasmania.

PREFACE

DC, **OA**, **BL**, and **AJ** contributed to the conceptualisation of the study, editing of the article, and approval of the four manuscripts for submission.

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Chapter One: Introduction

Accessibility and problem gambling prevalence association: An unresolved issue

Gambling is the act of gaming or wagering for money or something of value (James, O'Malley, & Tunney, 2017; Shaffer & Korn, 2002). Wagering involves placing a monetary bet on real-life events whose outcomes are uncertain. Such events may include horse or dog races, sports, financial markets, and political activities. In contrast, gaming is the act of placing a bet on an event with randomly determined outcomes (James, O'Malley, & Tunney, 2017; Shaffer & Korn, 2002). The distinction between wagering and gaming lies in the kind of events on which the bet is placed.

Gambling takes place in a land-based venue or on the internet, and it is performed on many different objects, referred to as games or machines (McBride & Derevensky, 2009; Williams, Volberg, & Stevens, 2012). Land-based gambling requires access to a venue and a gambling activity. Access to both gambling venues and machines is associated with problem gambling prevalence. However, the nature of the association between accessibility and problem gambling is not conclusively established (Shaffer, LaBrie, & LaPlante, 2004; Storer, Abbott, & Stubbs, 2009; Vasiliadis, Jackson, Christensen, & Francis, 2013). Some studies have found the association to be linear, while other studies have not (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). Reported associations tend to vary from one population to another (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). The manuscripts presented in this dissertation examine the accessibility and problem gambling association and identify effective supply and demand focused harm reduction interventions for problem gambling.

Research into the potential association between gambling accessibility and problem gambling prevalence began in the late 1980s (Volberg & Steadman, 1988; Williams et al., 2012). Three characteristics of gambling accessibility have received the most attention in the literature (Shaffer et al., 2004; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). They are the number of gambling venues, the number of gambling machines per venue, and the location of venues (Shaffer et al., 2004; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). These accessibility characteristics have individually been examined to determine their association with problem gambling prevalence. However, research has not used all these accessibility characteristics collectively to measure gambling accessibility. This disjointed approach is possibly because there is no proposed procedure for integrating these accessibility measures into a multidimensional measure of accessibility (Hing & Haw, 2009; Moore, Thomas, Kyrios, Bates, & Meredyth, 2011; Productivity Commission, 2010; Williams et al., 2012). Multidimensional accessibility is needed to provide a holistic view of the role of accessibility in the prevalence of problem gambling in the general adult population. The findings of studies on the role of the different components of accessibility in the prevalence of problem gambling are generally inconsistent, as demonstrated below.

Research has compared problem gambling prevalence across populations with different levels of gambling accessibility and found higher rates in populations with access to more gambling venues and machines (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013). Other studies have compared populations located at different proximities from gambling venues such as casinos and found that problem gambling prevalence tends to be higher in those located closer to gambling venues (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). However, there are several other inconsistencies in the above associations (Storer et al., 2009; Vasiliadis et al., 2013). For example, not all areas with greater access to gambling venues/machines or who live closer to a venue tend to have higher prevalence rates (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). These contradictory research findings indicate that the role of the various components of accessibility in the prevalence of problem gambling has yet to be firmly established.

Replication studies show that problem gambling prevalence rates typically change following changes in the accessibility characteristics of the gambling environment, such as increases in the number of gambling venues and machines (Ladouceur, Jacques, Ferland, & Giroux, 1999; Williams et al., 2012). In some populations, prevalence rates increase when gambling venues and machines increased (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). For others, prevalence rates remain almost the same or decline even as opportunities increase (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). Generally, increases in prevalence rates are mostly reported during the first few years following increases in gambling opportunities; however, prevalence tends to stabilize or decline after years of continued exposure (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012).

Three important unresolved issues in the literature on accessibility and problem gambling relationship concern the measurement of gambling accessibility, the unit of analysis of the association between accessibility and problem gambling, and the role of perceptual measures of accessibility in the prevalence of problem gambling (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). First, the Productivity Commission (2010) and researchers (Abbott, 2006; Williams et al., 2012) found that gambling accessibility is a multidimensional construct (Productivity Commission, 2001), yet most studies measured it with single indicators such as gambling venues, gambling machines, and a gambler's proximity to a gambling venue (Storer et al., 2009; Vasiliadis et al., 2013). For example, most studies have examined whether the density of gambling venues, the number of machines per venue, and proximity to a venue are individually associated with problem gambling prevalence (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). A multidimensional measure that combines the above individual accessibility measures into a single construct has yet to be used to explain individual or population differences in problem gambling prevalence (Productivity Commission, 2010; LaPlante & Shaffer, 2007).

Second, the accessibility and problem gambling prevalence association have mostly been examined at the states, provincial, and national levels (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). For example, in Australia, Canada, and the United States, most studies have examined states or provincial differences in prevalence rates, with higher rates in areas with a higher concentration of casino and non-casino EGMs (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). However, no study has directly examined whether individual level differences in problem gambling are accounted for by their differences in gambling accessibility, as measured by the density of gambling venues and machines (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). Reported individual-level association is mostly inferred from population-level analyses (Ladouceur et al., 1999; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012).

Lastly, research has mainly examined the association between accessibility and problem gambling prevalence with objective measures of accessibility such as the number of gambling venues, their per capita number of machines, and travel distance from residential areas to venues

(Ladouceur et al., 1999; Shaffer et al., 2004; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012).

Only two studies have measured gambling accessibility in terms of perceptions. One study asked respondents whether gambling opportunities were too widely available or not in Alberta (Williams, Belanger, & Arthur, 2011), and a second study asked American college students whether lotteries could easily be purchased (Wickwire et al., 2007). Both studies reported higher levels of perceptions of gambling availability and accessibility in the general population. Only Wickwire et al. (2007) examined the association between gamblers' perceptions and problem gambling. They found that college students who perceived that they could easily purchase lottery tickets were more likely to be regular gamblers but were not different from the others in their problem gambling. As a limitation, Wickwire et al. (2007) measured gamblers' perceptions of access to lotteries, but not other equally attractive gambling forms such as EGMs and table games.

Based on the identified gaps in the literature, the dissertation seeks to: (1) assess the role of perceptions of availability in the prevalence of problem gambling severity; (2) compare the relative effects of availability, accessibility, and their composite construct (a multidimensional measure) in predicting problem gambling risk and severity; (3) assess the relative and interaction effects of actual (objective) and perceptual (subjective) measures of gambling accessibility in predicting problem gambling risk and severity; and (4) determine whether there are differences in non-problem, low-risk, moderate-risk, and problem gamblers in their experiences with access to casinos, and how any potential differences are linked to childhood and intimate relationship experiences.

Organization of the rest of the dissertation

Chapters Two and Three, respectively, provide a comprehensive review of the literature on gambling accessibility and gambling behaviours, and an overview of the methodologies of the manuscripts presented in this dissertation. Four related manuscripts are presented in the subsequent chapters. All the manuscripts address the issue of gambling accessibility and its association with problem gambling using data from Alberta in Canada and Tasmania in Australia.

Chapter Four examines the association between accessibility and problem gambling severity and the moderating role of demographic, substance use, and psychosocial variables using a perceptual measure of accessibility. These associations were examined with linear regression models using 2008/2009 population-based survey data with a randomly selected sample of 1,388 Albertan adults (Williams et al., 2011).

Expanding on *Chapter Two* that accesses the role of accessibility with a perceptual measure, *Chapter Five* examines the role of accessibility with objective measures such as the number of gambling venues, the number of gaming machines (combined into a measure called availability), and gamblers' proximity to the nearest casino (accessibility). A multidimensional measure of accessibility with these measures was constructed using a formula described in the chapter. The availability, accessibility, and the multidimensional measures were compared to determine their relative associations with problem gambling risk and severity. The survey data (n = 5,033) from Alberta (Williams et al., 2011) were used to perform the analysis using bivariate and multivariate binary logistic regression (for problem gambling risk) and standard Poisson (for problem gambling severity) models.

Building on *Four and Five*, *Chapter Six* seeks to determine whether there were differences between actual and perceived measures of gambling accessibility in predicting the prevalence of problem gambling risk and severity with the Albertan survey data (n= 4,991). It also examines the interaction effects of both measures. Bivariate and multivariate Zero Inflated Poisson (ZIP) models were used to determine the difference between the actual and perceived measures and their interaction effects on problem gambling risk and severity.

Chapter Seven applies a mixed-methods design to determine differences between non-problem, low-risk, moderate-risk, and problem gamblers in their accessibility experiences with casinos in Alberta and Tasmania. Quantitative data (*n = 4,991 for Alberta and n = 2035 for Tasmania*) from both areas were analyzed to determine the extent to which the four gamblers types differ in their access to casinos and how their differences are patterned by age, gender, and place of residence. These quantitative data were analyzed descriptively only. Using descriptive qualitative research design, interviews with ten Albertans and fourteen Tasmanians were analyzed thematically to gambler types experiences with access to casinos, how their accessibility experiences shape gambling behaviour and are shaped by childhood adversities and intimate partner relationship problems.

Chapter Eight discusses the key findings of the four manuscripts, including recommendations for future research, their overall policy implications for problem gambling prevention, and a brief summary of the findings.

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Chapter Two: Background and literature review

The discussion is organized into six headings: (1) gambling and its prevalence, (2) gambling accessibility, (3) theoretical and empirical association between accessibility and gambling, (4) perceptions of gambling accessibility, (5) comorbidities of problem gambling, and (6) gambling harm minimization measures. Various public health interventions for problem gambling are discussed in the section on gambling harm minimization measures to provide more background information about the policy implications suggested in the manuscripts. For each section the literature is synthesized and discussed to provide further background insights into the four manuscripts presented in this dissertation. A summary of the literature is provided at the end of each section.

Gambling and its prevalence

Gambling involves wagering valuable items such as money on an event whose outcome is determined by chance (Ladouceur, 1996). Gamblers aim to win something that is of higher value than their original wager (Williams, Volberg, & Stevens, 2012). Until recent decades, gambling was a land-based activity. It was mostly undertaken at physical locations such as pubs, clubs, hotels, casinos, convenience shops, and others (Williams et al., 2012). In the past three decades, the gambling industry has expanded to include online platforms that allow gambling activities similar to those of the land-based. This expansion suggests that gambling has evolved from being solely a land-based activity to including an online-based activity (Williams et al., 2012).

Land and online-based platforms offer similar gambling types, though they differ in their modes and appearances (Wardle, Moody, Griffiths, Orford, & Volberg, 2011a). They include EGMs, lotteries, poker, bingo, sports betting, horse racing, and others (Cox, Yu, Afifi, & Ladouceur, 2005; Productivity Commission, 2010). The popularity of these activities varies across jurisdictions. In developed countries, for example, lotteries and EGMs such as video lottery machines (vlts) and slot machines are more popular (Williams et al., 2012). The rate of public involvement in land-based and online gambling activities vary, as discussed below.

Land-based gambling still attracts the largest number of gambling patrons worldwide when compared to online gambling. Over 61% of the global adult population participate in some form of land-based gambling activities each year (Abbott, Volberg, & Rönnberg, 2004; Gainsbury, Gainsbury, Russell, Hing, Wood, Lubman, & Blaszczynski, 2014; Pearce, Mason, Hiscock, & Day, 2008; Wardle, Moody, Griffiths, Orford, & Volberg, 2011; Williams et al., 2012). However, participation rate varies across countries, ranging from 35% in the Switzerland to around 86% in New Zealand (Calado & Griffiths, 2016). In the United States, for example, an estimated 76.9% to 82.2% of the adult population participate in gambling activities annually (Calado & Griffiths, 2016). Similarly, about 64% of Australians (Calado & Griffiths, 2016) and 85% of Canadians are gamblers (St-Pierre, Walker, Derevensky, & Gupta, 2014; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012).

People gamble for several reasons, but mostly for entertainment and to make money (Gainsbury et al., 2014). Some people spend significant time and money on gambling activities, while others do not (Williams, Rehm, & Stevens, 2011). People who have difficulty controlling their gambling time and money are called problem gamblers, and there are also low-risk and moderate-risk gamblers (Griffiths & Delfabbro, 2001; Hodgins, Stea, & Grant, 2011; Welte, Barnes, & Wieczorek, 2002). In contrast, gamblers who can control their gambling may be called recreational gamblers, and again, there are variations in this category (Griffiths & Delfabbro, 2001; Hodgins et al., 2011; Welte et al., 2002).

Between 0.4% and 5% of the adult gambling population have gambling-related problems (Calado & Griffiths, 2016; Cox et al., 2005; Delfabbro, 2013; Welte et al., 2002; Williams, Volberg, & Stevens, 2012). Rates are typically higher in areas where casino and non-casino gambling opportunities have recently become more available (Williams et al., 2012). About 5% of gamblers in emerging gambling markets, referring to areas where casinos or non-casino EGM venues have recently opened, may have mild to severe gambling problems (Calado & Griffiths, 2016; Cox et al., 2005; Delfabbro, 2013; Welte et al., 2002; Williams et al., 2012). However, rates are typically lower in mature gambling areas, referring to jurisdictions where casino or non-casino EGM venues have been available for a longer period of time (Calado & Griffiths, 2016).

Problem gambling causes harm to gamblers, their close associates, and society at large (Gainsbury et al., 2014). Some of the social and health problems reported by problem gamblers include financial loss, relationship dysfunction, depression, and anxiety (American Psychiatric Association, 2013; Gainsbury et al., 2014; St-Pierre et al., 2014). The management and treatment of gamblers with problems can be financially costly to governments. In the United States, for example, treatment and support services for problem gamblers cost the federal government about $5 billion every year (American Psychiatric Association, 2013). The cost may be currently higher as a result of the increasing gambling activities. At the same time, gambling has been an important source of revenue for governments. In Australia, $19 billion in revenue was raised from gambling between 2008 and 2009 (Productivity Commission, 2010). Other countries such as Canada, the United States, and the United Kingdom also record huge revenues from gambling each year (Philander, Bernhard, Wimmer, Singh, & Eadington, 2015; Williams et al., 2011). Public discussions on gambling have centered more on its social cost than on its benefits, often casting gambling as a social problem with inherent public health threats (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012).

Online gambling takes place on the internet through portable electronic devices such as computers, laptops, phones, TVs, tablets, and others (Gainsbury, Sally, Russell, Hing, Wood, Lubman, & Blaszczynski, 2015; Wood & Williams, 2009). Advancement in technology and the introduction of the internet made this form of gambling a possibility and attractive. For example, the expansion of the internet into homes, workplaces, on mobile devices, and public Wi-Fi networks have increase the accessibility of online gambling (Wood & Williams, 2009). Despite its increasing popularity, online gambling is not legally accessible everywhere. It is currently legal in Australia, Finland, Canada, the United States, and other countries (Wood & Williams, 2007a).

Although not every country has legalized it, the number of people who gamble on the internet is increasing annually (Gainsbury et al., 2015; Wood & Williams, 2009). Between 1% and 13% of the global adult population gamble online (Olason et al., 2010; Petry, 2006; Productivity Commission, 2010; Wood & Williams, 2009). The participation rate are increasing in Australia, Canada, the United States, and other places where online gambling has been legalized and internet is widely accessible to the public (Gainsbury et al., 2015; Wood & Williams, 2009). For example, online gambling in Australian adults increased from 1% in 1999 to 8.1 in 2011 (Wardle, 2007). Similar participation rates have been found in other developed countries (Jiménez-Murcia et al., 2011). Online gambling accounts for about 10% of gambling market revenue, despite the low participation rate compared to land-based gambling (Gainsbury et al., 2015).

As with land-based gambling, some online gamblers have gambling problems. Research shows that the number of problem gamblers among online gamblers are relatively higher than that among land-based gamblers (Gainsbury et al., 2015; Griffiths, Wardle, Orford, Sproston, & Erens, 2009; Wood & Williams, 2009). A 2006 British study found that 4.2% of their 473 adults online gamblers had gambling problems (Griffiths & Barnes, 2008). A year follow-up study of the sample by the authors showed that the number of gamblers with problems had increased to 5% (Griffiths et al., 2009). In the early 2000s when online gambling had just been introduced in North America, 43.3% and 34.1% of online gamblers in the United States and Canada, respectively, had gambling problems (Wood & Williams, 2007). The findings suggest that online problem gambling differs between jurisdictions and that rate may be declining over the years as the service becomes more accessible and its novelty declines.

Some scholars have suggested that online gambling participation and problem gambling have increased because of the proliferation of more internet sites offering such services (Griffiths & Barnes, 2008; Griffiths et al., 2009; Welte, Barnes, Wieczorek, & Tidwell, 2004). Other researchers have also argued that online gambling is more attractive because of its ease and convenience of access (Wood, Williams, & Lawton, 2007). Gainsbury et al. (2015) found that more than 66% of their study participants gambled online because it could be accessed whenever desired. Similarly, Wood et al. (2007) found that 42.7% of adults aged 18 years who find online gambling convenient tend to have moderate to severe problems. These gamblers tend to gamble 20 or more hours per week compared to 5 hours for non-problem gamblers. These findings show that problem gambling is higher in gamblers because they tend to gamble more frequently.

Another possible reason for the high rate of problem gambling among online gamblers is that most engage in multiple gambling activities (Gainsbury, Russell, Blaszczynski, & Hing, 2015). Such gambling practices may be due to the availability of a wide range of gambling activities on the internet and the ease at which multiple activities can be undertaken concurrently on the internet. For example, Gainsbury et al. (2015) found that online gamblers are more likely to play poker, blackjack, virtual EGMs, sports betting, and others concurrently. Wood, Griffiths, and Parke (2007) reported that online poker players usually play slot machines and cards at the same time. Participation in multiple online gambling activities has been associated with a greater risk of problem gambling (Gainsbury, Russell, Hing, Wood, & Blaszczynski, 2013). Having the chance to engage in multiple activities at the same time makes gambling attractive, motivating participation and increasing problem gambling.

While some studies have found the groups to be different (Gainsbury et al., 2015; Griffiths et al., 2009; Wood & Williams, 2009), land-based and online problem gamblers tend to be similar in their demographic characteristics. For both land-based and online gamblers, the majority tend to be males, younger, less educated, unmarried, unemployed, or employed in a low-paying job, and have a low income (Afifi et al., 2010; Tavares et al., 2010). In a nationally representative sample of Canadians, Afifi et al. (2010) found that in the past-year, the prevalence of problem gambling was 4.9% in males and 2.7% in females in 2001. Other research shows that gender differences in problem gambling are narrowing, as more women are engaging in gambling activities in recent years (Christensen, Dowling, Jackson, & Thomas, 2014).

In summary, it is clear from the literature that there are more recreational gamblers than problem gamblers (Abbott, 2006; Abbott & Volberg, 1999). Land-based gamblers currently outnumber online gamblers, yet the latter have higher problem gambling prevalence rates than the former, while online gamblers continue to increase in numbers (Abbott, 2006; Abbott & Volberg, 1999; Azmier & Clements, 2001; Productivity Commission, 2010; Shaffer, Hall, & Vander Bilt, 1999). Several reasons have been offered for the high number of online problem gamblers, which include the ease and convenience of access to online gambling. Both land and online-based gamblers are similar in their demographic characteristics, as the majority are males and young. The discussion below examines changes in access to land-based and online gambling opportunities in western countries.

A review of gambling accessibility in developed societies

In most societies, gambling takes place at land-based and online venues, as discussed previously (St-Pierre et al., 2014; Williams et al., 2012; Wood & Williams, 2009). Land-based gambling occurs in casinos, pubs, clubs, hotels, grocery stores, and other licence gambling venues (St-Pierre et al., 2014). These venues and their machines have increased in numbers over the years. In the United States, only two states had casinos prior to the late 1980s, but by the year 2010, 38 states had casinos (Association American Gaming, 2013). In 2012, the United States as a whole had 930 casinos with slot machines, and12,000 slots in non-casino venues (St-Pierre et al., 2014). Similarly, in the past 30 years, EGMs in Australia have increased from 48,439 to 198,725 (Markham, Doran, & Young, 2014). As in some other developed countries, Australian EGMs are available in casinos, pubs, hotels, and bars (Markham et al., 2014; Marshall & Baker, 2002; St-Pierre et al., 2014; Williams et al., 2012). Canada has also witnessed significant increases in gambling venues and machines over the years. A recent systematic review showed that about 30,312 gambling venues with over 96,000 VLTs currently operate in Canada (St-Pierre et al., 2014; Williams et al., 2012). Research from Europe and Asia have reported findings similar to those reported above (Williams et al., 2012).

The introduction of land-based gambling forms into the online gambling platform has led to increased gambling accessibility (Raventós & Zolezzi, 2011; Williams, Wood, & Parke, 2012; Wood & Williams, 2009). These online gambling forms include slot machines, VTLs, sports betting, lotteries, and poker. Gamblers can wager on these activities on the internet using either stationary or mobile devices. The possibility of being able to wager on both at land-based and online-based venues has significantly transformed access to gambling, making it easier and more convenient for patrons (Williams et al., 2012; Wood & Williams, 2009).

Additionally, access to gambling has also improved by advertising gambling activities in print and electronic media (Binde, 2009; Håkansson & Widinghoff, 2019; McMullan & Miller, 2008). Many gambling activities including horseracing and jackpots, are currently frequently advertised to the public, with the intent of increasing interest and participation (Binde, 2014; Håkansson & Widinghoff, 2019; McMullan & Miller, 2008). This practice has increased public awareness of the different types of gambling activities available to them, and consequently, made gambling more socially acceptable as a harmless recreational activity (Binde, 2009).

Because of the increases in lottery products, land-based gambling venues and machines including lotteries together with the introduction of online gambling and the frequent advertising of gambling, gambling has become more accessible to the public. In Australia, Canada, the United States, and other developed countries, many people now walk or travel short distances from homes or workplaces to gambling venues (Sévigny, Ladouceur, Jacques, & Cantinotti, 2008; St-Pierre et al., 2014; Vasiliadis et al., 2013). For example, EGMs are now available in pubs, clubs, lounges, and hotels, locations that are easily accessible to the public. Additionally, online gambling has brought EGMs and other forms of gambling activities closer to people, as these activities could be carried out from any location and at any time (Raventós & Zolezzi, 2011; Wood & Williams, 2009). These increases in access to gambling have deepened concerns among the general public and stakeholders about gambling harm (Blaszczynski, 2013; St-Pierre et al., 2014).

Other factors that have shaped the accessibility of gambling are the changes in regulatory policies (Blaszczynski, Ladouceur, & Shaffer, 2004; Marshall, 2005). Since the late 1990s, many governments across the world have relaxed regulations on gambling, allowing more venues and machines to be introduced for public consumption (Williams et al., 2012). Much of this development has come about as a result of government efforts to raise revenue for development through taxation of gambling activities. In Australia and Canada, previously stricter regulations, including the capping of gaming machines to fewer numbers in casinos and non-casino EGM venues have increased in recent years (Williams et al., 2012). Similarly, casinos and non-casino EGM venues now operate longer hours than they did previously (Blaszczynski et al., 2004; Williams et al., 2011). EGM density has also increased, especially in many countries with higher levels of gambling activities (Abbott, 2006).

In summary, exposure to gambling has increased over the years as a result of the liberalization of gambling regulation, expansion of the industry, the introduction of more attractive games such as EGMs, and the addition of online gambling platforms. This development might have contributed to increases in gambling activities in the general population of western countries. As discussed below, the exposure and adaptation hypotheses have been used to explain the association between exposure to gambling opportunities and gambling behaviour. These theoretical explanations and their research support are discussed next.

Theoretical and empirical explanations of the association between accessibility and gambling

The exposure and adaptation hypotheses have been used to explain the association between accessibility to gambling opportunities and gambling participation or problem gambling (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Both hypotheses examine how gamblers respond to changes in the accessibility characteristics of the gambling environment, as have been measured by changes in the number of gambling venues, number of machines, and the geographical location of gambling venues to places of residence, workplaces, and public gathering places (Abbott, 2006; Griffiths & Delfabbro, 2001; Shaffer et al., 2004; Williams et al., 2012). Gamblers tend to change their gambling behaviours by either increasing or decreasing their involvement (LaPlante & Shaffer, 2007; Shaffer et al., 2004). These developments are believed to occur in response to changes in the accessibility characteristics of the gambling environment, according to the exposure and adaptation hypotheses. These complementary theoretical explanations and their supporting empirical evidence are discussed below.

Exposure hypothesis and its empirical support

The exposure hypothesis explains that gambling participation and problem gambling both increase as more gambling venues and machines become available (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Its proponents used public health perspectives for the association between environmental toxins and health. The population health model of public health suggests that environmental toxins put people's health at risk when contact takes place. People can come into contact with toxins at multiple locations including home and their workplace. The health effects of toxins on people typically increases with increased levels of toxic exposure. The exposure hypothesis on gambling draws on this public health explanation of the association between environmental toxins and health to explain the potential effects of exposure to gambling opportunities (LaPlante & Shaffer, 2007; Shaffer et al., 2004).

The exposure hypothesis identifies gambling venues, types of gambling, and years of legal gambling as environmental exposures to gambling. Gambling venues include casinos, non-casino EGM venues, and other outlets. The various types of gambling types considered include EGMs, lotteries, horserace, and others. Years of legal gambling refers to the number of years a gambling activity has been legally permitted in a community (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Other secondary gambling exposures include gambling advertising, family history of gambling, and socioeconomic characteristics (LaPlante & Shaffer, 2007; Shaffer et al., 2004).

These accessibility characteristics of the gambling environment function similar to toxins, as explained previously. As in the case of the hypothesized association between toxins and health, the exposure hypothesis assumes that people with greater access to gambling venues and machines are more likely to gamble than those without access (LaPlante & Shaffer, 2007; Shaffer et al., 2004). The physical presence of gambling venues and machines results in two potential reactions: people may start gambling when a new gambling venue is opened in a community and in addition, those who already gamble may increase their gambling activities when more venues are opened.

Gambling venues and machines are believed to have dose effects on gambling (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Increased number of venues and machines increases exposure to gambling, which in turn increase gambling. The availability of different types of gambling increases the potency of exposure by making the activity more attractive to different demographics (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Additionally, years of legal gambling measures the number of years of exposure to gambling. Continued exposure from more years of legal gambling, can lead to continuous and sustained gambling, and the possibility of problematic gambling. The exposure hypothesis relies on some or all these explanations to make inferences about the association between exposure and gambling behaviour (LaPlante & Shaffer, 2007; Shaffer et al., 2004).

Shaffer et al. (2004) developed a mathematical formula, referred to as the Regional Exposure Model (REM), for estimating exposure effects from accessibility measures such as gambling venues, types of games, and years of legal gambling (LaPlante & Shaffer, 2007;

Shaffer et al., 2004). The secondary exposure measures mentioned previously were included in the mathematical formula as potential control variables. Exposure measures are assigned scores and added up to yield scores that estimate gambling exposure for groups rather than for individuals within groups (LaPlante & Shaffer, 2007; Shaffer et al., 2004). The REM is used to estimate gambling exposure and its association with gambling at the population level. Few studies have strictly followed the REM approach to assess gambling exposure, while many have applied aspects of the approach (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Research has used the REM, or an aspect to examine the association between gambling exposure and prevalence rates at the state and county level (LaPlante & Shaffer, 2007; Shaffer et al., 2004).

Gambling participation and problem gambling rates have both been found to be higher in jurisdictions with higher per capita gambling venues and machines (LaPlante & Shaffer, 2007; Shaffer et al., 2004). The evidence is found at the country, states, and local area levels of analysis. For example, between 0.4% and 5% of gamblers have gambling-related problems in Australia, Canada, and the United States (US) where there is high per capita casino and non-casino EGM venues compared to 0.3% and 2.2% for the United Kingdom and other European countries that have fewer such facilities (Abbott, 2006; Gerstein, Rachel, et al., 1999; Orford, 2010; Volberg & Steadman, 1988; Wardle, 2007; Williams et al., 2012). Countries with more gambling venues tend to have more gamblers and problems gamblers than those with fewer machines.

A similar trend is evident within countries. In the United States, Shaffer et al. (2004) used the REM to examine the association between gambling exposure and problem gambling in Nevada. Prevalence was higher in counties that had higher index scores on the REM. Two systematic reviews of studies on gambling opportunities found that problem gambling tends to be higher in within-country jurisdictions that had a higher density of casino and non-casino EGM venues than in areas with fewer such opportunities (Storer, Abbott, & Stubbs, 2009; Vasiliadis, Jackson, Christensen, & Francis, 2013). A local area study carried out in Richmond-Tweed in Australia shows that problem gamblers tend to be concentrated in areas with more EGMs (Marshall, 2005). Problem gamblers are more prevalent in areas with a higher density of gambling venues and machines, possibly because access to gambling is much easier in such areas.

Replication studies have shown that gambling participation and problem gambling might increase when new gambling venues are opened, or when new machines are introduced. In Quebec, lifetime problem gambling increased from 2.1% in 1989 to 2.4% in 1996 when casinos were first introduced (Ladouceur & Jacques, 1999). Current problem gamblers increased in numbers by 75% over the period. Shaffer et al. (1999) reviewed prevalence studies conducted from 1975 to 1996 in the United States and Canada. They found that in the United States, the average past year problem gambling was 0.8% prior to 1993, but it increased to 1.3% after 1993. The increase occurred at a time many states legalized and opened casino and non-casino EGM venues (Williams et al., 2012). Similarly, in Canada, problem gambling increased after more EGMs became available (Williams et al., 2012). In the United Kingdom, lottery purchases increased following the introduction of the national lottery in 1992 (Volberg, 2000). Other studies have confirmed these findings, suggesting that gambling participation and problem gambling seem to increase either minimally or significantly a few years following the introduction of new gambling opportunities (Dellis, Spurrett, Hofmeyr, Sharp, & Ross, 2013; Salaam, 2014; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2011).

The geographic location of gambling venues has also been found to be associated with gambling. The proximity of a gambling venue to home, workplace, and other public gathering places can influence gambling (Gerstein, et al., 1999). In the United States, the likelihood of becoming a moderate or problem gambler is about twice as high in gamblers who lived within 80 km of a casino (Gerstein et al., 1999). A study that examined problem gambling risk among gamblers who lived 16 km from a casino found that such gamblers were 90% more likely to become problem gamblers (Welte, Wieczorek, Barnes, Tidwell, & Hoffman, 2004). About 7.2% of the gamblers who lived 16 km from a casino were problem gamblers compared to 3.1% for those farther away (Welte, et al., 2004). Several other studies have reported similar findings, indicating that living too close to a venue seems to encourage regular and problem gambling (Abbott, 2006; Storer et al., 2009; Vasiliadis et al., 2013).

The association between proximity and gambling has been collaborated by research on gambling venue workers. Many studies with venue workers have found participation and problem gambling to be higher in this sample than in the general population of gamblers (Guttentag, Harrigan, & Smith, 2012). A survey conducted among casino workers in Queensland in Australia found that casino workers were 16 times more likely to be problem gamblers, ten times likely to be moderate-risk gamblers, and eleven times likely to be as low-risk gamblers compared to the general population (Hing & Breen, 2008). Other studies conducted in the United States and Canada have reported similar findings (Shaffer, Vander Bilt, & Hall, 1999; Shaffer & Hall, 2002). Generally, a higher problem gambling rate has been found in gamblers living within 5 km or less of a casino than in those farther away. These studies provide further support for the association between proximity and gambling, and the evidence seems to show that prevalence increases as distance to a venue decrease.

These research findings are in support of the exposure hypothesis, which suggest a positive association between exposure and gambling participation or problem gambling (LaPlante & Shaffer, 2007; Shaffer et al., 2004). However, some research findings have contradicted the exposure hypothesis (Abbott, 2006). In some areas, increases in gambling venues and machines have not been followed with increased gambling participation and problem gambling (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Both gambling participation and problem gambling have remained almost the same in these areas (for example, Nevada in the United States) despite increases in the casino and non-casino EGM venues (Williams et al., 2012). Research that has reported a non-linear association between increased accessibility and gambling behaviour has explained their findings within the adaptation theoretical framework, discussed below (LaPlante & Shaffer, 2007; Shaffer et al., 2004).

Adaptation hypothesis and its empirical support

The adaptation hypothesis counters the exposure explanation by suggesting that although increased opportunities to gamble can lead to increased gambling participation and problems, these increases may be temporary (Abbott, 2006; Abbott & Volberg, 1999; Shaffer et al., 2004). The adaptation hypothesis argues that exposure initially leads to a rise in gambling participation and problem gambling, but both slow and decline as gamblers adjust to the novelty of gambling activities (Abbott, 2006). In other words, changes in gambling behaviour resulting from increases in gambling venues and machines typically last until gamblers adapt to the novelty of the new opportunities (Shaffer et al., 2004).

Studies have found that problem gamblers tend to be fewer in jurisdictions where there are more gambling venues and machines, and populations have had access to such opportunities for longer periods. For example, in Nevada, Shaffer et al. (2004) found fewer problem gamblers in counties with more casinos where legal gambling has been available for many years. In support of this evidence, Shaffer's findings showed that most new residents of Nevada tend to have more problems with gambling than established residents. Similarly, Volberg found that gambling participation is higher in Nevada, but problem gambling has remained stable over the years, despite continued increases in casinos and non-casino EGM venues (Volberg, 2002).

In Australia, the PC (2010) found that states with higher EGMs per 1000 adults had more problem gamblers. However, Western Australia, which has a lower per capita EGMs than Tasmania, had a problem gambling rate of 0.7% compared to 0.4% for Tasmania. This finding supports the adaptation hypothesis and suggests that more gambling venues and machines may not be associated with higher problem gambling. Similar research findings have been reported by studies from Canada (Abbott, 2006). The Canadian province of Alberta, which has higher EGMs per capita adults, has lower rates of problem gambling than Nova Scotia, where there are fewer EGMs (Azmier & Clements, 2001). In New Zealand, the probable pathological prevalence was 1.2% in 1991, which reduced to 0.4% in 1996 (Abbott, 2006). The number of problem gamblers reduced after five years of exposure, suggesting that gamblers reduced their participation when the novelty wore off.

The reviewed literature shows that more prolonged exposure may not be associated with more problems, and it contradicts the exposure hypothesis (Abbott, 2006; Ladouceur, 1996; Williams et al., 2012). The evidence shows that problem gambling might increase for a few years after new gambling venues are opened but declines later through the processes of adaptation. Novelty is an important issue in the adaptation process (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Both gambling participation and problem gambling decline as the novelty of gambling declines (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012).

The specific time required for gamblers to adapt to exposure effects has not been established. However, a study by Ofori Dei, Christensen, Awosoga, Lee, and Jackson (2020) showed that a three-year period might be enough for gamblers to adjust to the novelty of gambling opportunities. In Alberta, Ofori et al. (2020) found that there are fewer problem gamblers in gamblers who have had access to casinos for more than three years than in those with three years or less exposure. Within three years of exposure to new gambling opportunities, some gamblers adjust their behaviour, reducing the rate at which they gamble to reduce problems. However, the number of years required for adaptation likely varies across populations and from one gambler to another.

Factors other than novelty may also lead to adaptation to the effects of gambling exposure (Abbott, 2006; Storer et al., 2009). These may include socioeconomic characteristics, neighbourhood socioeconomic conditions, and local area regulations on gambling. Research shows that gamblers in socioeconomically disadvantaged neighbourhoods tend to have a greater risk for problem gambling because of the high density of gambling venues and machines in these areas (Welte et al., 2004). In the United States, Barnes, Welte, Tidwell, and Hoffman (2013) found that most problem gamblers lived in deprived areas. In Tasmania in Australia, socioeconomically deprived local government areas are likely to have 24% of low-risk gamblers and 117% problem gamblers when compared to less deprived areas (Allen Consulting Group, 2011). Additionally, social conditions, such as unemployment and psychosocial problems, may make some gamblers more vulnerable to problem gambling (Welte, Barnes, Wieczorek, Tidwell, & Parker, 2004).

In summary, people are likely to participate more in gambling activities and experience problems when there are more gambling venues and machines, and when they live closer to a venue. The availability of more gambling venues makes it possible for more people to engage in gambling activities at the same time. Additionally, the availability of a wide range of gambling types increases gambling participation because people can find their preferred gambling type. Having more venues and machines, and a variety of games creates a gambling environment that meets the needs of diverse gamblers, and together increase gambling exposure. In addition, the location of a venue can influences gambling. Studies have shown higher gambling activities and problems in populations that are located close to gambling venues than in those farther away. However, proximity is not explicitly considered in the exposure hypothesis (LaPlante & Shaffer, 2007; Shaffer et al., 2004). In support of the adaptation hypothesis, however, gambling participation and problem gambling rate do not always change in response to increased access to gambling opportunities. Declines in the novelty of gambling lead gamblers to adjust to the exposure effects. Several other factors also contribute to gamblers' adjustment to gambling exposure. They include the gamblers' personal characteristics and their neighbourhood socioeconomic conditions. In addition to the literature which examines the impact of objectively measured gambling exposure on gambling behaviour, there is an emerging research interest in the role of subjective gambling exposure in gambling behaviour. The literature in this emerging research area is briefly reviewed below.

Perceptions of gambling availability and accessibility: An emerging area of research

Perceptions play an essential role in health and risky behaviours (Glanz, Rimer, Viswanath, & Orleans, 2008). Behavioural theories suggest that people's perceptions of a behaviour tend to determine their intentions and actual performance of the behaviour (Ajzen, 2011; Glanz et al., 2008). Addictive behaviours such as drinking, use of drugs, and gambling have been linked to different types of perceptions, such as perceived availability/accessibility, risk, and benefits (Paschall, Grube, Thomas, Cannon, & Treffers, 2012; Warren, Smalley, & Barefoot, 2015). Perceptions of availability and accessibility have received much attention as predictors of drinking and drug use but less attention as predictors of gambling addictions (Moore, Thomas, Kyrios, Bates, & Meredyth, 2011; Wickwire et al., 2007).

Addiction research has operationally defined perception of accessibility as an individual subjective estimation of both the quantity of an activity and the ease with which it can be accessed (Dei, Christensen, Awosoga, Lee, & Jackson, 2020; Wickwire et al., 2007; Williams et al., 2011). Perception of availability and perception of accessibility have been used interchangeably in the addiction literature (Dei et al., 2020). A large body of literature has found that drinking, smoking, and the use of illicit drugs are more prevalent in individuals who perceive that they can access substances without much difficulty (Paschall, Grube, Thomas, Cannon, & Treffers, 2012; Warren et al., 2015). Such perceptions appear to motivate regular use of substances among some individuals.

Only two studies have assessed the role of perceptions of gambling accessibility and problem gambling. Among 302 American adult college students, 92% perceived that purchasing of lottery tickets would be easier for them. Lotteries were considered to be generally more available (Wickwire et al., 2007). Despite the high perceptions of the easy accessibility of lotteries, respondent’s problem gambling behaviour was not significantly predicted by their perceptions. However, it predicted regular gambling by respondents who perceived that they could easily purchase lottery tickets. Wickwire et al. (2007) demonstrated with their findings that gamblers who believe that lottery tickets can be purchased without difficulty were more likely to be regular gamblers. However, their problem gambling levels were not significantly different from those perceived lottery ticket purchases to be more difficult.

The second study found that the perceived availability of casino and non-casino gambling opportunities was a significant predictor of problem gambling, as measured by the PGSI (Dei et al., 2020). The majority of gamblers who perceived gambling opportunities to be too widely available had the highest prevalence of gambling problems than those who did not perceive opportunities to be too widely available. The findings of Wickwire et al. (2007) and Dei et al. (2020) do not provide sufficient data to draw conclusions about the role of perceptions of gambling accessibility in gambling behaviour. However, they suggest that individual differences in regular gambling and problem gambling might be explained by the perceived accessibility to gambling. Therefore, the findings of the two studies have laid the foundation for further research on the role of perceptions of gambling accessibility in gambling behaviour.

A perceptual measure of gambling accessibility is inherently multidimensional because respondents consider several things in their evaluation (McCormack et al., 2004; Moore et al., 2011; Warren et al., 2015). For example, an individual subjective assessment of whether gambling is accessible may include a consideration of the quantity of venues/games, a venue’s proximity to the person, and the financial and sociocultural accessibility of gambling. Therefore, it may be said that a perceptual measure of gambling accessibility provides an opportunity to capture in a single measure, the wide range of the characteristics of gambling accessibility, as identified by the Productivity Commission (Productivity Commission, 2010). As the Commission acknowledged, it is more difficult to construct an objective measure of accessibility that takes into account the multidimensional characteristics of gambling accessibility because of lack of data (Productivity Commission, 2010). However, the perceptual measure appears to address these measurement challenges in a subjective manner.

In summary, perceptions of accessibility can encourage or discourage gambling behaviour in general or problem gambling. The study by Ofori et al. (2020) asked respondents whether they believed that casino and non-casino opportunities are too widely available or not. This perceptual measure of accessibility differs from a measure that asks whether gambling is available or accessible, as used in the study by Wickwire et al. (2007). The former has an underlying negative meaning because it assesses people's views on the acceptance level of the accessibility. Many factors can explain why people might consider the current level of gambling accessibility as acceptable or not. These might include attitudes towards gambling, awareness of and personal experiences with gambling, religious views on gambling, and many others. Next, is a discussion on the mental disorders, substance use, childhood adversities, and intimate partner relationship problems commonly found in gamblers.

Comorbidities of problem gambling

Problem gambling is a comorbid condition associated with commonly reported social and health problems such as mental disorders, substance use, childhood adversities, and intimate relationship problems (Afifi, Brownridge, MacMillan, & Sareen, 2010). These social and health problems are more common among gamblers with problems and less common in other gambler types such as non-problem, low-risk, and moderate-risk gamblers. The temporal relationship between disorders and problem gambling have been found to also vary by several demographic characteristics such as gender (Haw & Holdsworth, 2015). However, the sequence of the association of problem gambling with other social and health problems have yet to be determined. Therefore, currently, it is not firmly established whether problem gambling causes, for example, mental disorders or whether mental disorders cause problem gambling.

Many problem gamblers have mental disorders such as depression, anxiety, mood problems, and others (Cunsningham-Williams, Cottler, Compton, & Spitznagel, 1998; Shaffer & Korn, 2002). Cunningham-Williams et al. found that problem gamblers are three times more likely to report major depression than non-gamblers and non-problem gamblers. Other researchers have also found depression to be higher in problem gamblers (Erickson, Molina, Ladd, Pietrzak, & Petry, 2005). In the United States, Petry, Stinson and Grant (2005) found that more than one-third of American adult problem gamblers have other mental disorders. In a sample of 43,093 American problem gamblers, they found that 41.3% had anxiety disorders, 49.6% had mood disorders, with 60.8% reporting personality disorders (Petry et al., 2005).

Gamblers with more severe problems tend to have more mental disorders than those with relatively fewer gambling problems (Cunningham-Williams et al., 1998). Pathological gamblers, for example, are more likely to report multiple mental disorders than problem gamblers or probable problem gamblers (Dowling et al., 2015). Similarly, a graded-like association appears to exist between mental disorders and gamblers without problems such as non-problem, low-risk, and moderate-risk gamblers. For example, when compared to non-gamblers, low-risk, and moderate-risk gamblers report more mental problems (Cunningham-Williams et al., 1998; Petry et al., 2005; Rush, Bassani, Urbanoski, & Castel, 2008; Shaffer & Korn, 2002).

Although there is strong evidence linking mental health to problem gambling, cause and effect association has not been established. Research suggests that gambling is likely to results from experience with mental problems (Cunningham-Williams et al., 1998; Petry et al., 2005, 2005b; Rush et al., 2008; Shaffer & Korn, 2002). For example, in the study by Cunningham-

Williams et al., problem gamblers indicate that they became addicted to gambling because they struggled with major depression. Participants explained that they became gamblers following their mental problems. Some researchers suggest that gamblers typically use gambling to cope with mental disorders. For example, Getty, Watson, and Frisch (2000) found that the excitement of gambling provides temporary pleasant emotional relief to some gamblers who suffer from mental problems.

Very few researchers have sought to determine whether problem gambling leads to mental disorders. As a coping mechanism, frequent gambling could worsen existing mental problems of gamblers. In this way, gambling could lead to the development of severe mental problems. Additionally, gambling losses can lead to self-blaming, which can trigger mental problems such as mood disorders. In an experimental study, Hills, Hill, Mamone, and Dickerson (2001) showed that gambling losses could cause emotional trauma for gamblers. This trauma may further lead to the development of more severe mental problems when the losses become persistent and too high to afford. A study found that gamblers who tend to have more losses than wins, usually experience mild to moderate emotional problems (Rush et al., 2008; Yi & Kanetkar, 2011). Fewer studies are suggesting that gambling leads to mental problems compared to the evidence in the opposite direction (Cunningham-Williams et al., 1998).

A bidirectional association has been reported between mental health and problem gambling, and the direction varies by gender (Haw & Holdsworth, 2015). In a retrospective study of 267 gamblers from treatment centers, Haw and Holdsworth (2015) found that women usually experience mental and other disorders before experiencing gambling-related problems. The opposite was observed for men, as they tend to experience gambling-related problems before other disorders. However, several other studies have not drawn similar conclusions because of a lack of longitudinal data (Afifi et al., 2010; Cunningham-Williams et al., 1998; Hills et al., 2001; Rush et al., 2008).

Gambling and substance misuse

Problem gambling is commonly reported by people with other addictions such as smokers, heavy drinkers, and drug users (Hall et al., 2000; Kausch, 2003; Pietrzak, Molina, Ladd, Kerins, & Petry, 2005). In Austria, Horodecki (1992) found that 15% and 5% of a sample of 237 problem gamblers reported abusing alcohol and using drugs, respectively. The association of problem gambling with addictive behaviours as those above have been reported in several other populations. Again, as with mental disorders, some researchers suggest that substance use might precede problem gambling, while others have suggested otherwise. Vitaro, Brendgen, Ladouceur and Tremblay (2001) found that substance use motivates regular gambling, a risk factor for problem gambling. In the study by Cunningham-Williams et al. (1998), 65% of problem gamblers indicated that they started gambling and experienced problems after continued use of alcohol. In a national survey, Petry et al. (2005) found that heavy and lifetime drinkers were six and four times, respectively, more likely to be problem gamblers. Alcohol use can exacerbate both the time and money typically spent on gambling (Hall et al., 2000; Kausch, 2003; Vitaro et al., 2001). Although most studies suggest that substance use lead to problem gambling, the latter can also leads to the former (Cunningham-Williams et al., 1998; Hall et al., 2000; Kausch, 2003; Pietrzak et al., 2005).

There is evidence of comorbidity among problem gambling, substance use, and mental disorders (Rush et al., 2008). Depression and substance use have joint effects on problem gambling. For example, Rush et al. (2008) have found that problem gamblers who suffer from depression, anxiety, and other mental disorders also tend to abuse alcohol and other drugs. In American adults, problem gamblers with panic disorders, depression, anxiety, and mood disorders tend to be heavy drinkers, smokers, and marijuana users (Cunningham-Williams et al., 1998; Lesieur & Blume, 1991; Linden, Pope, & Jonas, 1986; Rush et al., 2008). Mental problems and substance abuse have been found to have a stronger synergistic influence on problem gambling than either comorbidity (Rush et al., 2008).

Gambling and childhood adversities

It is not only substance use and mental disorders that are common among gamblers with or without problems. Some studies have reported higher prevalence rates of gamblers experiencing childhood abuse (Kausch, Rugle, & Rowland, 2009; Petry & Steinberg, 2005). Kausch et al. (2009) found in 111 American pathological gamblers in a treatment facility that 64% had emotional trauma, 40.5% had physical trauma, and 24.3% had sexual trauma in childhood. In a national representative cross-sectional study of 3,334 Americans aged 18 years and older, Afifi et al. (2010) found that most problem gamblers have histories of childhood abuse. The findings of other studies by Hodgins et al. (2010) and Felsher, Derevensky, and Gupta (2009) also showed that abuses of various forms are commonly experienced by gamblers with problems. People with childhood histories of abuse and other adversities are at risk of problem gambling because they typically use gambling to deal with negative memories resulting from past traumas.

The association between problem gambling and childhood traumas could be explained by the life course theory that links adulthood experiences with early life experiences (Elder, Johnson, & Crosnoe, 2003; Shanahan, 2000). People with childhood emotional, physical, sexual, and other abuses may engage in gambling to deal with adulthood traumas from such experiences (Blaszczynski & McConaghy, 2009). Additionally, the General Theory of Addiction (Jacobs, 1986) suggests that some gamblers are likely to use gambling to modify negative emotions from past adversities.

Intimate relationship problems in gamblers

Dysfunctional intimate relationships can be a cause, consequence, or co-occur with gambling. Research indicates that relationship problems create a social environment that encourages the adoption of problematic behaviours (Keen, Pickering, Wieczorek, & Blaszczynski, 2015). Problem gambling is one of such problematic behaviours usually found in adults with intimate relationship problems. For example, intimate partners who have financial problems, unsettled disagreements, and feel isolated in their relationships tend to be problem gamblers (Afifi et al., 2010; Ciarrocchi & Hohmann, 1989; Kalischuk, Nowatzki, Cardwell, Klein, & Solowoniuk, 2006; Lee, 2015). Partners with such relationship problems may use gambling as a coping mechanism similar to that reported for childhood adversities (Kalischuk et al., 2006). Having quality interpersonal relationships may not necessarily prevent problem gambling in intimate partners, as is usually assumed (Afifi et al., 2010; Ciarrocchi & Hohmann, 1989; Kalischuk et al., 2006; Lee, 2015). Research has shown that when an intimate partner has a problem with gambling, the other is likely to develop it. This is particularly true when the partners have strong intimacy (Currie et al., 2006; Hodgins et al., 2010).

In summary, of the various gambling behaviours, problem gambling shows the strongest association with mental disorders, substance use, childhood adversities, and both functional and dysfunctional intimate relationship characteristics. These comorbidities of gambling are less prevalent in other groups of gamblers, such as non-problem, low-risk, and moderate-risk gamblers. Despite a large body of literature on these associations, there is still a lack of empirical evidence on the temporal sequence of the associations. As discussed below, because of the many social and health problems associated with problematic gambling, several interventions are available to address problem gambling behaviour.

Gambling harm minimization and interventions

As the number of gamblers with problems has increased over the years, efforts have been made to prevent or manage harm from gambling. Some of the measures focused on the demand for gambling, and others focused on the supply side (Oei & Gordon, 2008). Demand focused measures seek to reduce harm by targeting individual gamblers, whereas the supply measures reduce harm with a focus on populations rather than individuals. Some interventions that target individuals include Gambling Anonymous (GA), self-exclusion, and counselling. They are implemented by gambling operators rather than by governments or states, as is the case of supply-side interventions. Supply harm reduction measures have included limiting the number of casino and non-casino EGM venues permitted in a jurisdiction, reducing the concentration of venues in an area, limiting the number of machines per venue, restricting the operating hours of venues, and setting an age limit for gambling (Dickson, Derevensky, & Gupta, 2009; Williams, West, & Simpson, 2008).

GA uses multiple educational and counselling interactive programs to assist gamblers with problems to recover from their addiction (Oei & Gordon, 2008; Russo, McCormick, Ramirez, & Taber, 2006). Similarly, self-exclusion targets gamblers with problems by allowing them to exclude themselves from gambling at a venue for a period of time. This intervention asks problem gamblers to enter into an agreement with an operator to stop gambling at a given venue for a period, usually a year. Self-exclusion assists gamblers who are unable to control their gambling to do so with the help of a venue operator. Self-exclusion programs have been implemented by many casino and non-casinos EGM venues in Canada, Australia, and other places (Kotter et al., 2019).

Additionally, many countries now limit betting amounts. In Australia, some states have limited betting money on EGMs to a maximum of ten dollars (Gainsbury, Blankers, Wilkinson, Schelleman-Offermans, & Cousijn, 2014; Wardle et al., 2011). By capping betting amounts, gambling losses are minimized. In the United Kingdom, the prize money for lottery jackpot is limited to 500 pounds (Wardle et al., 2011). These limits were put in place to minimize public interest in the activity. While staking restrictions reduces gambling losses, winning restrictions make gambling less attractive when the payout is small (Wardle et al., 2011). Both measures, in the long run reduce, gambling-related harm for individual gamblers.

Warning messages are now placed on gambling machines to warn gamblers about the potential risks involved in the activity (Pates & Riley, 2012; Wardle et al., 2011; Williams et al., 2008). Some of these warning messages educate gamblers on what to do to minimize harm from gambling. Although the content of the messages might vary from one jurisdiction to another, a warning message is a popular demand-side harm minimization measure for all forms of gambling operators (Pates & Riley, 2012; Wardle et al., 2011; Williams et al., 2008). For example, research has shown that appraisal warning signs on EGMs promote responsible gambling among gamblers (Monaghan & Blaszczynski, 2010).

The various demand focused programs are effective in reducing individuals' gambling harm. However, they have minimal impact on the prevention of gambling-related harm at the population level (Ladouceur, Robert, Blaszczynski, & Lalande, 2012). For example, because demand focused harm reduction measures are mostly designed to targets individuals with gambling problems, they tend to ignore gamblers without problems but who might at some point in their gambling experience problems (Ladouceur et al., 2012). Such programs also do not target non-gamblers who may be at risk for problem gambling at a later time.

Supply focused harm minimization measures have been developed to complement or address the weaknesses of the individual targeted measures. By targeting the supply of gambling facilities and machines or products, the larger adverse impact of gambling on the population is reduced (Gainsbury et al., 2014; Jackson, Christensen, Francis, & Dowling, 2015). For example, in some developed countries, EGMs are not allowed in places closer to schools, airports, and shopping centers (Gainsbury et al., 2014). Even in areas where EGM venues are permitted, the per capita number of machines of a venue is restricted. In the Australian state of Tasmania, 3,680 EGMs are allowed in the whole state, and 2,500 EGMs of the total are located in clubs and hotels, with the remaining located in casinos (Allen Consulting Group, 2011). Similarly, in Alberta, 6000 vlts are permitted, and each venue can have up to 10 machines. Limiting the number of machines per venue helps in reducing the number of people that could play vlt at a given time in a jurisdiction (Williams et al., 2011). This capping system has helped minimize gambling activities in local areas (Abbott, 2006; Vasiliadis et al., 2013; Volberg, 2002). Limiting gaming venues and machines per location has a broader impact on gambling harm reduction in communities.

Restrictions on the operating hours of casino and non-casino EGM venues have been found to have contributed to problem gambling reduction in some jurisdictions. For example, prior to 2013, In Nova Scotia, Canada, EGMs are only accessible from midnight to early morning, making it difficult for people to gamble on such machines (Gainsbury et al., 2014). In this area, daytime EGM gambling is not permitted. As these operating hours restriction was instituted, problem gambling in Nova Scotia reduced by 5-9% (Gainsbury et al., 2014). A similar restrictive policy in Newfoundland in Canada (Gainsbury et al., 2014). In Australia, where EGM venues operate between 4 to 8 hours daily, evidence showed that problem gambling prevalence significantly when EGM venue operating hours were reduced (Abbott, 2006; Marshall & Baker, 2002).

Age restrictions have been found to prevent vulnerable populations such as children from gambling. In Canada, only those aged 20 years or older are legally permitted to gamble, although the age restrictions vary across the provinces. In the US, New Zealand, and Australia, the legal ages for gambling are 18 to 20 years. In New Zealand, persons aged 18 years can participate in non-casino gambling activities (Gerstein et al., 1999; Rossen et al., 2015). Age restrictions prevent problem gambling in younger people (Gerstein et al., 1999; Moore & Ohtsuka, 1997; Volberg, Gupta, Griffiths, Ólason, & Delfabbro, 2010).

In summary, the supply and demand targeted measures collectively help in minimizing harms from gambling at both the individual and population levels. Demand focused programs reduce gambling harm posed to individuals with gambling problems or those who gamble. However, the supply-side harm reduction measures tend to target all types of people, including gamblers with and without problems, and are usually implemented at the state or national level. Both demand and supply-side harm reduction programs generally prevent problem gambling by encouraging responsible gambling or minimizing gambling participation (Gainsbury et al., 2014; Pates & Riley, 2012). These programs could reduce the prevalence of problem gambling at local and national levels if appropriately implemented and enforced (Pates & Riley, 2012).

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Chapter Three: Overall research methodology

Research design

This dissertation used cross-sectional quantitative and qualitative data from Alberta in Canada and Tasmania in Australia to address the research objectives. The first three manuscripts used a secondary cross-sectional data collected on Albertans in the Social and Economic Impact of Gambling (SEIGA) surveys conducted in 2008 and 2009 (Williams et al., 2011). The fourth manuscript is a mixed-method study using data from Alberta and data from the Tasmanian Social and Economic Impact of Gambling (SEIGT) surveys conducted in 2011 (Allen Consulting Group, 2011; Williams et al., 2011).

Using a cross-sectional design, the Albertan and Tasmanian surveys collected data from research participants at a single point in time on specific research topics (Allen Consulting Group, 2011; Williams et al., 2011). Data on demographics, substance use, smoking, psychosocial issues, gambling behaviour, perception of gambling availability, gambling venues and machines, travel distance to casinos, childhood adversity, and intimate relationship dysfunction were analyzed in the present study.

The qualitative components of the mixed-methods manuscript adopt a descriptive qualitative design (Lambert & Lambert, 2012; Sandelowski, 2000). This naturalistic research method allows researchers to gather data on individuals' subjective experiences related to an issue of interest (Lincoln, 2007). For instance, it can be used to gain insight into how gamblers view access to gambling venues, what influences such views, and how they influence their gambling behaviour. Descriptive qualitative researchers seek to describe the accounts of research participants in less detail when compared to interpretive design (Lambert & Lambert, 2012; Sandelowski, 2000). Interpretation seeks to give meaning to participants' experiences. The researcher reflects on the descriptive accounts of the participants, synthesizes them, and then identifies general themes that unify the different accounts (Sandelowski, 2000). The sample size for a descriptive qualitative design can range from a few, to many participants, depending on the data needed to generate qualitative descriptive accounts (Lambert & Lambert, 2012; Sandelowski, 2000, 2009).

Study setting and population

Data for both the quantitative and qualitative studies came from Alberta and Tasmania. Both settings have all forms of legal gambling opportunities, including lotteries, EGMs, table games, and others, and a large segment of their residents participate in gambling (Allen Consulting Group, 2011; Williams et al., 2011). Tasmania and Alberta are among the regions in Australia and Canada, respectively, with the highest gambling participation rates (Allen Consulting Group, 2011; Williams et al., 2011). Problem gambling in both areas is modest compared to other areas of their respective countries. In 2011, 75% of Albertans and 64.8% of Tasmanians gambled (Allen Consulting Group, 2011; Williams et al., 2011). Between 2% to 3% of Albertans and 0.7% Tasmanians had gambling-related problems in 2011 (Allen Consulting Group, 2011; Williams et al., 2011). As of 2014, Alberta had 13,483 slot machines in casinos and race centers, 5989 vlts distributed across 903 locations, 2,650 lottery ticket centers, and 638 bingo venues in Alberta (Allen Consulting Group, 2011). In Tasmania, there were 3,572 EGMs located in 104 venues, 45 table games, 103 lottery outlets, 168 Keno venues, and 139 race wagering venues in 2014.

A random sample of 15,166 Albertans and 4,303 Tasmanians aged 18 years and older participated in the SEIGA and SEIGT telephone surveys (Allen Consulting Group, 2011;

Williams et al., 2011). Telephone calls were placed to households in the study areas to recruit participants, and those who agreed completed a questionnaire over the phone with assistance from a trained interviewer (Allen Consulting Group, 2011; Williams et al., 2011). For the quantitative studies in the current manuscript, data were analyzed for the sample in the SEIGA and SEIGT surveys who met the inclusion criteria and had complete data on the variables used in the analysis.

A purposive sample of 10 Albertan and 14 Tasmanian gamblers participated in the qualitative component of the mixed-methods study (see fourth manuscript). The Albertan qualitative participants were not part of the 2008 and 2009 SEIGA surveys; they were recruited from the general Albertan population in 2018 using advertising posters (see Appendix A for recruitment poster). On the other hand, the Tasmanian qualitative participants were part of the 2011 SEIGT survey, but the qualitative data were collected in 2015. The survey and interview participants were recruited from the eight Tasmanian local government areas (LGAs; such as Brighton, Break O'Day, Glenorchy, Devonport, Circular Head, Launceston, Sorell, and Clarence) and the rest of states (Allen Consulting Group, 2011)

Albertan qualitative study participants were interviewed by the author of this dissertation, while the Tasmanians were interviewed by the researchers who conducted the 2011 SEIGT survey. For Albertan and Tasmanian qualitative participants, the same open-ended questions (see interview guide in Appendix B) were used to collect data on age, gender, place of residence, PGSI score, travel distance to the nearest casino, experiences with access to casinos, childhood adversities, and intimate relationship experiences. Interviews with both the Albertan and Tasmanian qualitative study participants lasted about an hour.

Sampling methods of study surveys and weighting of data

Both the Social and Economic Impact of Gambling surveys conducted in Alberta and Tasmania used a random sampling method (Allen Consulting Group, 2011; Williams et al., 2011). Both were telephone surveys that were administered by experienced researchers. A supplementary email survey was carried out in Alberta (Williams et al., 2011).

In Alberta, the Consumer Contact company conducted the 2008 (between June 11 and August 31) and 2009 (between June 10 and August 31) surveys (Williams et al., 2011). The study population was divided into general, targeted, and online samples. Telephone surveys were carried out with the general and targeted populations, and the email survey used online samples. Respondents who were aged 18 years and older in households in the study areas were randomly contacted in these three study populations. More respondents were selected from the targeted study population (N = 3,624 for 2009 and N = 4,512 for 2008), followed by the general (N = 1,004 for 2009 and N = 3001 for 2008) and the online (N = 1,006 for 2009 and N = 2,019 for 2008) populations, respectively (Williams et al., 2011).

Each randomly selected respondent was contacted 16 times, two calls per evening (Williams et al., 2011). A total of 7.25 attempted calls were made to respondents who completed the survey. Many of the phone contacts took place in the evenings and on weekends (Williams et al., 2011). Interviews with Albertan survey respondents were brief, with an average completion time of 14.23 minutes. For the 2009 survey, the average telephone attempts with survey respondents were 8.51, with 14.55 minutes average interview completion time. The average survey response rates were 24.4% in 2008 and 28.6% in 2009 for the three study groups (Williams et al., 2011).

The Tasmanian study used a questionnaire with standardized Australian gambling survey questions for data collection (Allen Consulting Group, 2011). Two versions were used: the main and supplementary questions. All study respondents completed the main survey questionnaire, which covered a wide range of issues, whereas the supplementary survey questionnaire was administered to a sub-sample of the respondents. The main survey collected data on gambling-related issues such as gambling participation, EGM gambling, problem gambling severity, and others. Supplementary surveys collected data on lifestyle, and social issues, which include quality of life, substance use, financial difficulties, and others (Allen Consulting Group, 2011). The overall response rate for the Tasmania surveys was 31% (Allen Consulting Group, 2011).

The surveys from Alberta and Tasmania were both weighted to make the sample more representative of the general populations of the study areas (Allen Consulting Group, 2011; Williams et al., 2011). In Alberta, data were weighted by household size to account for under-sampling in households with large families and over-sampling in small-sized households (Williams et al., 2011). Data were also weighted by age and gender based on the 2006 Canadian census. The age and gender weights were used to correct for under-sampling of males and younger adults, a typical problem with gambling surveys. As evident in the SPSS dataset, respondents from the targeted population were excluded from the weighting procedure. It appears that the accessibility variable was not included in the weighting calculation (Williams et al., 2011). In Tasmania, household and population-based weights were applied to the data to make the sample representative of the general population of the state (Allen Consulting Group, 2011; Williams et al., 2011). A special formula developed by the authors of the survey (see the original document for details) was used to estimate the household weight. Population weight was estimated based on the 2006 census information for the LGAs and the entire states, stratified by age and gender (Allen Consulting Group, 2011; Williams et al., 2011).

Data analysis

Gambling data are analyzed in the literature with a wide range of parametric and non-parametric statistical methods and qualitative analytical methods. Different reasons, including the research questions, objectives, and the characteristics of the research data, informed the choice of the analytical method for the manuscripts presented in this dissertation. For the present research, different quantitative analytical models and a qualitative analysis were performed on the respective data according to the objectives of the manuscripts in this dissertation. For quantitative manuscripts, descriptive statistics such as percentages and frequencies were used to describe the characteristics of the respondents. Other analytical methods used for each manuscript are described below, including the rationale for their use.

Manuscript one used linear regression models to examine the association between perceived availability and problem gambling severity and the moderating role of demographics, substance use, and psychosocial problems using the 2008 and 2009 Albertan survey data. Linear regression models were used despite the fact that the problem gambling severity outcome variable of the analysis was slightly skewed. A logarithmic transformation was applied to correct the skewness, but it was not eliminated. Similar results were obtained when the slightly skewed and untransformed data were analyzed. For the moderation analysis, the association between perceived and problem gambling severity was examined at each level of the moderator.

The second manuscript used Poisson and binary logistic regression models to examine the relative associations of three measures of gambling exposure (availability, accessibility, and a composite measure) with an MRPG (referring to moderate-risk and problem gambling) risk and problem gambling severity with data from Alberta. The binary logistic regression models were used to compare the exposure measures in their associations with the risk of being an MRPG. The Poisson models were used to compare the measures in their associations with problem gambling severity. The variable measuring problem gambling severity had count data that ranged from 1 to 27, and the scores are concentrated at the left tail end of the distribution. A Poisson model was used because its fit count data better for the three exposure measures compared to a traditional linear regression model. Poisson and negative binomial regressions are the recommended statistical analytical methods for analyzing count data (Ridout, Demetrio, & Hinde, 1998).

In the third manuscript, a more complex analytical method, referred to as ZIP, was used to determine the relative and interactive effects of objectively (actual) and subjectively (perceived) measured gambling exposure on the likelihood of being an any-risk gambler (referring to low-risk, moderate-risk, and problem gamblers) and problem gambling severity. ZIP is usually used to model count data. It uses logistic and Poisson functions to model the zero and non-zero data separately and concurrently (Böhning, Dietz, Schlattmann, Mendonça, & Kirchner, 1999; Hall, 2000; Lambert, 1992). The reasons that informed the choice of ZIP over standard Poisson for the present analysis are explained below.

Research on the prevalence of problem gambling shows that some gamblers and not others are at more risk of problem gambling or become problem gamblers when they have more opportunities to gamble (Storer, Abbott, & Stubbs, 2009; Vasiliadis, Jackson, Christensen, & Francis, 2013; Williams, Volberg, & Stevens, 2012). This research finding suggests that there are some gamblers who may never experience problems with gambling regardless of whether there are increases or decreases in gambling opportunities. The above explanation suggests that there may be two groups of non-problem gamblers: (1) non-problem gamblers who may never become at-risk of problem gambling even as gambling opportunities increase and (2) non-problem gamblers who may become at-risk of problem gambling when there are increases in opportunities. Membership in these two groups could be better determined with a Poisson regression model, as it takes into account the group differences in vulnerability characteristics (Böhning et al., 1999; Hall, 2000; Lambert, 1992). The standard Poisson regression does not account for such vulnerability differences (Böhning et al., 1999; Hall, 2000; Lambert, 1992).

The first analysis of the third manuscript used the binary logistic regression function to determine the relative importance of the actual and perceived measures of exposure in predicting the likelihood of being any-risk gambler. The second analysis used Poisson function to determine the relative importance of the actual and perceived measures of exposure in predicting changes in problem gambling severity among gamblers with PGSI scores of 1 or higher. A third analysis used both the logistic and Poisson functions of the ZIP to examine the interactive effects of actual and perceived exposure measures on the likelihood of being any-risk gambler and the severity of problem gambling.

The fourth manuscript used a mixed-methods design to describe the experiences of four groups of gamblers (i.e., non-problem, low-risk, moderate-risk, and problem gamblers) with access to casinos. Both quantitative and qualitative analyses were carried out with data from Alberta and Tasmania. Quantitative data from Alberta and Tasmania were used to describe differences in the four gambler types in their proximity to casinos, segmented by their age, gender, and place of residence. Descriptive statistics such as percentages and frequencies were used to describe the groups.

The qualitative component of the fourth manuscript describes the gambler types' experiences with access to casinos. It explained their experiences with access to casinos and how such experiences influence gambling behaviour and are shaped by childhood adversities and intimate relationship problems. Interviews with ten Albertan and fourteen Tasmanian gamblers were analyzed thematically. A thematic analysis provides steps to identify patterns within qualitative data, organize similar views into concepts and then into themes that reflect research participants' experiences with a particular phenomenon. Thematic analysis involves six iterative steps: familiarization with data transcript, generation of initial codes, searching for themes from the codes, reviewing themes, refining and renaming theme to reflect participants' views properly, and writing up the results (Braun & Clarke, 2006). These steps were followed to generate the themes presented in the fourth manuscript.

Ethical considerations

Approval for this study was obtained from the ethics review board of the University of Lethbridge. Access to the archival Tasmanian gambling survey data was granted by the principal researchers from the Problem Gambling Research and Treatment Centre (Professor Alun Jackson and Associate Professor Nicki Dowling). Additionally, access to the Alberta gambling survey data was granted by Professor Robert Williams from the University of Lethbridge, the principal investigator of the study. As a principal researcher of this study, I did not have access to the key linking the identifiable information of the two datasets. The qualitative data from Tasmania was collected by the research team that conducted the Tasmanian survey. Approval for the collection of the qualitative data was granted by the University of Melbourne's Graduate School of Education Ethics Committee (see Appendix C; ethics number: 1340411.1). For the qualitative study conducted in Alberta, ethics approval was granted by the University of Lethbridge's Human Subjects Ethics Committee (ethics number: 2016-061).

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Chapter Four: The effects of perceived gambling availability on problem gambling severity

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Abstract

The aim of this study was to determine the moderating effects of sociodemographic characteristics, substance use, and psychosocial problems on the relationship between gambling availability and problem gambling severity. Bivariate and multivariate regression analyses of the 2008 and 2009 Social and Economic Impacts of Gambling in Alberta surveys showed that the perception of gambling as 'too widely available' was associated with a 1.4 times higher problem gambling severity score when adjusting for sociodemographic characteristics, psychosocial problems, and substance use. Factors such as age, gender, place of residence, and psychosocial problems had significant moderating effects. Our findings indicate that the perception of gambling availability is an important determinant of problem gambling behaviour.

Keywords: problem gambling, perceived availability, exposure adaptation hypothesis

Introduction

Gambling is a common recreational activity with about 65% to 90% of the global adult population gambling in the past year (Gainsbury et al., 2014; Wardle, Moody, Griffiths, Orford, & Volberg, 2011; Williams, Volberg, & Stevens, 2012). While many people gamble occasionally, others gamble more often, which may lead to problematic gambling behaviour. World-wide, the problem gambling prevalence rates range between 0.2% to 7.6% of the adult population (Cunningham-Williams, Cottler, Compton, Spitznagel, & Ben-Abdallah, 2000; Gainsbury et al., 2014; Wardle et al., 2011; Williams et al., 2012). Both individual and environmental factors give rise to problem gambling behaviour. One aspect of the environment that has been consistently associated with problem gambling is the availability of gambling opportunities (Abbott, Romild, & Volberg, 2014; Barratt, Livingston, Matthews, & Clemens, 2014; LaPlante & Shaffer, 2007; Strohäker & Becker, 2018; Vasiliadis, Jackson, Christensen, & Francis, 2013; Williams et al., 2012).

Gambling availability

In Australia, the Productivity Commission (2001) found that local areas with seven or more EGMs per 1,000 adult residents had higher problem gambling rates than the national average. A meta-analysis of antipodean gambling found that the density of EGMs explained 38% of the variance in problem gambling rates (Storer et al., 2009). In Australia, problem gambling severity rates increased approximately 65.4% for every one unit increase in EGM density (Storer et al., 2009). In a cross-national analysis, Williams et al. (2012) found that the standardized prevalence rates in Europe, where legalized gambling opportunities are less available, was 0.5%, compared to 7.6% in Asia, where there are more such opportunities. However, not all studies have shown a positive relationship between gambling venues, density, and problem gambling prevalence rates (St-Pierre et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012).

Several studies have examined the relationship between gambling availability and problem gambling rates over time (Bondidlfi, Jermann, Ferrero, Zullino, & Osiek, 2008; Delfabbro, 2008; Jacques, Ladiduceur, & Ferland, 2000; Room, Turner, & Ialomiteanu, 1999; Vasiliadis et al., 2013; Williams et al., 2012). These studies indicate that problem gambling severity rates increase immediately after gambling venues open. Other studies have shown that prevalence rates decline as the duration of exposure increases (St-Pierre et al., 2014; Vasiliadis et al., 2013). These findings support both the exposure and adaptation hypotheses (St-Pierre et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012). While the exposure explanation argues that problem gambling increases with increasing opportunities, the adaptation explanation posits that exposure effects decrease as the novelty of gambling diminishes (St-Pierre et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012).

Much of the research on gambling availability and problem gambling has focused on communities as the unit of analysis rather than the individual. These studies imply that individuals within the same community are equally impacted by gambling exposure. However, because of their differences in vulnerability and responsiveness to exposure (Marshall, 2005; Marshall & Baker, 2001), individuals living in the same jurisdiction are likely to be impacted differently by their exposure to gambling opportunities.

Some studies (Pearce, Mason, Hiscock, & Day, 2008; Rush, Veldhuizen, & Adlaf, 2007; Welte, 2004; Welte, Barnes, Wieczorek, Tidwell, & Hoffman, 2007) have addressed the above issue using disaggregated data. These studies have created gambling exposure scores based on EGM density in a defined jurisdiction and assign the same score to all individuals within the same area. A limitation of this approach is that it is only able to compare group differences rather than differences among individuals within groups.

Perceived gambling availability

Typically, gambling availability research has used objective measures (e.g., EGM numbers) to estimate the effects of exposure (St-Pierre et al., 2014; Vasiliadis et al., 2013). However, the Productivity Commission (2001) also identified the *perception of availability* as an important predictor of problematic gambling behaviour. The Commission argued that while the physical presence of gambling leads to its use, perception also plays a critical role (Productivity Commission, 2001).

Only two quantitative studies have examined the relationship between the perception of gambling availability and problem gambling. Wickwire et al. (2007) examined the relationship between perceived availability and problem gambling in a cross-sectional sample of college students in the United States and found a non-significant relationship. However, the Wickwire et al. (2017) study had limitations. Notably, only a few gamblers in their sample experienced any gambling harms and the authors only examined the relationship between perceived availability of lotteries and problem gambling. In the other study, Williams, Belanger, and Arthur (2011) found that approximately half of a sample of 15,000 adults in Alberta perceived gambling opportunities as too widely available but did not investigate the potential effects of this perception on problem gambling severity. In addition, two qualitative studies found that the perception of gambling availability influences gambling participation (Hing & Nisbet, 2010; Moore et al., 2011).

Gambling prevalence studies sometimes ask about people's perceptions of whether or not gambling opportunities are too widely available in a defined community (Williams et al., 2011). This subjective question is not equivalent to a question about whether or not opportunities are available (Wickwire et al., 2007). The question of whether gambling is too widely available inherently explores whether subjective judgements of higher levels of availability are associated with increasing problem gambling severity. This negative subjective view of gambling exposure on problem gambling has not received any theoretical attention in the gambling literature (Wickwire et al., 2007). For example, researchers have used the exposure hypothesis to explain the relationship between availability and gambling behaviour (Griffiths & Delfabbro, 2001; LaPlante & Shaffer, 2007). This hypothesis suggests that the prevalence of problem gambling increases as objectively measured availability increases. It defines availability using objective measures such as the density and number of gambling venues (LaPlante & Shaffer, 2007; Shaffer et al., 2004), ignoring the influence of perception.

Perceived availability of alcohol and drugs

Perception is a concept widely used in the public health literature to understand environmental influences on health behaviour (Knoblich & Sebanz, 2006). For example, in the alcohol literature, the perceived availability is often linked to drinking behaviour. Several studies of alcohol consumption have found that individuals who believe that alcoholic beverages are widely available in their communities drink more frequently and more heavily than others (Kuntsche, Kuendig, & Gmel, 2008a; Stanley, Henry, & Swaim, 2011; Warren et al., 2015). Research examining the availability of cannabis has found similar results. For example, a recent study found adolescents in urban areas who perceived cannabis to be more readily available had a higher rates of frequent cannabis use, and the greater perceived availability was able to mediate the influence of socio-economic status (Kazmer, Chomynova, & Csemy, 2019).

Correlates of problem gambling

Studies that have investigated problem gambling have identified several correlates of problematic gambling. For example, several sociodemographic characteristics including young age, male gender, low education, unemployment, low income, and disadvantaged neighbourhood, as well as substance abuse and psychosocial problems, have been associated with an increased risk of problematic gambling (Afifi, Cox, Martens, Sareen, & Enns, 2010; Beaudidin & Cox, 1999; Wareham & Potenza, 2010; Welte, Barnes, Tidwell, & Wieczorek, 2017). Males, for example, have been found in many studies to have about twice the rate of problem gambling as females (Afifi, Cox, et al., 2010a).

Purpose of the study

This study examined the effects of perceptions of gambling availability on problem gambling severity, and the moderating role of sociodemographic characteristics, psychosocial problems, and substance use. Based on the evidence in the alcohol and substance abuse literatures, we proposed that adults who perceive that gambling products and venues are too widely available in their community would have higher problem gambling severity scores as measured by the Problem Gambling Severity Index (PGSI). We further anticipated that although perceived availability would be a strong predictor of gambling severity, its effects would be partially dependent upon sociodemographic characteristics, psychosocial problems, and substance use.

Methods

Study data source and sample

This study analyzed data from the 2008 and 2009 Social and Economic Impacts of Gambling in Alberta surveys (SEIGA; Williams et al., 2011). The SEIGA collected data on problem gambling severity, sociodemographic characteristics, psychosocial problems, substance use, and other variables. Respondents were randomly selected by telephone from households in four Albertan locations: Southern Alberta, Calgary, Edmonton, and Northern Alberta. Each location had at least one casino and many other gambling forms such as lotteries, instant scratch tickets, sports betting, EGMs, Bingo, and horse racing (Williams et al., 2011).

A total of 12,141 adults aged 18 years and older were recruited from general and targeted populations in 2008 and 2009. For the 2008 survey, 3,001 and 4, 512 adults from the general and targeted populations were sampled with 25.5% and 23.3% response rates, respectively. For the 2009 survey, 1,004 and 3,624 adults came from the general and targeted populations, with 33.1% and 24.1% response rates, respectively. Overall, a total of 7,513 and 4,628 of adults participated in the 2008 and 2009 surveys, and their average response rates were, respectively 24.4% and 28.6%. The SEIGA methodology is reported elsewhere (Williams et al., 2011).

Measures

Study variables

The dependent and independent variables for this study were problem gambling severity and perceived gambling availability, respectively. Sociodemographic variables as well as psychosocial problems, and substance use, were treated as covariate variables. However, some of these covariates were also used as moderating variables based on the strength of their association with the dependent variable. Covariates with moderate to strong relationships with problem gambling severity were used as moderator variables in the regression analyses, as detailed below.

Sociodemographic characteristics. The sociodemographic characteristics examined in this study included gender, age, marital status, education, employment status, income, and place of residence. All sociodemographic variables in the SEIGA, except age and income, had categorical values (Williams et al., 2011). Age was further categorized into young (18-39 years), middle (40-64 years), and old (65 years and above) age groups. This was done purposely to determine how age groups moderated perceived gambling availability on gambling severity.

Problems with substance use and psychosocial problems. Subjects were asked if they had problems with substances such as alcohol and other drugs in the past year. Response options were 'yes' or 'no', with 'yes', indicating a problem. In addition, a 'yes' or 'no' response option was used to determine whether subjects had psychosocial problems (Williams et al., 2011). The psychometric characteristics of these measures were not provided by the original authors.

Perceived gambling availability. Perceptions of gambling availability were measured in the original study with a question that asked respondents about their opinions of gambling opportunities available in Alberta. Responses were originally categorized as: 'gambling is too widely available', 'the current availability of gambling fine', and 'gambling is not available enough' (Williams et al., 2011). For the purposes of the present study, the second and third responses were collapsed into a single category called 'gambling is not too widely available'. We henceforth refer to this new response category as 'not too widely available'. Combining these two responses was necessary because the sample size of respondents who perceived gambling as 'not available enough' was very small (1.4%) compared to the other two response categories

(54.7% for ‘gambling is too widely available’ and 43.9% for ‘the current availability of gambling fine’).

Problem gambling severity. The current study used the PGSI to measure problem gambling severity on a scale of 0 to 27. The PGSI categorizes respondents into 0 = ‘non-problem gambler or non-gambler’; 1–2 = a ‘low risk gambler’; 3–7 = a ‘moderate risk gambler’; and 8+ = a ‘problem gambler’. The PGSI, extensively used in prevalence studies, has internal consistency and test-retest reliability scores ranging from 0.77 to 0.85 (Currie, Casey, & Hodgins, 2010; Ferris & Wynne, 2001; Holtgraves, 2009; Loo, Oei, & Raylu, 2011). Congruent with the overall goal of this study, only data from subjects endorsing PGSI scores of 1 and above were analyzed. For the purposes of this study, we defined ‘problem gambling severity’ as having a PGSI score of 1 or higher; as scores of 1 or more indicate some risk of problem gambling. The variable ‘problem gambling severity’ was treated as a continuous variable in all analyses.

Data analysis

We analyzed data from subjects (n = 1,388) who endorsed scores of 1 or higher on the PGSI. The psychosocial problems and substance use variables had more than 7% missing data. The majority of the remaining variables had between 0.07% and 1.4% of missing data. None of the missing data were replaced as they appeared to be missing at random (Little & Rubin, 2002). The data were weighted by the sizes of households and by the population sizes of the four residential locations (i.e., Southern, Northern, Calgary, and Edmonton areas) to make the sample representative of the general Albertan population. SPSS version 25 was used to analyse the data where statistical significance was set at $p < 0.05$. All regression analyses were performed on weighted data. Problem gambling severity scores were unevenly distributed (the skewness value for the dependent variable was 2.1). Unsuccessful attempts were made to correct this uneven distribution with a logarithmic transformation. Therefore, we used the untransformed problem gambling severity variable for the regression analyses.

Descriptive statistics were initially used to describe subject characteristics. Percentage cross-tabulations were also used to estimate perceived gambling availability by age, gender, education, employment status, income, places of residence, psychosocial issues, and substance use. All descriptive analyses were performed on weighted and unweighted data (see Table 1).

Bivariate linear regression was used to estimate the effects of perceived gambling availability on problem gambling severity, without controlling for sociodemographic characteristics, psychosocial problems, and problems with substances. In addition, two multiple linear regression models were constructed to identify the independent effects of perceived gambling availability on problem gambling severity. The first multiple regression model controlled for sociodemographic covariates. The second model extends the first model by including in the model the variables psychosocial problems and substance use, as covariates.

Further multivariate regression models were computed to determine whether the effects of perceived availability on problem gambling severity were dependent upon sociodemographic characteristics, psychosocial problems, and substance use. First, a series of separate two-way interaction regression models were constructed to examine the interaction between perceived availability and each of the covariate variables that had moderate or strong relationships with problem gambling severity. Each two-way model included perceived availability, a covariate (e.g., gender), and their interaction terms. For these models, we reported the estimated regression coefficients for the interaction terms, since our goal was to determine interaction effects rather than main effects. Therefore, we did not report the main effects of the independent and moderator variables in the models.

Furthermore, three-way interaction regression models estimated the extent to which the effects of perceived availability on problem gambling severity are dependent upon the interaction of two covariate variables. For example, we estimate problem gambling severity differences between the group that perceived gambling was too widely available and the group that did not, by their gender and age jointly. All three-way models included main effects, first-order interaction terms, and second-order interaction terms. Since our focus is to determine second-order effects, we reported only the estimated regression coefficients for the second-order interaction terms. For the three-way models, only covariate variables with significant interaction terms in the two-way models were included. For all regression models, the response not too widely available and one of the categories of the covariate variables (e.g., male) was used as a comparison group. We used regression coefficients to describe the effects of the response variable (perceived availability), including the interaction terms.

Finally, we computed a series of separate linear regression models that decompose the effects of a covariate variable on the relationship between perceived availability and gambling severity for the two-and three-way interaction models. It should be noted that all the covariate variables used in the two-way and three-way interaction models had categorical responses, which makes it possible to decompose their effects. In our decomposition models (Kessler, 1979; Mandel, 1982; Seber & Lee, 2012), the influence of perceived availability was assessed at each level of a moderator variable on problem gambling severity. Our decomposition models differ from the two-way and three-way interaction models because they examine the effects of perceived availability within each level of a moderator. For example, when gender is used a moderator variable, we estimated perceived availability on problem gambling severity for males and females separately (Kessler, 1979; Mandel, 1982; Seber & Lee, 2012).

Results

Subject characteristics

Table 1 describes the study subjects. All the descriptive results were based on unweighted data. Over half (53%) of the subjects were male, and 47% were female. About 50% were aged 40 to 64 years, 38.6% were aged 18 to 39 years, and 11.2% were 65 years and older. The majority (62.2%) were married or in common-law relationships, with the rest being single, divorced, widowed, or separated. High school graduates (52.1%) were more numerous than that of the diploma (27.1%) and degree (20.8%) holders. Most (71%) subjects reported working either part-time or full-time. Over half (51.4%) earned between $20,000 and $60,000 per year. The residential locations of subjects vary, as many (42.9%) reported living in Northern Alberta and a few (17.9%) in Calgary. Most subjects reported not having psychosocial problems (80.5%) and not having problems with substances such as alcohol or illicit drugs (92.3%).

Table 1. Descriptive characteristics of subjects

Variables	Unweighted sample		Weighted sample	
	N (=1,388)	(%)	N (=1,033)	(%)
Mean (SD) PGSI (*scores of 1 to 27*)	2.55 (2.59)			
Gender				
Female	652	47	452	43.8
Male	736	53	581	56.2
Age groups				
Young adults (*18 to 39 yrs.*)	528	38.6	456	44.5
Middle-aged adults (*40 to 64 yrs.*)	687	50.2	480	46.8
Older adults (*65 yrs. and above*)	153	11.2	89	8.7
Marital status				
Single	324	23.5	359	34.8
Married/common law	856	62.0	545	52.8

Separated	45	3.3	29	2.8
Divorced	97	7.0	58	5.7
Widowed	58	4.2	40	3.9
Education				
High school	716	52.1	522	50.7
College Diploma	373	27.1	288	28.0
University degree	286	20.8	220	21.4
Employment status				
Working	972	71	732	71.2
Not working	397	29	295	28.8
Annual Income				
<$20,000	194	15.7	150	16.2
$20,000	97	7.8	100	10.8
$30,000	164	13.2	115	12.4
$40,000	145	11.7	101	11.0
$50,000	125	10.1	93	10.1
$60,000	107	8.6	60	6.5
$70,000	62	5	38	4.1
$80,000	71	5.7	50	5.4
$90,000	44	3.6	33	3.5
≥$100000	229	18.5	183	19.8
Place of residence				
Northern Alberta	383	42.9	134	13.0
Edmonton areas	162	18.2	434	42.1
Calgary areas	160	17.9	390	37.8
Southern Alberta	187	21	74	7.1
Perceived availability				
Too widely available	673	48.7	481	46.7
Not too widely available	709	51.3	550	53.3
Psychosocial problems				
Yes	270	19.5	227	22.0
No	1117	80.5	806	78.0
Problems with substances				
Yes	98	7.7	93	9.5
No	1183	92.3	889	90.5

Prevalence of problem gambling severity in the sample

The average past year average problem gambling severity score for adults with PGSI scores of 1 or higher was 2.6, with a standard deviation of 2.6. As shown in Figure 1, 54.6% (n=758) of the sample had a PGSI score of 1; 15.6% (n=216) had a score of 2; 9.3% (n=129) had a score of 3; 5% (n=69) had a score of 4; 3.7% (n=52) had a score of 5; 2.4% (n=33) had a score of 6; and 9.4% (n=131) had gambling severity scores of 7 or greater. Seventy percent (n=974) and 20.4% (n=283) of the sample had PGSI scores of 1-2 and 3-6, respectively. As Figure 1 indicates, the proportion of adults with problem gambling severity scores decreased as scores on the PGSI increased.

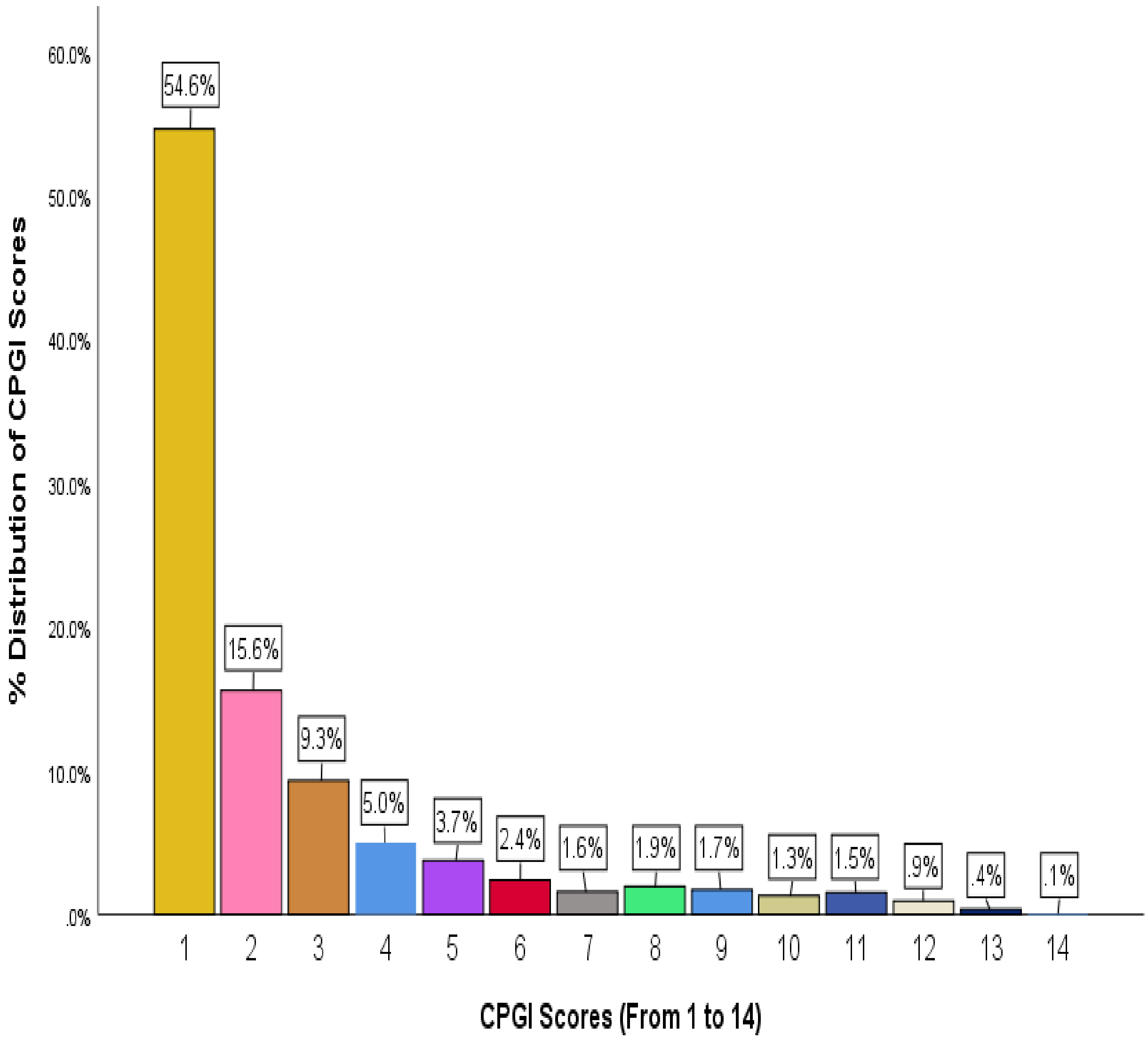

Figure 1: Percentage distribution of gambling severity, as measured by PGSI. Note that scores of 14 and above on the PGSI were combined, and the percentage values shown are unweighted.

Perceptions of gambling availability

The perceptions of gambling availability are described in Table 2. The percentage of adults who believed that gambling opportunities were too widely available and those who did not are relatively even. Slightly under half (48.7%) perceived that gambling opportunities are too widely available. Respondents in this group were more likely to gamble on lotteries (13.1%), instant scratch tickets (9.8%), video lottery terminals (7.7%), and slot machines (7.7%).

Perceptions of availability vary by sociodemographic characteristics (Table 2). Adults who had the highest frequency in each category were: perceived availability as too widely available, 28.1% are middle-aged, 26.4% had a high school education or less, 33.3% were employed, 25.5% were females, 8.1% earn less than $20,000 a year, and 22% live in Northern Alberta. For those perceiving less availability, 24.2% were young adults, 25.8% had a high school education or less, 37.6% were employed, 29.8% were males, 10.2% earn $100,000 or more per year, and 20.8% live in Northern Alberta.

Table 2. Perceptions of gambling availability by selected socio-demographics

Variables	Too widely available (48.7%)	Not too widely available (51.3%)
Gender		
Female	25.5	21.5
Male	23.2	29.8
Age groups		
Young adults	14.4	24.2
Middle-aged adults	28.1	22.2
Older adults	6.1	5.1
Education		
High school	26.4	25.8
College Diploma	12.9	14.2
University degree	9.6	11.2
Employment status		
Working	33.3	37.6
Not working	15.6	13.5
Annual Income		
<$20,000	8.1	7.6
$20,000	4.3	3.6
$30,000	6.7	6.6
$40,000	6.2	5.5
$50,000	4.5	5.7
$60,000	4.4	4.2
$70,000	2.2	2.8
$80,000	2.2	3.5
$90,000	1.7	1.9
≥$100000	8.3	10.2
Place of residence		
Northern Alberta	22	20.8
Edmonton areas	8.9	9.2
Calgary areas	8.8	9.2
Southern Alberta	10.3	10.7

Note. The values in the table are unweighted.

As shown in Table 3, over half (61.9%) of adults who perceived availability as not too widely available had a PGSI-gambling severity score of 1 compared to 46.7% who perceived gambling as too widely available. Further, 13.4% of adults who perceived gambling as too widely available had severity scores of 8 or greater. Comparatively, few (2.6%) who perceived gambling as not too widely available group had severity scores of 8 or greater.

Table 3. PGSI-problem gambling severity levels by perceptions of gambling availability

PGSI gambling severity scores	Too widely available (100%)	Not too widely available (100%)
1	46.7	61.9
2	13.5	17.5
3	10.3	8.5
4	5.9	4.1
5	4.9	2.7
6	3.1	1.7
7	2.2	1.0
8 or greater	13.4	2.6

Note. Respondents with a PGSI score of 0 were excluded from the analysis as this study focused on gamblers at risk or with some problems. Reported PGSI scores are unweighted and range from 1 to 27.

Bivariate and multivariate effects of perceived availability on problem gambling severity

Model 1 of Table 4 indicates that problem gambling severity is 1.35 times (b = 1.35, p < 0.001) higher in adults who perceive gambling to be too widely available than in those who did not when their sociodemographic characteristics, psychosocial problems, and problems with substance use are not controlled. As shown in Models I (b = 1.39, p < 0.001) and II (b = 1.25, p < 0.001), problem gambling severity remains almost the same even after controlling for these covariates.

Table 4. Bivariate and multivariate effects of perceived availability on problem gambling severity

Variable	*b*	SE	95% CI	
MODEL I				
Perceived availability				
Too widely available	*1.349***	*0.15*	*1.03*	*1.65*
Not too widely available (*Ref.*)				
MODEL II				
Perceived availability				
Too widely available	*1.393***	*0.17*	*1.07*	*1.72*
Not too widely available (*Ref.*)				
Gender				
Female	0.101	0.18	-0.24	0.44
Male (*Ref.*)				
Age groups				
Middle-aged adults	0.350	0.20	-0.03	0.73
Older adults	0.599	0.38	-0.14	1.34
Young adults (*Ref.*)				
Marital status				
Single	0.628*	0.20	0.23	1.03
Separated	0.918	0.48	-0.02	1.86
Divorced	0.698	0.37	-0.03	1.42
Widowed	0.153	0.47	-0.78	1.09
Married/common (*Ref.*)				
Education				
College Diploma	-0.534*	0.20	-0.92	-0.15
University degree	-0.615*	0.22	-1.04	-0.19
High school (*Ref.*)				
Employment status				
Working	0.473*	0.21	0.07	0.88
Not working (Ref.)				
Annual Income	0.015	0.03	-0.04	0.07
Place of residence				
Northern Alberta	-1.145*	0.38	-1.88	-0.41
Edmonton areas	-1.132**	0.33	-1.77	-0.49
Calgary areas	-1.047*	0.33	-1.70	-0.40
Southern Alberta (*Ref.*)				

Note: The b values are unstandardized regression coefficients. The sample sizes are weighted to correct for overrepresentation and vary from 881 to 1031. Model I tests the effects of perceived availability on gambling severity without adjusting for covariates. Model II tests the effects of perceived availability while adjusting for socio-demographics such as gender, age, marital status, education, employment, and place of residence. Ref. = reference group. *$p < .05$; **$p < .001$

Table 4. Bivariate and multivariate effects of perceived availability on problem gambling severity (continued)

Variable	*b*	SE	95% CI	
MODEL III				
Perceived availability				
Too widely available	*1.25***	*0.16*	*0.93*	*1.57*
Not too widely available (*Ref.*)				
Gender				
Female	-0.07	0.17	-0.40	0.26
Male (*Ref.*)				
Age groups				
Middle-aged adults	0.42~	0.19	-0.05	0.79
Older adults	1.25*	0.38	0.51	2.00
Young adults (*Ref.*)				
Marital status				
Single	0.53	0.20	-0.15	0.92
Separated	0.93	0.45	-0.04	1.82
Divorced	0.39	0.38	-0.35	1.13
Widowed	0.05	0.47	-0.87	0.96
Married/common (*Ref.*)				
Education				
College Diploma	-0.64**	0.19	-1.01	-0.26
University degree	-0.57*	0.21	-0.98	-0.17
High school (*Ref.*)				
Employment status				
Working	0.66*	0.20	0.26	1.06
Not working				
Annual Income	0.03	0.03	-0.03	0.08
Place of residence				
Northern Alberta	-0.97*	0.38	-1.71	-0.23
Edmonton areas	-0.91*	0.32	-1.54	-0.28
Calgary areas	-0.86*	0.33	-1.50	-0.21
Southern Alberta (*Ref.*)				
Psychosocial problems				
Yes	1.50**	0.2	1.11	1.89
No (*Ref.*)				
Problems with substances				
Yes	0.83*	0.28	0.28	1.38
No (*Ref.*)				

Note: The b values are unstandardized regression coefficients. The sample sizes are weighted to correct for overrepresentation and vary from 881 to 1031. Model III tests the effects of perceived availability while adjusting for gender, age, marital status, education, employment, place of residence, psychosocial problems, and substance use. Ref. = reference group. *p < .05; **p < .001

Modifying role of socio-demographics, psychosocial problems, and substance use in the effects of perceived availability on gambling severity

The models in Tables 5 use linear regression to estimate the interaction effects of perceived availability and selected covariates on problem gambling severity. Separate models were created for each interaction, resulting in a total of five interaction models. Models 1 through 3 estimate the interaction between perceived availability and each of the selected sociodemographic variables. Models 4 and 5 estimate the interaction of perceived availability, first with psychosocial problems, and then with substance use. Each model controls for the main effects of the variables. The models in Table 5 indicate that age, gender, place of residence, and psychosocial problems significantly interacted with perceived availability to influence problem gambling severity.

In Model I of Table 5, older (b = 1.14) and middle-aged (b = 0.82) adults who perceived gambling to be too widely available had higher problem gambling severity scores than did young adults who did not. Interestingly, Model II shows that problem gambling severity is 1.14 times higher in males who perceived gambling as not too widely available than in females (b = -1.14) who perceived gambling to be too widely available. Furthermore, Model III indicates that adults who live in Southern Alberta and perceived gambling to be too widely available had higher problem gambling severity scores than those who did not and live in the Northern (b = -1.58), Edmonton (b = -2.21), and Calgary areas (b = -1.30).

Table 5. Regression coefficients showing modifying effects of socio-demographics, psychosocial problems, and substance use relationship between perceived availability and problem gambling severity

Variable	*b*	95% CI	
MODEL I			
Perceived availability			
Too widely available	0.86**	0.40	1.32
Not too widely available (*Ref.*)			
Age groups			
Middle age adults	-0.13	-0.55	0.30
Older adults	-0.63	-1.48	0.22
Young adults (*Ref.*)			
Perceived availability*Age			
*Too widely available*Middle age*	*0.82**	*0.19*	*1.46*
*Too widely available*Older adults*	*1.14**	*0.01*	*2.28*
MODEL II			
Perceived availability			
Too widely available	1.86**	1.45	2.26
Not too widely available (*Ref.*)			
Gender			
Female	0.51	0.10	0.93
Male (*Ref.*)			
Perceived availability*Gender			
*Too widely available*Female*	*-1.14***	*-1.75*	*-0.54*
MODEL III			
Perceived availability			
Too widely available	2.98**	1.86	4.09
Not too widely available (*Ref.*)			
Place of residence			
Northern	-0.26	-1.27	0.75
Edmonton area	-0.22	-0.66	1.10
Calgary area	-0.12	-1.00	0.76
Southern (*Ref.*)			
Perceived availability*Residence			
*Too widely available*Northern*	*-1.58**	*-2.97*	*-0.19*
*Too widely available*Edmonton area*	*-2.21***	*-3.42*	*-1.01*
*Too widely available*Calgary area*	*-1.30**	*-2.52*	*-0.08*

Note: The sample sizes are weighted to correct for overrepresentation and vary from 1023 to 1031. NS and unstandardized regression coefficients (***b***) without asterisk indicate non-statistically significant interaction effects. Models I-II test the moderating effects of socio-demographic variables. *Ref.* = reference group. * $p < .05$; ** $p < .001$.

In Model IV (see Table 5 below), problem gambling severity was 2-fold higher in adults who perceived gambling to be too widely available and had psychosocial problems than in those who perceived it not too widely available and had no psychosocial problems. Surprisingly, Model V shows that substance use had no significant interaction effects with perceived availability on problem gambling severity (b = -.589, p = 0.287).

Table 5. Regression coefficients showing modifying effects of socio-demographics, psychosocial problems, and substance use relationship between perceived availability and problem gambling severity (Continued)

Variable			
	b	95% CI	
MODEL IV			
Perceived availability			
Too widely available	0.02	-0.44	0.47
Not too widely available (*Ref.*)			
Psychosocial problems			
Yes	-0.24	-0.77	0.28
No (*Ref.*)			
Perceived availability*Psychosocial problems			
*Too widely available*Yes*	*2.80***	*2.03*	*3.58*
MODEL V			
Perceived availability			
Too widely available	1.47**	1.15	1.79
Not too widely available (*Ref.*)			
Problem with substances			
Yes	1.48**	0.82	2.13
No (*Ref.*)			
Perceived availability*Substances			
*Too widely available*Yes*	*-0.59*	*-1.68*	*0.50*

Note: The sample sizes are weighted to correct for overrepresentation and vary from 1023 to 1031. NS and unstandardized regression coefficients (b) without asterisk indicate non-statistically significant interaction effects. Models IV & V test the moderating effects of psychosocial problems and substance use. *Ref*. = reference group. * p < .05; ** p < .001.

Table 6 presents four regression models that decompose the moderating effects of age, gender, place of residence, and psychosocial problems. These models compare problem gambling severity between adults who perceived gambling to be too widely available and those who did not at each level of the moderating variable. Practically, this analysis enables us to better determine the moderating role of each category of the moderating variable on the effects of perceived availability on problem gambling severity.

Model I of Table 6 shows that too widely available was associated with higher levels of problem gambling severity in older adults (b = 2.004), followed by middle-aged (b = 1.684), and younger (b = 0.860) adults, respectively. Older adults who perceived gambling to be too widely available compared to those who did not had higher problem gambling severity than young and middle-aged adults who had the same perception. Middle-aged adults who perceived gambling to be too widely available also had more gambling problems than did young adults with the same perception.

In Model II, males (b = 1.857) who perceived gambling to be too widely available had higher problem gambling severity scores than females (b = 0.713) of the same perception. Males who perceived gambling to be too widely available more gambling problems than females with the same perception.

For Model III, problem gambling severity was about 3-fold higher in adults who perceived gambling as too widely available and live in Southern Alberta, 1.7-fold higher for Calgary area adults, 1.4-fold higher for Northern Albertans, and 76.2% higher for Edmonton area adults. Southern Albertans who perceived gambling to be too widely available had, respectively, 2.2-fold and 1.6-fold higher problem gambling severity than adults of the same perception and living in Edmonton and Northern areas.

Table 6. Decomposition regression analysis on the effects of perceived availability on problem gambling severity, at each level of age, gender, place of residence, and for each depressive group

Variable	Perceived gambling too widely available
	b
MODEL I	
Age groups	
Young adults	0.860**
Middle-aged adults	1.684**
Older adults	2.004**
MODEL II	
Gender	
Female	0.713*
Male	1.857**
MODEL III	
Place of residence	
Northern Alberta	1.395**
Edmonton areas	0.762*
Calgary areas	1.678**
Southern Alberta	2.976**
MODEL IV	
Psychosocial problems	
Yes	2.723**
No	0.763**

Note: The sample sizes are weighted to correct for overrepresentation and vary from 1023 to 1031. The *b* values are unstandardized regression coefficients. Each model examines the effects of perceived availability at each level of a moderator. The referent category for perceived availability is the group that perceived gambling not too widely available. Model I tests the effects of perceived availability for each age group. Model II tests the effects of perceived availability for each gender. Model III tests the effects of perceived availability for each place of residence. Model IV tests the effects of perceived availability for each depressive group.
* $p < .05$; ** $p < .001$

Lastly, in Model IV, adults who had psychosocial problems and perceived gambling to be too widely available had a 2.7-fold increase in problem gambling severity compared to a 76.3% increase for those who did not have psychosocial problems. Problem gambling severity is over twice as high in adults who perceived gambling to be too widely available and had psychosocial problems than in those who had the same perception but had no psychosocial problems.

Joint moderating role of socio-demographics, psychosocial problems, and substance abuse on the effects of perceived availability on problem gambling severity

Table 7 presents three-way interaction models. Four statistically significant effects were found, but the interactions among age, area of residence, and perceived availability, which are also significant, are not presented because of their complexity. Those relationships had no clear pattern.

In Model I, gender, age, and perceived availability had significant interaction effects on problem gambling severity ($p = 0.015$). Problem gambling was higher in older females who perceived gambling to be too widely available than in young males who did not ($b = 2.92$). Similarly, middle-aged females who perceived gambling to be too widely available had higher problem gambling severity scores than did young males who did not ($b = 1.02$).

For Model II, significant interactions were found between perceived availability, gender, and place of residence ($p < 0.001$). This model also shows that problem gambling severity was higher in females in Northern Alberta ($b = 4.54$) and Edmonton areas ($b = 2.63$) who perceived gambling to be too widely available than in Southern Albertan males who did not. On the other hand, Calgary area females who perceived gambling to be too widely available did not differ from Southern Albertan males who perceived gambling as not too widely available in their problem gambling severity scores.

Table 7. A three-way joint modifying effects of socio-demographics, psychosocial problems, and substance use on the relationship between perceived availability and problem gambling severity

Variable	*B*	95% CI	
MODEL I			
Perceived availability			
Too widely available	1.64**	1.06	2.21
Not too widely available (*Ref.*)			
Age groups			
Middle age adults	-0.02	-0.56	0.52
Older adults	-0.09	-1.30	1.12
Young adults (*Ref.*)			
Gender			
Female	0.76*	0.16	1.36
Male (*Ref.*)			
Perceived availability*Age*Gender			
*Too widely available*Middle age*Female*	*1.02*	*-0.27*	*2.31*
*Too widely available*Older adults*Female*	*2.92**	*0.63*	*5.21*
MODEL II			
Perceived availability			
Too widely available	4.61**	3.13	6.08
Not too widely available (*Ref.*)			
Gender			
Female	0.26	-1.36	1.89
Male (*Ref.*)			
Place of residence			
Northern	-0.19	-1.51	1.13
Edmonton area	0.05	-1.11	1.22
Calgary area	-0.18	-1.34	0.97
Southern (*Ref.*)			
Perceived availability*Residence*Gender			
*Too widely available*Northern*Female*	*4.54***	*1.78*	*7.31*
*Too widely available*Edmonton area*Female*	*2.63**	*0.23*	*5.02*
*Too widely available*Calgary area*Female*	*2.26*	*-0.17*	*4.68*

Note: Sample sizes are weighted to correct for overrepresentation and vary from 1023 to 1031. The b values are unstandardized regression coefficients. Model I tests the joint moderating effects of gender and age on the relationship between perceived availability and problem gambling severity. Model II tests the joint moderating effects of gender and place of residence on the relationship between perceived availability and problem gambling severity. Unstandardized regression coefficients without asterisk indicate non-statistically significant interaction effects. Note that since the focus of this analysis is on the second order interaction effects, we did not report the first-order interaction effects (two-way interaction terms are not included in this table). *Ref.* = reference group.* $p < .05$; ** $p < .001$

Finally, Model III shows significant interactions among perceived availability, gender, and psychosocial problems ($p = 0.025$). In this model, females who perceived gambling to be too widely available and had psychosocial problems had 1.6-fold ($b = -1.60$) lower problem gambling severity scores than males who perceived gambling as not too widely available and did not have psychosocial problems.

Table 7. Three-way joint modifying effects of socio-demographics, psychosocial problems, and substance use on the relationship between perceived availability and problem gambling severity (Continued)

Variable			
	b	95% CI	
MODEL III			
Perceived availability			
Too widely available	1.13**	0.70	1.56
Not too widely available (*Ref.*)			
Gender			
Female	0.47	0.03	0.91
Male (*Ref.*)			
Psychosocial problems			
Yes	0.252	-0.46	0.97
No (*Ref.*)			
Perceived availability*Psychosocial problems*Gender			
*Too widely available*Yes*Female*	*-1.60*	*-3.00*	*-0.200*

Note: Sample sizes are weighted to correct for overrepresentation and vary from 1023 to 1031. The b values are unstandardized regression coefficients. Model III tests the joint moderating effects of gender and psychosocial problems on the relationship between perceived availability and problem gambling severity. Unstandardized regression coefficients without asterisk indicate non-statistically significant interaction effects. Note that since the focus of this analysis is on the second order interaction effects, we did not report the first-order interaction effects (two-way interaction terms are not included in this table). *Ref.* = reference group.* $p < .05$; ** $p < .001$

The models in Table 8 decompose or break down the joint moderating effects of age, gender, place of residence, and psychosocial problems. In Model I, the perception that gambling was too widely available was strongly associated with higher problem gambling severity scores in older females (b = 2.361) and in middle-aged males (b = 2.195). In addition, the perception that gambling was too widely available increases the likelihood of higher problem gambling severity scores for middle-aged females (b = 1.127) and young males (b = 1.637), but not for young females ($p > 0.05$) and older males ($p > 0.05$).

Model II shows that the perception that gambling was too widely available increases problem gambling severity scores by 1.74-fold and by 91% for females in Northern Alberta and Calgary areas, but had no significant influence on females in the Southern Alberta (p = 0.277) and Edmonton areas (p = 0.745).

Section two of Model II indicates that males who live in Southern Alberta had more gambling problems (b = 4.609) when they perceived gambling to be too widely available compared to their counterparts in Calgary (b = 2.371), Edmonton (b = 1.219), and Northern (b = 0.918) areas. This model also shows that among males who perceive gambling as too widely available, problem gambling severity increased in all four residential areas in Alberta, and more so in the south. For females who perceived gambling was too widely available, a similar effect was only evident in Calgary and Northern areas.

Lastly, Model III shows that the perception that gambling was too widely available was associated with a 1.6-fold increase in problem gambling severity for females who had psychosocial problems, but not for those without such problems. For males, the perception that gambling was too widely available increases problem gambling severity scores in both those with (b =4.057) and without (b =1.131) psychosocial problems, but more strongly in the former.

Table 8. Regression coefficients examining the effects of perceived availability on problem gambling severity, at each level of age, place of residence, for each gender, and depressive group

	Perceived gambling too widely available	Perceived gambling too widely available
	Females	Males
	b	*b*
MODEL I		
Age groups		
Young	-0.452	1.637**
Middle	1.127**	2.195**
Older	2.361**	1.534
MODEL II		
Place of residence		
Northern Alberta	1.745*	0.918*
Edmonton areas	0.129	1.219**
Calgary areas	0.911*	2.371**
Southern Alberta	0.893	4.609**
MODEL III		
Psychosocial problems		
Yes	1.571*	4.057**
No	-0.243	1.131**

Note: The sample sizes are weighted to correct for overrepresentation and vary from 1023 to 1031. Model I tests the effects of perceived availability for each level of gender and age. Model II tests the effects of perceived availability for gender and place of residence. Model II tests the effects of perceived availability for gender and psychosocial problems. Reported b values are unstandardized regression coefficients, and those without asterisk are not significant. * $p < .05$; ** $p < .001$.

Discussion

Our study contributes to the literature by identifying strong correlational effects of perceived gambling availability on problem gambling severity among adults in the general population. Research on alcohol use has reported that actual and perceived availability of alcohol outlets tends to influence the prevalence of problem drinking in the general population (Kuntsche et al., 2008a; Paschall et al., 2012; Rabow, Schwartz, Stevens, & Watts, 1982; Stanley et al., 2011). Perceived availability has generally shown a stronger association with problem drinking behaviour than objectively measured availability. Based on this evidence, we predict perceptions of gambling availability may be more important than actual exposure in explaining individual- and population-level differences in problem gambling.

We want to point out that most research on the relationship between gambling availability and gambling behaviour has placed more emphasis on objectively measured indicators of gambling availability (Abbott et al., 2014; Barratt et al., 2014; LaPlante & Shaffer, 2007; Storer et al., 2009; Vasiliadis et al., 2013; Welte et al., 2009; Williams et al., 2012). Our study expands this literature and looks more specifically at how perceptions of gambling availability influence problem gambling severity and identifies factors that moderate this influence. We found that adults who perceived gambling to be too widely available compared to those who do not had higher problem gambling severity scores even after controlling for other variables. For example, when sociodemographic characteristics, psychosocial problems, and substance use were controlled for, adults who perceived gambling to be too widely available had 1.4 times higher problem gambling severity scores. This finding contradicts a previous study that investigated the relationship between perceived availability and problem gambling (Wickwire et al., 2007). Those authors did not find a significant relationship. However, the contradiction may be explained in the following way.

First, participants in the Wickwire et al. (2007) study were college students, whereas ours were a sample from the general population. Studies have shown differences between students and the general population in the characteristics that influence problem gambling (Adams et al., 2007; Nowak & Aloe, 2014; Williams et al., 2012). In addition, the difference between our findings and that of Wickwire et al. may be related to how perceived gambling availability was defined. While Wickwire et al's. (2007) study focused on the perception of lottery products, we analyzed data from a range of gambling activities (Williams et al., 2011). Hence, it is possible that the perceived availability can be a risk factor for problem gambling if broadly conceptualized, as in our study. Future studies should examine how different conceptualizations of gambling availability might explain why some individuals experience higher levels of gambling problems when exposed to gambling availability.

We propose a basic explanation for why perception of gambling availability may be an important determinant of problem gambling severity. It is our belief that adults who perceived gambling to be too widely available may have more information about gambling products in their community, where to access them, and the promotional offers encouraging them to gamble. Such knowledge and awareness could induce these adults to gamble more than they can manage. This explanation is supported in the alcohol literature that found people who perceived alcoholic beverages to be widely available drink more heavily than those with less knowledge (Kuntsche et al., 2008; Stanley et al., 2011; Warren et al., 2015).

Another key finding is that several individual-level factors were found to moderate the effects of perceived availability, including age. Individuals aged 65 years or older, reported the highest levels of problematic gambling when they perceived that gambling is too widely available. We further noted that the effects of perception decrease with decreasing age. These findings parallel that of Welte et al. (2009) who found that older individuals experience higher levels of gambling problems when they live in areas that are densely populated with gambling opportunities compared to those that are younger. In addition, older adults sometimes gamble to cope with feelings of social isolation and loneliness (Shoyleva & Johnson, 2011; Silverstein & Parker, 2002; Tira, Jackson, & Tomnay, 2014; Toepoel, 2013). On this basis, we speculate that gambling severity was higher in older adults who perceived gambling to be too widely available because they seek out gambling to relieve feelings of boredom and isolation (Clarke et al., 2006). This speculation also fits with studies that show recently arrived immigrants who feel isolated are more likely to engage in gambling and experience gambling problems (Canale et al., 2017; Petry, Armentano, Kuoch, Norinth, & Smith, 2003; Wilson, Salas-Wright, Vaughn, & Maynard, 2015).

We found evidence of a moderating effect for gender. Higher levels of problem gambling severity were observed in males who perceived gambling to be too widely available than in females with the same perception. Gender differences may explain this finding. Males have generally been found to experience more gambling problems than females when exposed to gambling opportunities (Dowling et al., 2017; Johansson, Grant, Kim, Odlaug, & Götestam, 2009; Potenza et al., 2001; Welte, Barnes, Wieczorek, Tidwell, & Parker, 2001; Williams et al., 2015; Williams et al., 2012). From the above evidence, it seems that males in our study were more reactive to perceptions of gambling availability compared to females. If this is the case, then as we have reported, perception of availability might serve as a stronger cue to problematic gambling-related behaviour for males than for females.

Furthermore, the geographical area where one lives served as a significant moderator in explaining gambling severity differences between adults who perceived availability to be too widely available and those who did not. We found that Southern Albertans who perceive gambling to be too widely available had 3-fold higher problem gambling severity than adults of the same perception who lived in other parts of the province. Interestingly, problem gambling severity levels decreased as residential locations change from the south to the north. Several studies of problem gambling have shown that prevalence rates tend to be higher in areas with more gambling opportunities (Gilliland & Ross, 2005; Rush et al., 2007; Wardle, Keily, Astbury, & Reith, 2014). However, the concentration of gambling opportunities is unlikely to explain the observed geographical differences in the association between perceived availability and problem gambling severity, since EGMs and other wagering products are widely available in all the four geographical locations (McClure, 2015; Williams et al., 2011, 2012). Therefore, we recommend that future research investigates the reasons why problem gambling severity and perceptions of availability might vary by place of residence.

By considering the psychosocial characteristics of the subjects, we identified that the perception that gambling was too widely available was associated with substantially higher levels of problem gambling severity in adults who frequently experience psychosocial problems. Psychosocial problems doubles problem gambling severity scores in adults who perceived gambling to be too widely available. This finding is consistent with previous studies that have reported more gambling problems in adults with mood disorders (Beaudidin & Cox, 1999; Blaszczynski & Nower, 2002; Clarke, 2006; Currie et al., 2006; Dowling, Cowlishaw, Jackson, Merkouris, Francis, & Christensen, 2015; Dowling et al., 2017; Gupta & Derevensky, 1998; Johansson et al., 2009; Petry, 2005). Depressed adults may be more at risk for problem gambling when they perceive gambling to be too widely available because such a perception might encourage frequent gambling episodes as a coping mechanism for emotional problems.

Lastly, our findings provide support for a joint moderating effect. Both the three-way regression models and its follow-up decomposition analyses showed that gender interacts with age, places of residence, and substance use problems to influence the perception of availability on gambling severity. There is limited literature on the relationship between gambling availability and behaviour at the intersection of multiple moderating variables (Barratt et al., 2014; Storer et al., 2009; Vasiliadis et al., 2013; Volberg, 1994; Welte et al., 2007; Welte, 2004; Welte et al., 2009; Wickwire et al., 2007).

The effect of joint moderating variables is illustrated where higher problem gambling severity was observed in older females when age and gender were jointly included in the regression models as moderators. This same analysis showed that for males, the perception that gambling was too widely available had a stronger impact on problem gambling severity in middle-aged adults. Insights into these findings come from our cross-tabulation analyses that showed more females reporting higher problem gambling severity scores in their later years when they perceived gambling was too widely available, while males did so in their middle age. We are not aware of any study that has investigated the relationship between perceived availability and problem gambling severity moderated by both age and gender (Welte et al., 2009). Therefore, our findings provide new insights into the possible joint moderating effects of age and gender on the relationship between perceived availability and problem gambling severity.

We observed earlier that perceived availability has a stronger influence on problem gambling severity among adults living in Southern Alberta. However, our three-way decomposition model showed that this effect is confined to males in Southern Alberta, but not for females. We further noted that for females, the perceived availability was too widely available was associated with higher problem gambling scores only among those living in the Calgary area and in Northern Alberta, while its effects on males were evident across the four residential locations. More research is needed to explain why the prevalence rate of problem gambling severity is much higher for Southern Albertan males who perceived gambling was too widely available than for females with the same perception.

In addition, the three-way decomposition model revealed that having problems with psychosocial problems increases the effects of perceived availability on problem gambling severity more strongly in males than in females. For example, the results showed that if a male perceived gambling to be too widely available and frequently experiences psychosocial problems, he would have about a 200% higher chance of reporting higher problem gambling scores than would a female with the same conditions. Clearly, the results demonstrated that although psychosocial problems were associated with increased problem gambling severity for both males and females who perceived gambling was too widely available, males exhibit greater vulnerability. Petry (2005) and other researchers (Beaudidin & Cox, 1999; Suomi, Dowling, & Jackson, 2014; Turner, Jain, Spence, & Zangeneh, 2008) have found that problem gambling severity is higher in individuals with emotional problems, as gambling is often used as a coping mechanism. Our findings call for an extensive gender-based analysis into this issue.

Implications

The proliferation of legalized gambling opportunities are on the rise in industrialized countries (Storer et al., 2009; Vasiliadis et al., 2013; Volberg, 1994; Welte et al., 2007). One of the key drivers of the expansion of the gambling industry is the economic benefit it provides for governments. Current increases in the public visibility of gambling products and venues appear to have led to increased awareness and knowledge of their availability in the general population. As indicated by our descriptive analysis, close to half of (48.7%) our sample believed that gambling opportunities were too widely available in Alberta in the years 2007 and 2008. These individuals also reported higher levels of problem gambling than those who perceived gambling to be not too widely available. This finding suggests that focussing on perceptions of gambling may be an effective target for interventions.

More specifically, adults who perceived gambling opportunities as too widely available in their community, were to gamble and experience problems with gambling. This finding suggests that educational campaigns need to inform the public with intervention options. Additionally, perceived availability had a strong effect on problem gambling in certain populations such as males, older adults, and persons who have psychosocial problems. Educational campaigns can feature these groups. Finally, the higher levels of gambling problems seen in adults who have psychosocial problems and perceived that gambling was too widely available may use gambling to cope with negative emotions possibly resulting in gambling problems.

Additionally, population level interventions for problem gambling have in the past two decades targeted the objective gambling environment (Blaszczynski, Ladouceur, & Shaffer, 2004b; Dickson, Derevensky, & Gupta, 2004). These include laws that limit access to gambling by putting a cap on the number of casino and non-casino EGM venues allowed in a geographic area, restricting the operating hours of gambling venues with EGMs, and age restrictions (Gainsbury, Blankers, et al., 2014). These interventions, which prevent problem gambling by influencing the actual gambling environment, have not been completely effective (Gainsbury et al., 2013; Shaffer, Didnato, LaBrie, Kidman, & LaPlante, 2005).

A complementary intervention would be to target the subjective appraisal and perceptions of the gambling environment. Population-level gambling harm could be reduced with interventions that seek to reduce perceptions of the availability of gambling products, and this could be done by reducing or restricting the advertising of gambling opportunities to the general public. This public health policy is likely to have an impact on the prevalence of problem gambling as research indicates perception drives a significant amount of behaviour (McCormack et al., 2004).

Our study expanded the scope of the exposure hypothesis by demonstrating the need to consider perception as a measure of gambling exposure. At present, the hypothesis focuses on only objective measures of gambling exposure such as the density and proximity of gambling venues, linking these measures to gambling harm (Abbott, 2006; LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012). We found that perceived exposure increased problem gambling severity by 1.4 times even after controlling for mediating variables. In contrast, the objective gambling exposure literature has mostly found a variable relationship between availability and gambling harm (Abbott, 2006; LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012).

Although perception and objective measures are thought to be similar measures of the same construct (Caspi, Kawachi, Subramanian, Adamkiewicz, & Sorensen, 2012; McGinn, Evenson, Herring, Huston, & Rodriguez, 2007), our results suggests that they may differ substantially in their effects. One unpublished study using perceptual and objective measures of gambling exposure found mixed results (Ofori, Christensen, Awosoga, Lee, & Jackson, in preparation). Those authors found a stronger association between perceived exposure and gambling harm than between actual exposure and harm. This evidence and others (Ball et al., 2008; Hoehner, Brennan Ramirez, Elliott, Handy, & Brownson, 2005; Orstad, McDidnough, Stapleton, Altincekic, & Troped, 2017) supports our argument that perceived and objective exposure measures are different, and for that reason, a perceptual measure of gambling exposure should be considered in the exposure hypothesis.

Strengths, limitations, and conclusions

Our study has a number of strengths. This is one of the few studies that examines perceived gambling availability on the prevalence of problem gambling severity in the adult population. Our findings extend the literature providing insights into the extent to which perceptual processes regarding the availability of gambling opportunities influence gambling behaviours. In addition, this study is the first to determine the moderating roles of sociodemographic, psychosocial, and substance use characteristics on perceived availability and problem gambling severity. Another strength of the study is that the data came from four separate Albertan areas.

There are a few limitations to this study. As a major limitation, the cell sizes of some of the categorical variables were highly uneven. For example, only 20% of respondents reported psychosocial problems. However, we attempted to correct the uneven distribution of the sample by using weighted samples in our analyses. Lastly, the dependent variable, problem gambling severity, was not evenly distributed. However, these effects are likely to be minimal because of the large size of our sample. Furthermore, since our study was cross-sectional, we cannot infer any causal effects, despite the observed strong relationship between perceived availability and gambling severity. As subjective assumptions are inherently biased, this also is a limitation.

In conclusion, the findings of this study demonstrate that the prevalence of problem gambling severity is a function of perceived gambling availability. This suggests that restricting gambling advertising might reduce the rate at which adults gamble and experience problems. Further, the effect of perception is partially dependent on a number of individual-level characteristics and psychosocial problems. Perceptions of gambling availability has the potential to influence how easy or difficult it is to access gambling products. In turn, this can influence the extent to which people engage in gambling and experience problems. We suggest that future research should examine the relative effects of perceived and actual gambling availability on gambling severity in both adolescents and adults (Suomi et al., 2014).

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Chapter Five: A composite measure of gambling exposure: Availability, accessibility or both?

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Abstract

Measures of availability and accessibility are often used separately or interchangeably to measure gambling opportunities exposure. This study examined the advantages of measuring gambling exposure with availability, accessibility, and a composite measure. Logistic and Poisson regression analyses were performed to determine the relative importance of these exposure measures in predicting problem gambling behaviour using data from the 2008 and 2009 Socioeconomic Impact and Gambling Survey in Alberta (SEIGA). The composite measure of gambling exposure strongly predicted both moderate-risk and problem gambling (MRPG) risk and severity of problem gambling better than the prediction by the availability or accessibility measures. The results demonstrate that individual differences in problem gambling behaviour are better predicted by the composite measure of exposure.

Keywords: gambling availability, gambling accessibility, composite exposure measure, problem gambling, Alberta

Introduction

Exposure to gambling is a well-documented risk factor for problem gambling (St-Pierre, Walker, Derevensky, & Gupta, 2014; Storer, Abbott, & Stubbs, 2009; Vasiliadis, Jackson, Christensen, & Francis, 2013). Exposure has been measured in many ways in the literature. Some researchers have measured exposure in terms of the number of gambling venues and/or the number of machines available (Abbott, 2006; St-Pierre et al., 2014; Storer et al., 2009; Vasiliadis et al., 2013). Others have assessed the distance between residences and the nearest gambling venue (Abbott, 2006; St-Pierre et al., 2014; Storer et al., 2009; Vasiliadis et al., 2013). The aim of this study was to assess the relative importance of the gambling availability measures, gambling accessibility measure, and a composite measure of both that predicts problem gambling behaviour among adults.

Although internet gambling has increased gambling accessibility, terrestrial gambling has the highest number of gambling patrons. Between 1% and 13% of gambling occurs online (Canale, Griffiths, Vieno, Siciliano, & Molinaro, 2016; Gainsbury et al., 2015), compared to 80% for terrestrial gambling (Abbott, Volberg, & Rönnberg, 2004; Gainsbury, Russell, et al., 2014; Mason, 2008; Wardle, Moody, Griffiths, Orford, & Volberg, 2011; Williams et al., 2012). Availability measures of exposure such as the number of gambling venues and the number of machines per venue have been found to predict problem gambling behaviour in the general population. In Australia and New Zealand, a meta-analysis found that problem gambling rates increased by an average of 8% in local areas for each additional gambling venue (Storer et al., 2009). A review by Williams et al. (2012) also showed that the prevalence of problem gambling was likely to increase by an average of 1% to 3% when a new casino is opened in a community.

These empirical studies demonstrate that availability measures such as the density of casinos and the per capita number of machines influence problem gambling rates.

Accessibility research has linked the proximity of a gambler to a gambling venue to problem gambling rates (Abbott, 2006; Williams et al., 2012). In Australia, Canada, and the United States, gamblers who live within 15km of a gambling venue report more problems than those who live further away (Pearce, Mason, Hiscock, & Day, 2008; Philander, 2019; Robitaille & Herjean, 2008; Sévigny, Ladouceur, Jacques, & Cantinotti, 2008; Welte, Wieczorek, Barnes, Tidwell, & Hoffman, 2004; Young, Markham, & Doran, 2012). Two processes may explain the proximity and prevalence association. Some problem gamblers might relocate to live closer to gambling venues because of their higher interest levels in the activity. Alternatively, living closer to gambling venues might lead to greater gambling involvement and problem gambling. Similarly, research from the United Kingdom indicates that problem gambling prevalence is higher in areas with highly concentrated gambling venues than in areas with fewer gambling venues (Volberg, 2000; Williams et al., 2012). An Australian qualitative study found that casino workers have higher problem gambling rates (Hing & Nisbet, 2010), presumably because of their greater contact with gambling.

However, few studies have examined the combined association of availability and accessibility with problem gambling. A notable exception was the study by Welte, Barnes, Tidwell, Hoffman, and Wieczorek (2016) who found that living within 50 km of six or more casinos increased problem gambling rates. However, that study had two important limitations. Their analysis did not consider the density of gaming machines per casino. Additionally, the authors did not assess exposure effects with the combined measures of availability and accessibility. Rather, they statistically assessed the effects of casino density at different distances from a casino with problem gambling. Their findings, though informative, are comparable to the findings of other analyses that examine the effect of exposure using separate measures (St-Pierre et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012). Therefore, the combined influence of availability and accessibility remains unknown.

Existing composite measure of exposure to gambling opportunities

Shaffer, LaBrie, and LaPlante (2004) proposed the Regional Exposure Model (REM) to assess how accessibility and duration of exposure influence problem gambling. Shaffer et al. (2004) suggest that the presence of gambling venues influences community problem gambling rates following a bitonic function: initially new gambling venues increase problematic gambling but over time, the influence of the venues decreases. Research appears to support the REM hypothesis. Increased gambling opportunities, referred to as *emerging gambling areas*, almost always lead to an increase in the prevalence of problem gambling (Abbott, Stone, Billi, & Yeung, 2016; Philander, 2019; St-Pierre et al., 2014; Storer et al., 2009; Vasiliadis et al., 2013; William Welte, Barnes, Tidwell, & Hoffman, 2009). Similarly, populations with access to gambling venues for many years, referred to as *mature gambling areas*, appear to show declining problem gambling rates (Abbott, 2006; Vasiliadis et al., 2013; Volberg, 1994; Williams et al., 2012). Although the REM has been found to predict problem gambling behaviour in different populations, these associations are relatively weak (St-Pierre et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012).

The present study

One major limitation of the REM is that it does not include a measure of accessibility such as the distance between residence and the nearest gambling venue (LaPlante & Shaffer, 2007; Shaffer et al., 2004). Our study addressed this limitation by proposing a method that combines availability and accessibility measures to estimate exposure to gambling opportunities for individuals within populations. The proposed method, which is explained in detail below, suggests that exposure increases as the number of gambling venues and machine numbers increase, and as the distance travelled to gambling venues becomes shorter. Our research question is: How does availability, accessibility, and a composite measure of gambling exposure explain the risk and severity of problem gambling in emerging and mature gambling areas?

Methods

Study setting and population

This study is a secondary analysis of data from the 2008 and 2009 SEIGA. SEIGA is a population-based survey that collected demographic and gambling data. Questionnaires were administered via telephone to 15,166 randomly surveyed adults aged 18 years and older in Southern, Calgary, Central, Edmonton, and Northern areas of Alberta, Canada (Williams, Belanger, & Arthur, 2011). Two surveys were conducted per year: one in 2008 that yielded a sample of 3001 and 4,512 people, and the other in 2009, with a sample of 1,004 and 3,624 people. Their average response rates were 24.4% for the 2008 surveys and 28.6% for the 2009 surveys. After exclusion of respondents with missing data, the final sample for our various analyses was 5,033 adults. All respondents included in the analysis participated in gambling activities in the past year. Details of the SEIGA survey are described elsewhere by the original investigators (Williams et al., 2011).

Measures

Demographic characteristics. SEIGA collected data on respondents' demographic characteristics: age, gender, marital status, education, occupational status, and income (Williams et al., 2011). These characteristics were included in the analysis as covariates, as they have been associated with both the risk and severity of problem gambling (Welte, Barnes, Tidwell, & Wieczorek, 2017; Williams et al., 2012). All the demographic variables of this study except income comprised categorical data.

Problem gambling. SEIGA assessed problem gambling among respondents using the Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001). The PGSI consists of nine items that are rated on 4-point scale, with response options ranging from never (0) to almost always (3). Scores range from 0 to 27 and can be used to categorize gambling severity across the continuum of risk: non-problem gambling (scores of 0), low-risk gambling (scores of 1–2), moderate-risk gambling (scores of 3–7), and problem gambling (scores of 8 or more). The PGSI has shown very good internal consistency, validity, sensitivity, and specificity in previous research. The moderate risk and problem gamblers were combined, as has been done in a number of studies (Dowling et al., 2018) due to the small numbers in the problem gambling category in particular, and will be referred to as the MRPG risk group. Additionally, problem gambling severity was separately assessed using PGSI scores of 1 or greater, with higher scores indicating greater severity.

Availability measure of exposure. To measure gambling exposure based on the number of gambling venues and machines, the number of casinos was divided by the number of slot machines (henceforth slots), and then divided by the sample of an area and multiplied by a 50% weighted score. This measure will be referred to as 'availability,' and the formula for estimating the availability exposure score is as follows:

Availability = [(number of gambling machines / number of venues) / sample per area] * 50% weighted score of a study area

Further, we applied 50% weighting to each study area to correct for possible oversampling in the emerging gambling areas (Williams et al., 2011). This was achieved by dividing 50 by the percentage value of the number of respondents per area**.** For example, to calculate a 50% frequency weight score for respondents from the same study area, we divided 50 by the percentage of the sample of that area. Table 9 provides details of the equation and how it was used to estimate scores of gambling exposure from two availability indicators (*i.e., the number of gambling machines and the number of gambling venues per area*).

Table 9. Regression Estimating gambling availability scores for five geographical areas of Alberta

		Study Areas				
		South	***Calgary***	***Edmonton***	***North***	***Central***
1	Sample of study area	836	874	655	1624	1044
2	50% weighting	3.010	2.857	3.842	1.550	2.410
3	Number of slots	1231	4586	5073	1296	849
4	Number of casinos	4	7	8	5	3
5	Estimated availability scores	1.108	2.158	3.720	0.247	0.653

As shown in Table 9 above, the estimated availability scores range from a minimum of 0.247 to a maximum of 3.720, with higher scores indicating greater exposure to gambling opportunities. All respondents within a study area were assigned the same study area availability score.

Table 10 shows that the distribution of the PGSI scores is almost the same across the five SEIGA survey areas. For example, almost the same percentage of respondents in the five areas had a PGSI score of 0 (ranging from 71.1% to 78.1%) and a score of 8 or higher (ranging from 1.8% to 3%).

Table 10. PGSI scores by respondents' residential areas

	SEIGA survey areas				
	South (N = 836)	Calgary (N = 874)	Central (N = 1044)	Edmonton (N = 655)	North (N = 1624)
PGSI Scores	N (%)				
0	635 (76.0)	660 (75.5)	803 (76.9)	466 (71.1)	1268 (78.1)
1	83 (9.9)	98 (11.2)	114 (10.9)	79 (12.1)	160 (9.9)
2	30 (3.6)	38 (4.3)	28 (2.7)	38 (5.8)	70 (4.3)
3	27 (3.2)	29 (3.3)	28 (2.7)	22 (3.4)	50 (3.1)
4	12 (1.4)	10 (1.1)	17 (1.6)	15 (2.3)	18 (1.1)
5	10 (1.2)	9 (1.0)	12 (1.1)	6 (0.9)	14 (0.9)
6	6 (0.7)	8 (0.9)	6 (0.6)	8 (1.2)	12 (0.7)
7	4 (0.5)	6 (0.7)	5 (0.5)	3 (0.5)	3 (0.2)
8 or more	29 (3.0)	16 (1.8)	31 (3.0)	18 (2.7)	29 (1.8)

Accessibility measure of exposure. We also estimated *accessibility* based on the distance respondents must travel to the nearest casino from their homes (Williams et al., 2011). Postal addresses of respondents were used to determine their travel distances, which was measured in kilometers. The northern, central, and southern areas were more rural, and such their populations were widely dispersed compared to the Calgary and Edmonton areas.

As shown in Table 11, respondents from the southern, central, and northern Albertan areas had longer travel distances to the nearest casino compared to those from the Calgary and Edmonton metropolitan areas. These travel distance differences between the SEIGA areas were corrected for by having the same size for the study areas using a normalized version of the 50% weighting. The 50% weighting was normalized by dividing the scores by the mean score.

Table 11. Mean travel distance to the nearest casino by respondents' residential areas

	Study areas				
	South (N = 836)	Calgary (N = 874)	Central (N = 1044)	Edmonton (N = 655)	North (N = 1624)
	Mean (SD)				
Travel distance to the nearest casino (in km)	20.7 (31.8)	19.2 (26.3)	46.8 (49.4)	18.1 (26.1)	30.0 (50.5)

When the normalized weight was applied to the analysis, it gave the study areas the same sample size, as shown in Table 12. Another advantage was that the regression coefficients and odds ratios reported in the results section are not inflated when the sample sizes are equal across the SEGA study areas (see Tables 1-6 in Appendix E).

Table 12. Unweighted and normalized sample sizes of the SAGE study areas

	South	Calgary	Edmonton	North	Central	Total sample
Unweighted sample	836	874	655	1624	1044	5033
Normalized weighted sample	1007	1007	1007	1007	1007	5035

The estimated distances from home to the nearest casino for the entire SEIGA respondents are presented in Table 13. About 80% of the SEIGA respondents lived between 0.1km and 50km away from a casino, and only 6.4% lived 100 km or more from a casino. Exposure increases as the distance travelled becomes shorter.

Table 13. Distances travelled by respondents from home to the nearest casino in Alberta

Distance from home to nearest casino (km)	Cumulative % of sample within the ranges
0.1km to 5.0km	27.3
5.1km to 10km	49.3
10.1km to 15km	56.8
15.1km to 20km	61.2
20.1km to 25km	65.6
25.1km to 30km	67.6
30.1km to 35km	70.7
35.1km to 40km	73.4
40.1km to 45km	77.0
45.1km to 50km	80.3
50.1km to 55km	81.6
55.1km to 60km	82.4
60.1km to 65km	84.8
65.1km to 70km	86.2
70.1km to 75km	86.9

75.1km to 80km	88.9
80.1km to 85km	90.7
85.1km to 90km	92.4
90.1km to 95km	93.6
95.1km to 100km	94.1
100.1km or more	100

Composite measure of exposure. We used availability measure of exposure divided by accessibility measure of exposure to create a composite measure of exposure. This is illustrated as: $\text{Composite exposure} = \text{Availability}/\text{Accessibility}$

The estimated composite exposure scores for the respondents are shown in Table 14. Higher scores indicate greater overall composite exposure to gambling opportunities.

Emerging and mature gaming environments. SEIGA participants came from two gaming environments: emerging and mature areas (Williams et al., 2011). In this study, emerging areas refer to places where casinos had been available for less than three years, whereas mature areas have had casinos for three or more years during the time of the SEIGA survey (Williams et al., 2011).

Data analysis

Structure of the SEIGA data. SEIGA survey collected individual respondents data from five geographic regions (*i.e., Southern, Central, Northern, Calgary, & Edmonton areas*) of the province of Alberta (Williams et al., 2011). Data on the availability measures of exposure were collected for the populations of the five study areas, while the data on the accessibility measure were collected for individuals within each study area (Williams et al., 2011). Since the unit of analysis of this study was at the individual level, data collected at the regional-level were disaggregated to the individual level. For example, the availability data were disaggregated to the individual level by assigning the same score (see Table 9) to individuals from the same study area.

Statistical methods for analyzing count data. The PGSI uses count integers from 0 to 27 to measure problem gambling behaviour in the general population (Ferris & Wynne, 2001). Data from the PGSI are usually highly skewed because of the large proportion of respondents that have a zero score. For example, 76.1% of SEIGA respondents had a zero score on the PGSI, and 23.9% had non-zero scores.

A common analytical approach for the PGSI is to convert responses into categorical data (Abbott & Volberg, 2006; Ferris & Wynne, 2001). For example, responses to the PGSI can be categorized into groups of non-problem gamblers, low-risk gamblers, moderate-risk gamblers, and problem gamblers (Abbott & Volberg, 2006; Ferris & Wynne, 2001). These categories of problem gambling behaviours are typically analyzed with non-parametric statistical techniques such as logistic regression and chi-square (Storer et al., 2009; Vasiliadis et al., 2013; Welte et al., 2016; Welte, 2004; Williams & Volberg, 2010). However, a major problem with this type of analysis is that it does not allow researchers to conduct parametric analyses.

Alternatively, researchers have treated PGSI data as continuous data. However, as previously noted, the PGSI scores are often highly skewed. Different statistical methods have been employed to analyze count data on addictive behaviours with highly skewed distributions (Delucchi & Bostrom, 2004). Some researchers transform such data to make them normal, and treat them as continuous data and analyze the data with conventional least squares statistical methods (Böhning et al., 1999; Famoye & Singh, 2006; Hall, 2000; Lambert, 1992; O'Hara & Kotze, 2010). However, for example, log transformation of the PGSI usually does not make the scores normally distributed (Delucchi & Bostrom, 2004; Hammer & Landau, 1981; Tabachnick & Fidell, 2012; Abbott & Volberg, 2006; Williams et al., 2012).

Another approach is to analyse highly skewed count data using Poisson and negative binomial regression (Lambert, 1992; Ridout et al., 1998; Rodriguez, 2007; Strawderman, Cameron, & Trivedi, 2006). These non-conventional methods have been found to better fit count data with skewness without the need to transform the data (Delucchi & Bostrom, 2004; Fletcher, MacKenzie, & Villouta, 2005; Lambert, 1992).

Data analysis steps. Two separate analyses were performed on the PGSI data. First, a binary logistic regression was used to determine how the measures of availability, accessibility, and the composite measure of exposure differentiate respondents with PGSI scores of 0 to 2 (*non-MRPGs*) from those with scores of 3 and higher (MRPG) (Dowling et al., 2018). Separate logistic regression models were built for each predictor and the outcome variable. This analysis estimates the odds (*called risk of MRPG*) of a gambler being an MRPG versus being a non-MRPG (reference category) as predicted by the measures of exposure.

For the second analysis, the focus was to determine the extent to which the three measures of exposure explain problem gambling *severity* among respondents with a total PGSI score of 1 and greater, as has been done in other studies using a category of '*any risk*' gamblers (Dowling et al., 2019). Poisson regression was used for this analysis, as the non-zero PGSI count data were highly skewed (Famoye & Singh, 2006; Lambert, 1992). Again, separate Poisson models were used to estimate the effects of each measure of exposure. For the first and second analyses, the base regression models do not control for covariates, while the subsequent models control for demographic characteristics of the respondents.

Stata Version 15 (Stata Corp, 2019) was used to analyze the data, and all logistic and Poisson analyses were performed on 50% frequency-weighted normalized data (see Table 12 above). Statistical significance was determined at the 0.05 alpha level (95% confidence interval). The results from the logistic and Poisson regressions are, respectively, presented in odds ratios and in regression coefficients (Famoye & Singh, 2006; Lambert, 1992).

Results

Descriptive characteristics of respondents

A total of 33% (N = 2478) of the data were missing at random due to non-response to the PGSI questions (Williams et a., 2011). Other variables (age = 2.3%; marital status = 0.6%; education = 0.9%; income = 16.9%; employment = 1.0%) used in the analysis had fewer missing data. This missing data leaves a sample of 5,033 for our final analysis. There were no multivariate outliers in all the regression analyses, as checked with the Cook's D. The Cook's scores for the various reported regression models ranged from as low as 0.078 to as high as 0.299.

As shown in Table 14, respondents were more likely to be females (52%), middle-aged (56.2%) adults, married or in a common-law relationship (70.0%), have a post-secondary education (52.7%), be employed (70.9%), have an annual personal income less than $100,000 (78.5%), and live in northern Alberta (32.3%).

Table 14. Descriptive characteristics of respondents

Variables	Unweighted sample	
	N (=5,033)	(%)
Gender		
Female	2618	52.0
Male	2415	48.0
Age groups		
Young adults (*18 to 39 yrs.*)	1531	30.8
Middle-aged adults (*40 to 64 yrs.*)	2801	56.2
Older adults (*65 yrs. and above*)	647	13.0
Marital status		
Single	784	15.6
Married/common law	3554	70.8
Separated	143	2.8
Divorced	306	6.1
Widowed	235	4.7
Education		
High school	2370	47.3
College Diploma	1562	31.2
University degree	1076	21.5
Employment status		
Working	3556	70.9
Not working	1457	29.1
Annual Income		
<$20,000	514	11.7
$20,000	283	6.4
$30,000	473	10.7
$40,000	471	10.7
$50,000	459	10.4
$60,000	381	8.6
$70,000	341	7.7
$80,000	325	7.4
$90,000	214	4.9
≥$100000	948	21.5
Regions of residence in Alberta		
South	836	16.6
Calgary areas	874	17.4
Central areas	655	13.0
Edmonton areas	1624	32.3
North	1044	20.7

Note. Unweighted data presented in the descriptive table. Respondents had 0 or higher PGSI score and a non-zero composite exposure score.

Respondents had a mean PGSI score of 0.80 (SD = 2.4). There were 76.1% non-problem gamblers (n = 3832), 14.7% low-risk gamblers (738), 6.8% moderate-risk gamblers (n = 340), and 2.4% problem gamblers (n = 123) based on respondents PGSI scores (used unweighted data). Non-problem and low-risk gamblers were combined into a category called non-MRPGs, while moderate risk and problem gamblers were combined into a moderate risk and problem gamblers (*MRPGs*) category.

There were 27 casinos with 13,035 slot machines in Alberta at the time of the SEIGA surveys (Williams et al., 2011). Just over 55% of the casinos and 74.1% of the slots were in the Calgary and Edmonton areas (see Table 9). Across study areas, 27.8% of the respondents lived within 5km of a casino, and 70.7% lived below the mean (30.9 km) level. Calgary (M =15.2) and Edmonton (M =15.3) respondents have shorter average travel distances to casinos than residents of other areas.

Scores on the composite exposure measure reflect the number of slot machines per casino and respondents' travel distance to the nearest casino from home. For instance, the composite exposure scores indicate that exposure to gambling opportunities increases as respondents' distance to the nearest casino gets shorter, and the number of slot machines per casino increases. In Table 15, respondents' composite exposure scores ranged from 0.001 to 6.375, with a mean score of 0.158 (SD = 0.30). Three quarters (71.9%) of respondents had scores below or at the mean level. Emerging and mature area respondents, respectively, had mean composite exposure scores of 0.107 (SD = 0.25) and 0.178 (SD = 0.38). A t-test was used to compare the exposure scores between the mature and emerging areas, and they are significantly different from each other ($p < 0.001$).

Table 15. Composite scores for exposure to gambling opportunity

Estimated composite exposure scores			N	Cumulative % of scores
0.001007304	to	0.007300013	500	9.9
0.007309115	to	0.013505442	489	19.7
0.013537899	to	0.024060776	508	29.7
0.024075918	to	0.054728855	511	39.9
0.054784998	to	0.076237516	505	49.9
0.076668236	to	0.106852581	499	59.8
0.107378596	to	0.147503020	504	69.9
0.148245778	to	0.209353937	503	79.9
0.211853632	to	0.354142693	504	89.9
0.354997978	to	3.283731300	507	99.9
5.368929800	to	6.374568470	3	100

Note. Estimated scores here show respondents' level of exposure to gambling opportunities, as measured by measures of availability and accessibility.

Correlation among the three exposure measures

Kendall's tau b was used to test the correlations between the three exposure measures, and all were statistically significant (Table 16). The composite measure is strongly negatively correlated with accessibility (*Kendall's tau b = -0.845*) and weakly positively correlated with availability (*Kendall's tau b = 0.204*). There is a weak negative correlation between availability and accessibility measures (*Kendall's tau b = -0.030*).

Table 16. Kendall's tau b correlations between gambling exposure measures

	Availability	Composite
	Coefficients (p-value)	Coefficients (p-value)
Accessibility	-.030** (0.004)	-.845** (0.001)
Availability	-	.204** (0.001)

Associations of availability, accessibility, and composite measure of exposure with the risk of being an MRPG in the general sample

In Model I of Table 17, the risk of being an MRPG is positively associated with the composite (*OR* = 1.34, 95% *CI* = 1.14, 1.56) and availability (*OR* = 1.06, 95% *CI* = 1.02, 1.10) measures, and negatively with the accessibility measure (*OR* = 0.99, 95% *CI* = 0.99, 1.00). The risk of being an MRPG has a stronger association with the composite exposure than with the two exposure measures. Controlling for demographic characteristics in Model II did not change the results meaningfully.

Table 17. Univariate and multivariate logistic regression of associations of composite, availability, and accessibility exposure measures with MRPG risk in emerging and mature areas combined

	Composite exposure	Availability exposure	Accessibility exposure
Variable	*OR* (95%CI)	*OR* (95%CI)	*OR* (95%CI)
MODEL I			
Exposure measures	1.34** (1.14, 1.56)	1.06** (1.02, 1.10)	0.99*(0.99, 1.00)
MODEL II			
Exposures	1.31**(1.12, 1.55)	1.07*(1.02, 1.12)	0.99*(0.99, 1.00)
Gender			
Female	1.60**(1.44, 1.78)	1.65**(1.49, 1.83)	1.62**(1.47, 1.78)
Male (Ref.)			
Age groups			
Young	0.92 (0.75, 1.12)	0.82*(0.68, 0.99)	0.88 (0.73, 1.05)
Middle	1.16**(1.04, 1.31)	1.07 (0.96, 1.20)	1.12*(1.01, 1.24)
Older (Ref.)			
Marital status			
Married/Common	2.06**(1.53, 2.77)	1.84**(1.40, 2.44)	1.98**(1.52, 2.57)
Separated	1.27 (0.97, 1.66)	1.18 (0.91, 1.52)	1.28*(1.00, 1.63)
Divorced	1.85**(1.28, 2.69)	1.74*(1.23, 2.47)	2.13**(1.54, 2.95)
Widowed	1.84**(1.34, 2.54)	1.73**(1.27, 2.34)	1.87**(1.41, 2.48)
Single (Ref.)			
Education			
Diploma	1.92**(1.67, 2.21)	1.97**(1.73, 2.26)	1.89**(1.67, 2.14)
Degree	1.34**(1.15, 1.55)	1.39**(1.21, 1.61)	1.30**(1.14, 1.48)
<High school (Ref.)			
Occupation			
Working	0.94 (0.83, 1.07)	1.02 (0.91, 1.15)	0.97 (0.86, 1.08)
Not working (Ref.)			
Income	0.94**(0.92, 0.96)	0.94**(0.92, 0.96)	0.93**(0.92, 0.95)

Note. *OR* = odds ratio. A single asterisk (*) means *p-value* $\leq$ 0.05; double asterisks (**) mean *p-value* < 0.001. Ref. = reference category. The outcome variable for the logistic models is dichotomous: non-problem (respondents with PGSI scores of 0 to 2; used as a reference category) and MRPGs (those with PGSI scores of 3 or higher). The analysis was performed on the combined data from emerging and mature areas.

Associations of availability, accessibility, and composite measure of exposure with problem gambling severity in the combined sample

In model I of Table 18 (also see Figure 2 below), problem gambling severity increased as scores on the composite measure increased (*b* = 0.37, 95% *CI* = 0.11, 0.63), and severity rates decreased as accessibility (or travel distance to a casino) decreased (*b* = -0.004, 95% *CI* = -0.01, -0.003). However, severity rates are not associated with the availability measure (*b* = -0.04, 95% *CI* = -0.9, 0.01). The associations remained almost the same in model II after controlling for demographics.

Table 18. Univariate and multivariate Poisson regression of associations of composite, availability, and accessibility exposure measures with problem gambling severity in emerging and mature areas combined

	Composite exposure	Availability exposure	Accessibility exposure
Variable	*b(95%CI)*	*b(95%CI)*	*b(95%CI)*
MODEL I			
Exposure measures	0.37**(0.11, 0.63)	-0.04 (-0.90, 0.01)	-0.004*(-0.01, -0.003)
MODEL II			
Exposures	0.40**(0.13, 0.67)	-0.03 (-0.09, 0.02)	-0.005**(-0.01, -0.004)
Gender			
Female	0.22**(0.08, 0.36)	0.21*(0.07, 0.36)	0.20*(0.06, 0.35)
Male (Ref.)			
Age groups			
Young	0.45**(0.19, 0.71)	0.43**(0.17, 0.69)	0.46**(0.20, 0.72)
Middle	1.00**(0.81, 1.10)	0.95**(0.80, 1.09)	0.96**(0.82, 1.10)
Older (Ref.)			
Marital status			
Married/Common	0.26 (-0.14, 0.65)	0.28 (-0.12, 0.67)	0.20 (-0.20, 0.59)
Separated	-0.24 (-0.60, 0.13)	-0.24 (-0.61, 0.12)	-0.25 (-0.62, 0.11)
Divorced	1.66**(1.10, 2.23)	1.65**(1.08, 2.22)	1.62**(1.05, 2.18)
Widowed	0.87 (0.40, 1.34)	0.86**(0.39, 1.33)	0.83**(0.36, 1.29)
Single (Ref.)			
Education			
Diploma	0.42**(0.24, 0.60)	0.38**(0.20, 0.56)	0.45**(0.27, 0.62)
Degree	-0.02 (-0.20, 0.17)	-0.02 (-0.21, 0.17)	0.06 (-0.13, 0.24)
<High school (Ref.)			
Occupation			

Working	-0.38**(-0.56, -0.21)	-0.37**(-0.54, -0.19)	-0.36**(-0.54, -0.19)
Not working (Ref.)			
Income	-0.12**(-0.14, -0.09)	-0.12**(-0.14, -0.10)	-0.12**(-0.14, -0.10)

Note. *b* = regression coefficients. A single asterisk (*) means p-value < 0.05; double asterisks (**) mean p-value < 0.001. Ref. = reference category. The outcome variable for the Poisson models is problem gambling severity measured with PGSI scores of 1 to 27; it was treated as a continuous variable and higher score indicates greater severity. The analysis was performed on the combined data from emerging and mature gaming areas.

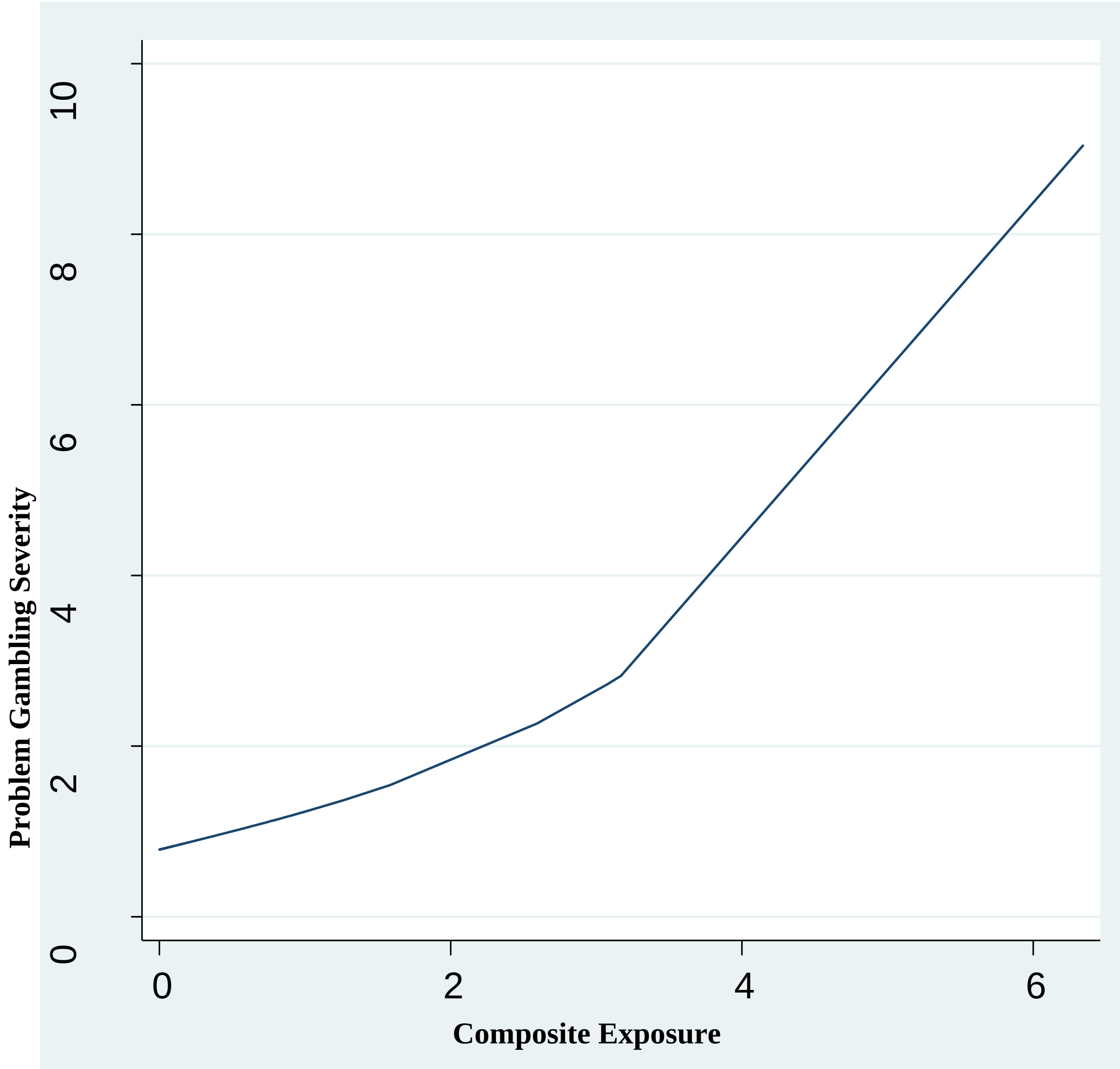

Figure 2: Association between the composite exposure and problem gambling severity. This association is measured in combined samples from emerging and mature areas. This figure illustrates results from the Poisson model in Table 18.

Associations of availability, accessibility, and composite measures of exposure with the risk of being an MRPG separately for respondents in emerging and mature areas

Model I of Table 19 shows that the association between the risk of being an MRPG and the composite exposure is positive among respondents in emerging areas (*OR* = 1.27, 95% *CI* = 0.98, 1.63) and negative among those in mature areas (*OR* = 0.75, 95% *CI* = 0.56, 1.01). In both emerging and mature areas, significant associations are found in Models II (all ps < 0.05) after controlling for demographic characteristics.

Table 19. Univariate and multivariate logistic regression of association between the composite exposure measure and MRPG risk in emerging and mature gaming areas

	Emerging gambling area		Mature gambling area	
	MODEL I	MODEL II	MODEL I	MODEL II
Variable	*OR* (95%CI)	*OR* (95%CI)	*OR* (95%CI)	*OR* (95%CI)
Composite exposure	1.27**(0.98, 1.63)	1.41*(1.07, 1.84)	0.75**(0.56, 1.01)	0.70*(0.49, 1.00)
Demographics				
Gender				
Female		1.30*(1.05, 1.62)		1.72**(1.40, 2.10)
Male (Ref.)				
Age groups				
Young		0.97 (0.64, 1.46)		1.01 (0.71, 1.43)
Middle		1.36*(1.07, 1.73)		1.11 (0.90, 1.38)
Older (Ref.)				
Marital status				
Married/Common		1.7 (0.60, 1.73)		1.02 (0.60, 1.73)
Separated		1.3 (0.53, 1.35)		0.84 (0.53, 1.35)
Divorced		1.2 (0.56, 2.16)		1.10 (0.56, 2.16)
Widowed		0.8 (0.98, 3.05)		1.73 (0.98, 3.05)
Single (Ref.)				
Education				
Diploma		1.96** (1.49, 2.57)		2.44**(1.87, 3.18)
Degree		1.15 (0.84, 1.57)		1.39*(1.05, 1.85)

<High school (Ref.)		
Occupation		
Working	0.94 (0.74, 1.21)	1.05 (0.83, 1.32)
Not working (Ref.)		
Income	0.95*(0.91, 0.99)	0.93**(0.90, 0.96)

Note. *OR* = odds ratio. A single asterisk (*) means p-value < 0.05; double asterisks (**) mean *p-value* < 0.001. Ref. = reference category. The outcome variable for the logistic models is dichotomous: non-problem (respondents with PGSI scores of 0 to 2; used as a reference category) and MRPGs (those with PGSI scores of 3 or higher). The analysis was performed separately for respondents from emerging and mature gaming areas.

Associations of availability, accessibility, and composite measures of exposure with problem gambling severity separately for respondents in emerging and mature gaming areas

Model II of Table 20 (also see Figure 3 below) shows that problem gambling severity in emerging areas increases significantly as scores on the composite exposure measure increase (b = 0.60, 95% CI = 0.04, 1.15) and after controlling for demographic characteristics. In contrast, after controlling for demographics, the severity rates in mature areas decline even as the composite exposure levels increase (b = -0.40, 95% CI = -0.76, -0.04). In emerging areas, the association becomes significant after controlling for demographics.

Table 20. Univariate and multivariate Poisson regression of association between the composite exposure measure and problem gambling severity in emerging and mature areas

	Emerging gambling area		Mature gambling area	
	MODEL I	MODEL II	MODEL I	MODEL II
Variable	*b*(95%CI)	*b*(95%CI)	*b*(95%CI)	*b*(95%CI)
Composite exposure	0.46 (-0.07, 1.00)	0.60*(0.04, 1.15)	-0.54*(-0.94, -0.15)	-0.40*(-0.76, -0.04)
Demographics				
Gender				
Female		-0.28 (-0.58, 0.03)		0.16 (-0.12, 0.43)
Male (Ref.)				
Age groups				
Young		-0.12 (-0.65, 0.42)		-0.04 (-0.52, 0.44)
Middle		1.17**(0.86, 1.48)		1.27**(0.98, 1.55)
Older (Ref.)				
Marital status				
Married/Common		0.66 (-0.05, 1.37)		-1.67**(-2.67, -0.67)
Separated		1.20**(0.58, 1.82)		-1.47*(-2.42, -0.51)
Divorced		7.00**(5.42, 8.58)		-3.02** (-4.06, -1.97)
Widowed		1.75**(0.83, 2.67)		-0.40 (-1.52, 0.73)
Single (Ref.)				
Education				
Diploma		1.28**(0.93, 1.62)		0.38 (-0.02, 0.77)
Degree		0.43*(0.04, 0.82)		-0.43*(-0.81, -0.06)
<High school (Ref.)				

Occupation		
Working	-0.19 (-0.55, 0.17)	0.28 (-0.09, 0.64)
Not working (Ref.)		
Income	-0.10**(-0.16, -0.05)	-0.11**(-0.16, -0.07)

Note. *b* = regression coefficients. A single asterisk (*) means p-value < 0.05; double asterisks (**) mean *p-value* < 0.001. Ref. = reference category. The outcome variable for the Poisson model is problem gambling severity measured with PGSI scores of 1 to 27; it was treated as a continuous variable and a higher score indicates greater severity. The analysis was performed separately for respondents from emerging and mature gaming areas.

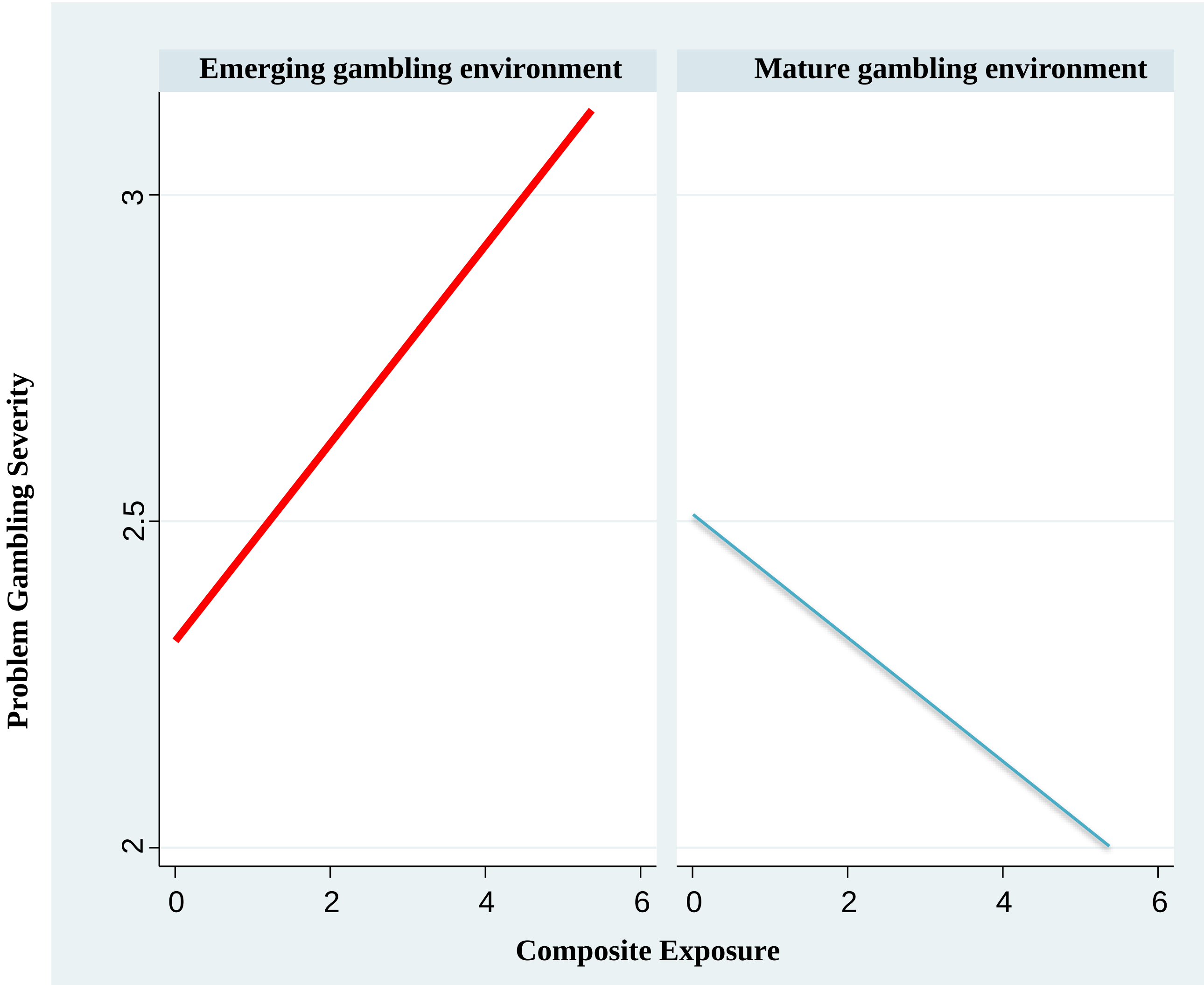

Figure 3: Association between composite exposure and problem gambling severity. This association is examined for the sample from emerging and mature gaming areas. This figure illustrates results from the Poisson model in Table 20.

Discussion

The benefit of a composite measure of exposure to gambling opportunities

Overall, the univariate and multivariate regression analyses showed that the composite measure, compared to the availability and accessibility measures alone, explained a greater proportion of the risk and severity of problem gambling in adults. In the combined sample from emerging and mature gambling markets, the composite exposure measure explained, on average, 32% of the risk of an adult gambler being an MRPG. Additionally, about 38% of the rate of problem gambling severity was explained by the composite exposure. Comparatively, the availability and accessibility measures of exposure predicted less than 7% of the risk and severity of problem gambling in the combined sample. The association of either risk or severity with the composite exposure is about 90% higher than that found for the availability and the accessibility measures. Studies that have assessed the separate effects of the availability and accessibility measures of exposure have found that they demonstrate weak to moderate associations with problem gambling (Storer et al., 2009; Vasiliadis et al., 2013; Welte et al., 2016; Williams et al., 2012).

The composite exposure was not as strong in predicting the risk of being an MRPG compared with problem gambling severity. On average, the composite exposure accounted for 33% of the risk of being an MRPG and explained 38.7% of the problem gambling severity rate. Therefore, the composite exposure seems to be more reliable in explaining the severity of problem gambling among adults. Additionally, compared to studies applying the REM (LaPlante & Shaffer, 2007; Shaffer et al., 2004; St-Pierre et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012), the present study showed our composite exposure measure better predicted both the risk and the severity of problem gambling.

Assessing the performance of the availability and accessibility measures of exposure to gambling opportunities

The accessibility measure had the weakest association with both the risk and severity of problem gambling in the combined sample from emerging and mature gambling markets. Living closer to a gambling venue only minimally increases the risk of moderate and problem gambling. Similarly, the number of MRPGs in the general population may minimally increase when gambling venues are located close to residential places. These findings appear to counter existing literature that has documented stronger association between proximity and problem gambling prevalence (Storer et al., 2009; Vasiliadis et al., 2013; Welte et al., 2016; Williams et al., 2012). This may be because our study examined the relationship between a continuous proximity variable and problem gambling prevalence, while previous studies have assessed this association using categorical measures for both variables (Storer et al., 2009; Vasiliadis et al., 2013; Welte et al., 2016; Williams et al., 2012).

Of the three measures of exposure, only the availability measure predicted problem gambling rate but not the risk of being an MRPG. These findings are consistent with existing literature, as most studies have found weaker associations between the density of casinos or EGM venues and the prevalence of problem gambling in the general population (Abbott, 2006; Marshall, 2005; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). When the number of casinos or EGMs in a community increases, the number of gamblers with the problem may increase their gambling activities, leading to increased problems. However, increased proliferation of casinos and other gambling outlets may not necessarily increase the incidence of problem gambling in the general population. Overall, these findings demonstrate that the incidence and prevalence of problem gambling are differentially influenced by the availability measure of exposure.

In general, the availability and accessibility measures of exposure individually underestimated the association between gambling exposure and problem gambling compared to the composite exposure measure. However, the accessibility measure appears to be less predictive. For example, the availability measure explained about 6% of the risk of problem gambling, while the accessibility explained only 1%. The composite exposure has a stronger association with both problem gambling risk and severity compare to the availability and accessibility measures.

Testing the exposure and adaptation hypotheses with a composite measure of exposure to gambling opportunities

The composite exposure measure was used to test the exposure and the adaptation hypotheses (LaPlante & Shaffer, 2007; Shaffer et al., 2004) in our sample. The exposure hypothesis suggests that higher risk and higher rates of problem gambling result from increased exposure to gambling opportunities (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012). On the other hand, the adaptation hypothesis argues that increased exposure does not always lead to increase problem gambling in the general population as some gamblers may adjust to the novelty of the activity over time and reduce their participation and gambling problems (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012).

We tested these hypotheses by comparing the association between the composite exposure measure and each outcome measure separately for respondents who have had access to casinos with slot machines where they live for three or more years (called mature gambling areas) and for those who had access for less than three years (called emerging gambling areas). Our findings supported both hypotheses. In emerging areas, the results indicate that both the risk and severity of problem gambling increased as scores on the composite exposure measure increased. For example, an increase in the scores on the composite exposure increased the risk of being an MRPG by 27% and increased problem gambling severity by 60%.

In support of the adaptation hypothesis (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012), the results showed that the composite exposure measure was negatively associated with both problem gambling risk and severity in mature gambling areas. For risk, an increase in the scores on the composite exposure resulted in a 25% reduction in the likelihood of being an MRPG. Similarly, problem gambling rates reduced by an average of 47% even when scores on the composite exposure increased. These findings suggest that gamblers are likely to adjust to the novelty of gambling activities within three or more years following continued contact with casino or non-casino EGM venues.

The findings for the exposure and adaptation hypotheses provide insight into how to define mature and emerging gambling environments. For this study, we used a three-year duration of direct exposure to casinos to categorize respondents into mature and emerging gaming areas. Although the literature does not specify the number of years required for populations to adapt to exposure effects (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012), our results show that three years of continued exposure may be enough for some populations to adapt. However, some researchers suggest that it might take longer than three years for some populations to adapt to exposure effects (Abbott, 2006; Pearce et al., 2008; Sévigny et al., 2008; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). We believe that three years could be used as a cut-off to categorize populations into groups of mature and emerging gaming areas.

Strengths and limitations

Previous research to reliably assess the association between exposure to gambling opportunities (i.e., accessibility and availability) and problem gambling has been impeded by the lack of a comprehensive measure for gambling exposure (LaPlante & Shaffer, 2007; Shaffer et al., 2004; St-Pierre et al., 2014; Vasiliadis et al., 2013). However, our composite exposure measure appears to have addressed this gap. We created a composite measure of exposure to gambling opportunity by combining the availability and accessibility measures of exposure.

An important strength of this study is the newly developed formula for estimating exposure to gambling opportunities for individuals. Previous approaches for estimating gambling exposure have mostly focused on populations rather than on the individuals within the population. Since individuals within the same population or community are likely to differ in their levels of exposure to gambling opportunities, it was necessary to identify the best approach to capture the individual differences in exposure within populations. Our proposed formula for estimating gambling exposure at the individual level addresses this gap in the literature. The formula can be used to determine individual differences in exposure to gambling opportunities, and how such differences may explain why, within the same community, some people have gambling problems while others do not.

Additionally, our use of logistic and Poisson regression methods for the assessment of the performance of the availability, accessibility, and the composite measures of exposure strengthens our findings. Results from these analyses were complementary, providing stronger support for the utility of the composite exposure measure in predicting both the risk and severity of problem gambling among adults. The composite exposure measure increased the measurement precision of gambling opportunities, providing a more reliable variable for assessing the association between exposure to gambling opportunity and problem gambling behaviour. It could also be used to assess the association between gambling exposure and problem gambling for both individuals and groups.

The composite exposure measure captures both the availability and accessibility aspects of exposure to gambling opportunities (Abbott, 2006; Pearce et al., 2008; Sévigny et al., 2008; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). Our results further indicate that the combined influence of the availability and accessibility measures of exposure cannot be captured by either component alone. For example, the composite exposure explained 34%-37% of the risk of being an MRPG and the severity of problem gambling; however, the availability and accessibility measures only predicted 0.4%-6% of the risk of being an MRPG and the severity of problem gambling. Moreover, the findings for the composite exposure measure generally support the view that exposure to gambling opportunities is a multidimensional rather than a unidimensional issue.

The study has limitations. We used Poisson regression to assess the association between the exposure measures and the severity of problem gambling. However, Poisson regression has been found to be less superior for fitting count data that are overly dispersed (Böhning et al., 1999; Hall, 2000; Lambert, 1992). Data from our PGSI measure were highly dispersed, as the variance was far larger than the mean. Therefore, it is possible that the Poisson estimated associations might not be entirely accurate because of the overdispersion in the data. Negative binomial regression is recommended for count data with overdispersion (Famoye & Singh, 2006; Lambert, 1992). We attempted fitting the data with negative binomial regression but the Poisson regression was a better fit to the data (Böhning et al., 1999; Famoye & Singh, 2006; Hall, 2000; Lambert, 1992).

Another limitation is that slot machines but not table games were considered in our measure of gambling exposure. Casinos typically have table games such as blackjack, and a large number of casino gamblers have been found to play these games (Abbott, 2006; Pearce et al., 2008; Sévigny et al., 2008; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). The reported exposure effects may have been underestimated because table games were not included in the estimation. However, as the formula for calculating exposure is laid-out, future research can include all types of games and gambling facilities in the calculation of gambling exposure. For example, future research could include all types of games and gambling venues in the first equation to determine individuals' levels of gambling exposure. When a wide range of gambling venues and games are considered in the calculation, it will improve the accuracy of the estimation of gambling exposure. Additionally, having a more accurate estimate of gambling exposure could help to better determine the contribution of exposure to individual differences in gambling behaviour. Further, our analysis was limited to terrestrial gambling. We did not include online gambling opportunities.

Conclusion

Our composite measure of gambling opportunity, which combines the availability and accessibility measures of exposure, had a stronger relationship with both the risk and severity of problem gambling compared to either measures alone. The composite exposure was also able to delineate the patterns of association between exposure and problem gambling in emerging and mature gambling environments. In emerging areas, it showed that exposure and problem gambling are positively related, and their association in mature areas was found to be negative.

Proximity was the least predictive exposure measure. Further research is needed to assess the ways in which distance to casinos from residential areas influences the risk and prevalence of problem gambling in populations that have easier access to gambling facilities. Because many people now own cars in contemporary societies, it may be easier for gamblers to travel long distances to casinos and other gaming outlets frequently regardless of their socioeconomic constraints. Improved transportation and the increasing expansion of gambling venues have reduced the amount of time needed to travel to a gambling venue, thus making access much more straightforward. However, as found by Young et al. (2012), proximity to gambling venues appears to have a greater influence on participation in gambling activities than on the prevalence of problem gambling.

An issue that needs to be investigated is how internet gambling might have reduced the impact of proximity on territorial gambling behaviour. Prior to the advent of internet gambling (Gainsbury et al., 2014; Wood, Routledge, & 2012, 2012), proximity played an important role in influencing access to gambling venues and regular participation in terrestrial gambling activities (Thomas et al., 2011). Since many gambling opportunities are now accessible online via mobile devices (Gainsbury et al., 2014; Wood et al., 2012), it would be of interest to determine in future studies the effects of proximity to a terrestrial gambling venue on problem gambling among gamblers who gamble online and offline.

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Chapter Six: The relative and interactive effects of actual and perceived gambling exposure on gambling behaviour

A version of this chapter is submitted to the *Journal of Gambling Studies* as: "Dei, S. M. O., Christensen, D. R., Awosoga, O., Lee, B. K., & Jackson, A. C. (under review). The relative and interactive effects of actual and perceived gambling exposure on gambling behaviour."

Abstract

Actual and perceptual measures of exposure to gambling opportunities are important predictors of problem gambling. This study used zero-inflated Poisson (ZIP) regression to assess the relative importance and interactive effects of actual and perceived exposure to gambling opportunities on any-risk gambler (ARG; referring to low-risk, moderate-risk, and problem gamblers) and problem gambling severity among adults using data from the 2008 and 2009 Social and Economic Impacts of Gambling in Alberta surveys (SEIGA). The results of the logistic ZIP models indicate that when assessed simultaneously, actual exposure has a significantly stronger association with ARG. However, the Poisson ZIP models show that perceived exposure better explains problem gambling severity. These associations vary significantly for gamblers from emerging and mature areas. Further, actual and perceived exposure had significant interaction effects on ARG risk but not on severity rates. These findings suggest that the prevalence of problem gambling behaviour could be reduced by using supply related restrictions, and educational or restrictive policies to decrease public awareness of gambling opportunities.

Keywords: Actual exposure, perceived exposure, ARG, problem gambling severity

Introduction

The prevalence of problem gambling has been correlated with measures of exposure to gambling opportunities (St-Pierre et al., 2014; Storer et al., 2009; Williams et al., 2012). Accessibility characteristics such as the number of gambling venues, gambling machines, and the travel distance to a gambling venue have been used to measure actual exposure to gambling opportunities (St-Pierre et al., 2014; Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). Exposure to gambling opportunities has also been defined and measured based on an individual's perceptions of the availability of gambling facilities (Wickwire et al., 2007; Williams, Belanger, & Arthur, 2011). The present study examined the relative importance and the interactive effects of actual and perceived measures of exposure to gambling opportunities on problem gambling risk and severity in a multivariate analysis that adjusts for demographic characteristics.

In line with the exposure hypothesis (LaPlante & Shaffer, 2007; Howard J. Shaffer et al., 2004), some studies have reported that problem gamblers have access to more gambling venues and machines, and have shorter travel distances to gambling venues (many live within 50km of the closet venue) (Storer et al., 2009; Vasiliadis et al., 2013). When combined, the density and distance measures of actual exposure to gambling opportunities strongly predict problem gambling severity in adults (Dei et al., 2020). However, individually, they have shown weak to moderate associations with problem gambling (Storer et al., 2009; Vasiliadis et al., 2013). Dei et al. (2020) constructed a measure of actual exposure to gambling opportunities by combining the number of casinos, their per capita number of slot machines, and the travel distance to the nearest casino. They found that the risk and severity of problem gambling increased by 34% and 37%, respectively, as scores on the composite measure of exposure increased by a unit. However, when gambling exposure was measured by either the number of casinos and slot machines or travel distance to the nearest casino, exposure accounted for less than 6% of the problem gambling risk and severity (Dei et al., 2020). These findings show that the combined density and proximity measures of gambling exposure were stronger predictors of problem gambling than individual measures.

Some researchers have found support for the adaptation hypothesis (LaPlante & Shaffer, 2007), reporting that the rate of problem gambling stays the same or decreases over time even as the actual levels of exposure to gambling opportunities increase (Storer et al., 2009; Vasiliadis et al., 2013; Welte, Barnes, Wieczorek, Tidwell, & Hoffman, 2007; Williams et al., 2012). Proponents of the adaptation explanation argue that when gamblers adjust to the novelty of gambling activities, they reduce their engagement, and this reduces both the risk and severity of problem gambling (Storer et al., 2009; Vasiliadis et al., 2013). Evidence supporting this explanation has come from different populations. In the study by Dei et al. (2020), a composite measure of exposure to gambling opportunities was negatively correlated with problem gambling severity in gamblers who have had access to casinos for three or more years. Similarly, in the state of Nevada in the United States, problem gambling rates are lower among residents exposed to gambling opportunities for a greater number of years than in those who have recently moved to the area (LaPlante & Shaffer, 2007; Volberg, 2002). Although this body of literature links problem gambling to measures of actual gambling opportunities, they do not suggest any possible association between perceived exposure to gambling opportunities and problem gambling.

Only two studies to date have examined the association between a perceptual measure of exposure to gambling opportunities and problem gambling. One study found a significant association (Dei et al., 2020), while the other did not (Wickwire et al., 2007). Dei et al. (2020) assessed exposure to gambling opportunities based on respondents' perceptions of whether casino and non-casino gambling venues were more widely available in their communities. They found that respondents who perceived these opportunities to be more widely available were 1.25-times more likely to be problem gamblers than those who did not. Wickwire et al. (2007), who measured exposure to gambling opportunities based on whether respondents believe that they could easily purchase lottery tickets, did not find a significant association between perceived exposure and compulsive purchases of the tickets. The non-significant association may be the result of the low rate of problem gambling in their sample and the fact that participation in lotteries is less harmful than participation in gambling on slots. Therefore, there is mixed evidence on the possible association between perceived exposure and problem gambling, warranting the need for more research into this association.

Despite the literature linking actual and perceived measures of exposure to gambling opportunities to problem gambling prevalence (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012), there are no studies on their relative importance as predictors. However, a number of studies on alcohol, physical activity, and social capital have assessed the relative effects of actual and perceived measures of exposure. For example, problem drinking behaviour has been found to be strongly associated with perceived availability rather than with actual alcohol availability (Kuntsche, Kuendig, & Gmel, 2008b; Stanley et al., 2011). Similarly, perceived and not actual access to neighbourhood facilities for physical activity has a stronger association with the level of physical activity among adults (Hoehner et al., 2005a; McCormack et al., 2004). With regard to social capital, it has been found that perceived support predicts better health than received support (Haber, Cohen, Lucas, & Baltes, 2007; Norris & Kaniasty, 1996). These public health studies suggest that the perceptual measures of exposure may be more important than actual availability as predictors for a range of behaviours.

Actual and perceived exposure have been found to have interaction effects on drinking behaviour. Stanley et al. (2011) found that alcohol misuse is more common among drinkers who had access to more alcohol outlets and perceived the outlets to be easily accessible. Similar interaction effects between perceived and actual gambling behaviour might also exist. There is a possibility that the association between actual exposure and problem gambling might vary between gamblers who perceived themselves to be more exposed to opportunities than those who do not. This possibility is examined in the present study.

Purpose of study

Data from the SEIGA surveys was used to address three research questions. (1) What are the relative effects of actual and perceived gambling exposure on the likelihood of being any-risk and problem gambling severity before and after controlling for individual demographic characteristics? (2) Are the relative effects of actual and perceived opportunity different for respondents from emerging and mature gambling areas? (3) Are there interaction effects between actual and perceived opportunity on ARG and problem gambling severity?

Methods

Study sample

This study analyzed data from the 2008 and 2009 SEIGA surveys (Williams et al., 2011). These telephone and email surveys collected data on socio-demographics, gambling behaviours, and other psychosocial variables from 12,141 adults aged 18-years and older. The email surveys were administrated to respondents residing in the study areas to supplement the telephone surveys. After the exclusion of respondents with missing data (0.8%), 4,991 respondents remained for the final analysis. All respondents of this study had participated in some form of commercial gambling activities in the past year. Details of the survey design and measures are described by the original investigators (Williams et al., 2011).

Measures

Demographic characteristics. The SEIGA studies collected data on respondent's demographic characteristics such as age, gender, marital status, education, occupational status, income, and their place of residence (Williams et al., 2011). These characteristics were included in the analysis as covariates, as they have been found to be associated with both the risk and severity of gambling problems at the individual and population levels (Welte, Barnes, Tidwell, & Wieczorek, 2017; Williams et al., 2012). All the demographic variables of this study except income had categorical data.

*ARG***.** SEIGA used the Problem Gambling Severity Index (PGSI) to assess respondent's problem gambling behaviour (Ferris & Wynne, 2001a). The PGSI consists of nine items that are rated on a 4-point scale, with response options ranging from never (0) to almost always (3). Scores range from 0 to 27 and can be used to categorize gambling behaviour across the continuum of risk: non-problem gambling (scores of 0), low-risk gambling (scores of 1–2), moderate-risk gambling (scores of 3–7), and problem gambling (scores of 8 or more). The PGSI has shown very good internal consistency, validity, sensitivity, and specificity in previous research (Ferris & Wynne, 2001). For the present study, low-risk, moderate risk, and problem gamblers were combined into a single category called "any-risk gamblers (ARG)" and compared to non-problem gamblers (Dowling et al., 2018). In a ZIP logistic regression analysis, the actual and perceived exposure measures are compared to determine whether they influence the ARG and non-problem gamblers differently and independently.

Problem gambling severity. Problem gambling severity is operationally defined as having a score of 1 or more on the PGSI. A cutoff of 1 was used to define problem gambling severity to place the focus on gamblers who are at risk for experiencing gambling-related problems or who have already developed problems. Analysis of problem gambling severity is performed with the Poisson component of the ZIP regression method. Unstandardized regression coefficients are used to determine changes in problem gambling severity, as explained by actual and perceived exposures.

Actual exposure to gambling opportunities. We used the number of casinos, their per capita slot machines, and the travel distance to the nearest casino from home to estimate actual exposure to gambling opportunities for each respondent in the SEIGA surveys. This was done by dividing the number of machines by the number of casinos in an area. These estimated average scores were divided by the scores of the distance measure. Details of this calculation are described in a previous study (*see manuscript two above*). The estimated scores for actual exposure to gambling opportunities are shown in Table 21 below. Higher scores indicate greater actual gambling exposure.

Table 21. Estimated scores for respondent's actual exposure to gambling opportunities

Estimated scores			*N*	Cumulative % of scores
0.00101	-	0.00685	216	9.9
0.00691	-	0.01242	216	19.7
0.01255	-	0.01938	225	29.7
0.01949	-	0.04778	222	39.9
0.04829	-	0 .07539	219	49.9
0.07562	-	0.11060	221	59.8
0.11123	-	0.14926	221	69.9
0.15031	-	0.21185	216	79.9
0.21249	-	0.35500	224	89.9
0.35711	-	5.36893	220	99.9
6.37457			2	100

Note. Estimated scores in this table indicate respondents actual gambling opportunities, as measured by the number of casinos in their communities, their per capita slot machines, and the distance from the nearest to their residential address.

Perceived exposure to gambling opportunities. We used individual perceptions of the availability of gaming venues or gaming machines to measure perceived exposure (Williams et al., 2011). Respondents were asked whether they perceive casinos, non-casino EGMs, lotteries, and other gambling products to be available in Alberta. Responses to this question were originally categorized as: “gambling is too widely available”, “the current availability of gambling is fine”, and “gambling is not available enough” (Williams et al., 2011). For the purposes of this study, respondents in the second and third categories were categorized as “less exposed” and those in the first category as “more exposed”. It was necessary to collapse the last two groups because the sample size for ‘not available enough’ group was very small (1.8%) compared to the “too widely available” (44.1%) and the “current availability of gambling is fine” (54.1%) groups. The percentages of gamblers in the ‘less exposed’ and ‘more exposed’ categories are reported across the PGSI scores in Table 22.

Table 22. PGSI-problem gambling severity levels by perceptions of gambling availability

PGSI gambling severity scores	More exposed N (100%) = 2202	Less exposed N (100%) = 2789
0	1642 (74.6)	2152 (77.2)
1	195 (8.9)	337 (12.1)
2	89 (4.0)	113 (4.1)
3	75 (3.4)	81 (2.9)
4	40 (1.8)	32 (1.1)
5	26 (1.2)	25 (0.9)
6	25 (1.1)	15 (0.5)
7	11 (0.5)	10 (0.4)
8-27	99 (4.5)	24 (0.8)

Note. Reported PGSI scores are unweighted and range from 0 to 27. The 'more exposed' PGSI scores range from 0 to 27. The 'less exposed' group scores range from 0 to 19.

Emerging and mature gambling areas. In support of the exposure and adaptation hypotheses, respectively, the association between gambling opportunities and problem gambling tends to be positive in emerging areas, and negative in mature areas (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Vasiliadis et al., 2013; Williams et al., 2012). For the purposes of this study emerging areas refer to places where casinos had been available for less than three years, whereas mature areas have had casinos for three or more years during the time of the SEIGA survey (Williams et al., 2011). About 45.4% (*N* = 1377) of SEIGA respondents lived in emerging areas, and 54.6% (*N* = 1658) lived in mature areas.

The mean actual gambling opportunity score for respondents from emerging areas is 0.1149 (SD = 0.31), and scores range from a minimum opportunity score of 0.002 to a maximum opportunity score of 5.369. For those from mature areas, the mean score is 0.1948 (SD = 0.45), and scores range from a minimum opportunity score of 0.003 to a maximum opportunity score of 6.375. The total sample size for the above analysis is 1346, with 38.8% missing data due to the emerging/mature area variable). The estimated mean actual gambling opportunity scores indicate that overall, respondents in mature areas have greater access to casinos with slot machines and live closer to casinos (measuring actual opportunity) than respondents in emerging areas.

Data analysis

Structure of the SEIGA data. The SEIGA surveys collected data on the measures of exposure to gambling opportunities for individuals from five geographic regions (*i.e., Southern, Central, Northern, Calgary, & Edmonton areas*) in the province of Alberta (Williams et al., 2011). Data on the number of casinos and their per capita number of slot machines were collected for the five study areas, while data on travel distance to the nearest casino were collected for individuals in these areas (Williams et al., 2011). The population level data were disaggregated to the individual level to estimate a respondent's actual level of exposure to gambling opportunities.

*Modelling PGSI data with ZIP regression***.** ZIP regression is typically used to analyze count data with many zero values (Famoye & Singh, 2006; Lambert, 1992; Ridout et al., 1998). Count data can be categorized into zero and non-zero total values (Ridout et al., 1998). These data are analyzed with linear and non-linear regression functions simultaneously by ZIP. First, ZIP uses a logistic regression function to compare the sample with a zero total value or score with those with a non-zero total value. Second, it uses a Poisson function to examine variations in the ARG group (Famoye & Singh, 2006; Lambert, 1992).

ZIP is an appropriate statistical method for analyzing variables with count data such as the PGSI. Addictive behaviour scores such as problem gambling is typically highly skewed because only a minority of the general population have addictions. For example, a total of 3,794 (76%) of SEIGA respondents were non-problem gamblers (had a PGSI score of zero), and 1,197 (24%) were ARG (had PGSI scores of 1 or more). The ZIP regression performs logistic and Poisson regression analyses on these groups of gamblers simultaneously, as explained below.

ZIP Logistic Regression. The logistic regression components of the ZIP regression were used to assess the risk of membership in the ARG group, as explained by actual and perceived exposures. This analysis determined whether the number of ARGs relative to non-problem gamblers increases as scores on the actual exposure measures increases and whether most of the ARG relative to non-problem gamblers perceived themselves to be more exposed to gambling opportunities. ZIP logistic regression is similar to the traditional binary logistic regression. However, ZIP logistic regression has an advantage over the latter because when differentiating groups, it inherently acknowledges that different processes determine membership of a group (Lambert, 1992).

ZIP Poisson regression. The ZIP Poisson regression was used to examine problem gambling severity. This analysis examines whether actual and perceived exposures explain variations within the ARG group differently and independently. ZIP Poisson is more appropriate for examining variation in the PGSI scores of 1 or higher because of the large dispersion in the scores. Like the data on the PGSI, count data with large dispersion, as indicated by a higher variance than the mean, are better estimated by ZIP Poisson than by traditional linear regression methods (Böhning et al., 1999; Famoye & Singh, 2006; Hall, 2000; Lambert, 1992).

*Data analysis steps***.** First, the ZIP logistic and Poisson regressions were used to determine the independent and relative effects of actual and perceived exposure, respectively, on the risk of becoming a problem gambler and the severity of problem gambling in the combined sample from emerging and mature areas (see earlier section).

Second, we repeated the above logistic and Poisson analyses separately for the sample from emerging and mature gambling areas. This second analysis sought to test the exposure and adaptation hypotheses. Finally, the logistic functions of the ZIP were used to examine the interaction effects of actual and perceived gambling exposure on the risk of becoming a problem gambler, while the Poisson function was used to examine their interaction effects on problem gambling severity rates. For significant interactions, a decomposition analysis was performed to assess changes in the problem gambling risk and severity across scores on the actual exposure measure, separately for gamblers who perceived themselves to be more exposed and for those who did not.

For the first and second analyses, two ZIP models were estimated, one without covariates, and the other adjusted for the demographic characteristics. Both analyses have the same set of independent and control variables. However, for the interaction analysis, only the main effects of the interaction and not the demographic variables were controlled for. The results from the logistic and Poisson portions of the ZIP are, respectively, presented in odds ratios and in regression coefficients (Famoye & Singh, 2006; Lambert, 1992). A weighted variable was created using the frequencies of the five geographical areas where the SEIGA survey was conducted. All ZIP analyses were performed on weighted data to correct for oversampling. Data were analyzed with Stata Version 15 (Stata Corp, 2019) and a statistical significance was determined at the 95% confidence interval. All line graphs were created with predicted marginal means and were smoothed with the polynomial curve fitting function in Stata.

Results

Descriptive characteristics

Table 21 (see above) shows the estimated scores for respondents' actual levels of exposure to gambling opportunities, as measured by the number of casinos, their per capita number of slot machines, and the distance to their nearest casino. Respondents' actual exposure scores range from a minimum value of 0.001 to a maximum value of 6.375, where higher scores indicate greater actual exposure to gambling opportunities. The mean actual exposure score is 0.16 (*SD* = 0.30), and 72.5% had actual exposure scores below or at the mean level. Only 2.3% of respondents had a score of 1 or greater.

Perceived exposure to gambling opportunities was measured based on respondents' perceptions of whether they were more or less exposed to casinos and other gaming opportunities in their communities. Almost half (44.1%) of the respondents perceive that they were more exposed to gambling opportunities. Among these gamblers, the majority were female (55.1%), in their middle age (60.4%), had completed high school or less (49.6%), employed (68.6%), and live in Northern Alberta (33.7%). In Table 22, a higher percentage of respondents who perceived themselves to be more exposed to gambling opportunities had a PGSI score of 8 or higher (4.5%).

Table 23 presents demographic characteristics for the 4,991 respondents of this study. The highest percentage of each demographic variable were female (51.8%), in their middle age (56.3%), married or in a common-law relationship (70.8%), had less than or completed high school (47.5%), working (71.0%), had an annual personal income of $100,000 or more (21.5%) and lived in the Northern area of Alberta (32.3%). A total of 76% (n = 3,794) of the respondents were non-problem gamblers and 24% (n = 1,197) were ARG.

Table 23. Descriptive characteristics of respondents

Variables	Unweighted sample	
	N (=4,991)	Percentage (%)
Gender		
Female	2587	51.8
Male	2404	48.2
Age groups		
Young adults (*18 to 39 yrs.*)	1518	30.7
Middle-aged adults (*40 to 64 yrs.*)	2781	56.3
Older adults (*65 yrs. and above*)	638	12.8
Marital status		
Single	781	15.7
Married/common law	3524	70.8
Separated	141	2.8
Divorced	302	6.1
Widowed	232	4.7
Education		
High school	2357	47.5
College Diploma	1554	31.3
University degree	1055	21.2
Employment status		
Working	3531	71.0
Not working	1440	29.0
Annual Income		
<$20,000	510	11.7
$20,000	280	6.4
$30,000	470	10.7
$40,000	466	10.7
$50,000	457	10.4
$60,000	379	8.7
$70,000	336	7.7
$80,000	323	7.4
$90,000	213	4.9
≥$100000	941	21.5
Place of residence		
Southern Alberta	828	16.6
Calgary areas	865	17.3
Central areas	1036	20.8
Edmonton areas	649	13.0
Northern Alberta	1613	32.3
Gambling status		
ARG	1197	24
Non-problem gamblers	3794	76

Note. Values represent here respondents who had complete data for the PGSI, actual gambling opportunity, and the perceived gambling opportunity measures.

Association between actual and perceived exposure to gambling opportunities

ETA correlation test was used to assess the strength of the association between the actual and perceived measures of exposure to gambling opportunities. This was done to determine whether there would be collinearity problems if the actual and perceived measures are used simultaneously in the ZIP regression analyses. ETA analysis shows a weak positive and non-significant association between actual and perceived opportunity (*ETA* = 0.009). Respondents' perceptions of opportunity increased as their scores on the actual opportunity increased. The weak association between these measures suggests that they may be differentially associated with problem gambling behaviour when examined together.

The independent and relative effects of actual and perceived gambling exposure on ARG and problem gambling severity in emerging and mature areas combined

ARG. The logistic models in Table 24 show that the likelihood of being an ARG is not associated with perceived exposure (*OR* = 1.005, *p* = 0.910) but with actual exposure (*OR* = 0.668, *p*= 0.015) when examined together in the combined sample from emerging and mature areas. ARG increases by 27.2% for a one unit increase in the actual exposure score. The associations remain statistically significant after adjustment for demographic characteristics (see Model II).

Table 24. The independent and relative effects of actual and perceived gambling exposure on ARG and problem gambling severity in emerging and mature areas combined

	Logistic Section		Poisson Section	
	OR	*P-value*	*Coefficient (b)*	*P-value*
MODEL I				
Perceived exposure				
More exposed	1.005	0.910	0.761**	0.001
Less exposed (*Ref.*)				
Actual exposure	0.727*	0.026	0.150*	0.034
MODEL II				
Perceived exposure				
More exposed	0.978	0.648	0.755**	0.001
Less exposed (*Ref.*)				
Actual exposure	0.668*	0.015	0.178*	0.017
Gender				
Female	1.320**	0.001	-0.099**	0.001
Male (Ref.)				
Age groups				
Young	0.587**	0.001	-0.041	0.384
Middle	0.826*	0.029	0.179**	0.001
Older (Ref.)				
Marital status				
Married/Common	1.446**	0.001	-0.164**	0.001
Separated	1.317*	0.046	0.262**	0.001
Divorced	1.371*	0.004	0.070	0.121
Widowed	1.317*	0.036	-0.018	0.764
Single (Ref.)				
Education				
Diploma	1.239**	0.001	-0.128**	0.001
Degree	1.195*	0.006	-0.207**	0.001
≤High school (Ref.)				
Occupation				
Working	0.972	0.631	0.072*	0.012
Not working (Ref.)				
Income	1.053**	0.001	-0.034**	0.001

Note. Likelihood Ratio (LR) = 1196.03; $p < 0.001$ for MODEL I. LR = 1553.44.83; $p < 0.001$ for MODEL II. *OR* = odds ratio. Ref. = reference category. The outcome variable for the logistic models is dichotomous: ARG and non-problem gamblers (reference category). The outcome variable for the Poisson models is problem gambling severity (continuous variable). The analysis was performed on the combined data from emerging and mature gaming areas.

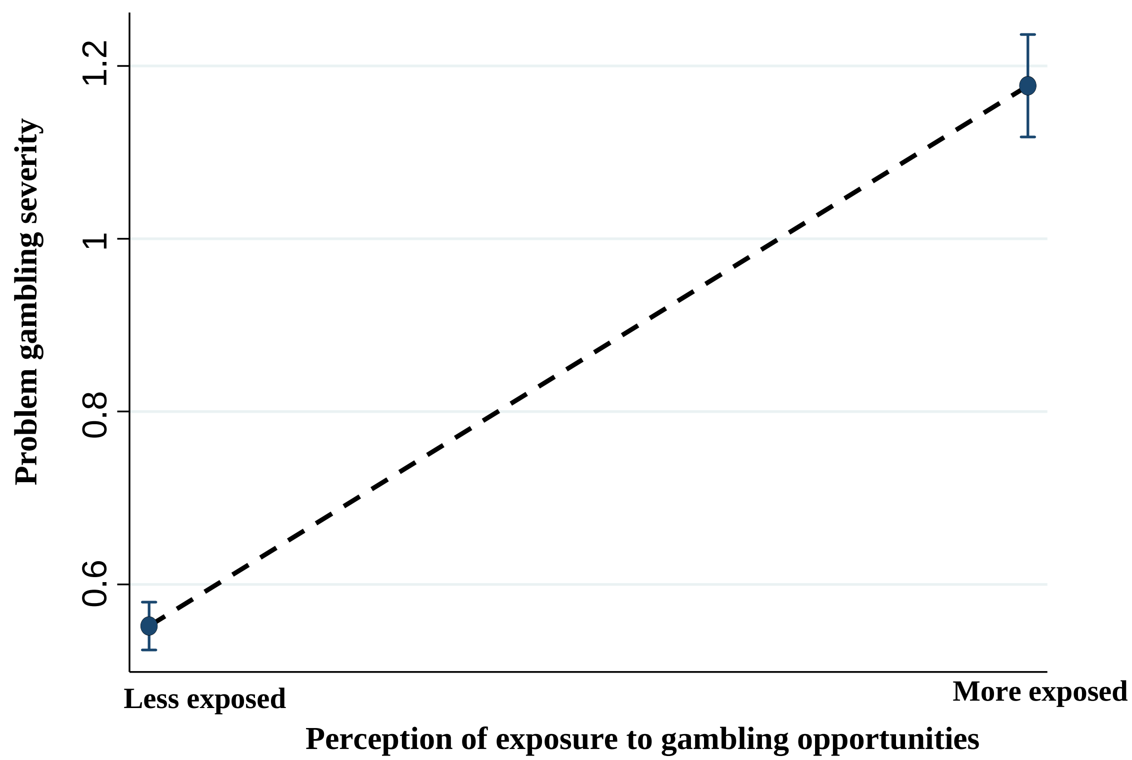

Figure 4: Association between perceived exposure and problem gambling severity in emerging and mature areas combined. This figure illustrates results from the Poisson model in Table 24. Scores (1-27) on the PGSI and those on the actual exposure measure were used to create this

Problem gambling severity. When analyzed together in the Poisson model I of Table 24, perceived (b = 0.761, p = 0.001) and actual (b = 0.150, p = 0.034) exposure were significantly associated with problem gambling severity. However, severity rates were more strongly associated with perceived than with actual exposure. Severity rates are 76.1% higher in gamblers who perceive themselves to be more exposed than in those who did not. For one unit increase in actual exposure score, rates increase by 15% (see Figure 5), a much smaller increase than that for perceived exposure. These associations do not change in Model II that controls for demographic characteristics.

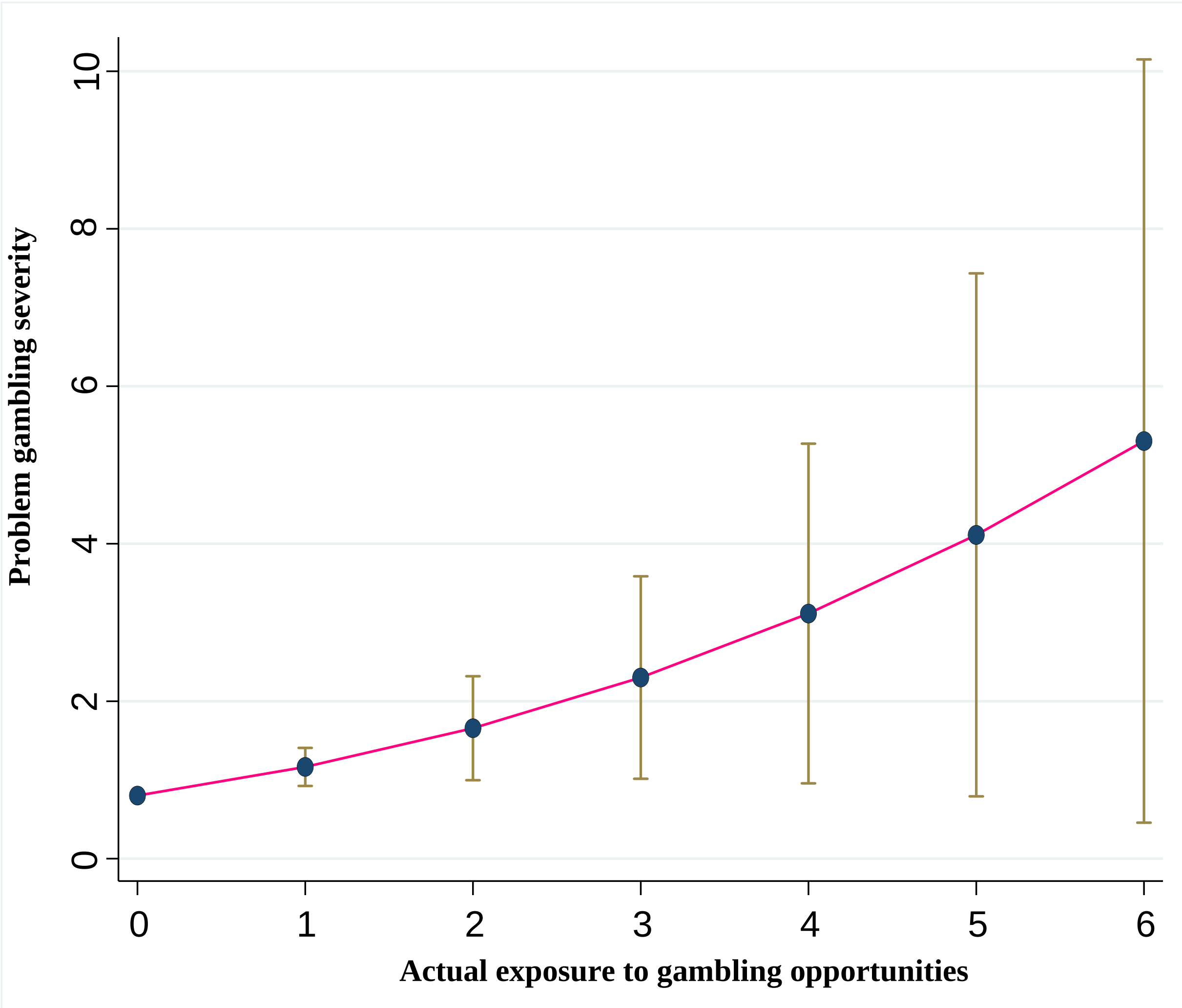

Figure 5: Association between actual exposure and problem gambling severity in emerging and mature areas combined. This figure illustrates results from the Poisson the model in Table 24. Scores (1-27) on the PGSI and those on the actual exposure measure were used to create this graph.

The independent and relative effects of actual and perceived exposure on ARG and problem gambling severity in emerging areas

ARG. The logistic model I in Table 25 shows that neither perceived (*OR* = 0.948, *p* = 0.598) nor actual (*OR* = 0.766, *p* = 0.499) exposure significantly predict the risk of becoming a problem gambler in emerging areas. Adjustment for demographic characteristics in Model II does not change these associations.

Table 25. The independent and relative effects of actual and perceived gambling exposure on ARG and problem gambling severity in emerging areas

	Logistic Section		Poisson Section	
	OR	*P-value*	*Coefficient (b)*	*P-value*
MODEL I				
Perceived exposure				
More exposed	0.948	0.598	1.134**	0.001
Less exposed (*Ref.*)				
Actual exposure	0.766	0.499	0.104	0.366
MODEL II				
Perceived exposure				
More exposed	1.023	0.849	1.202**	0.001
Less exposed (*Ref.*)				
Actual exposure	0.449	0.54	0.152	0.232
Gender				
Female	1.393*	0.005	0.088	0.132
Male (Ref.)				
Age groups				
Young	1.252	0.342	0.717**	0.001
Middle	1.505	0.061	0.910**	0.001
Older (Ref.)				
Marital status				
Married/Common	1.263	0.150	0.177*	0.025
Separated	1.846	0.069	1.692**	0.001
Divorced	2.692**	0.001	0.328*	0.018
Widowed	1.408	0.370	-0.518	0.077
Single (Ref.)				
Education				
Diploma	1.522*	0.002	-0.316**	0.001
Degree	0.745	0.052	-0.710**	0.001

≤High school (Ref.)				
Occupation				
Working	0.712*	0.014	0.147*	0.023
Not working (Ref.)				
Income	1.108**	0.001	-0.042**	0.001

Note. Likelihood Ratio (LR) = 1196.03; *p* < 0.001 for MODEL I. LR = 1553.44.83; *p* < 0.001 for MODEL II. *OR* = odds ratio. Ref. = reference category. The outcome variable for the logistic models is dichotomous: ARG and non-problem gamblers (reference category). The outcome variable for the Poisson models is problem gambling severity (continuous variable). The analysis was performed on the sample from emerging areas.

Problem gambling severity. As shown in the Poisson Model I of Table 25, problem gambling rates were associated with perceived (b = 1.134, $p < 0.001$) but not with actual (b = 0.104, p = 0.366; see Figure 6) exposure in emerging areas. Prevalence rates are 1.1-fold higher among gamblers who perceive themselves to be more exposed than in the gamblers who did not. These associations remain unchanged in Model II after adjusting for demographic characteristics.

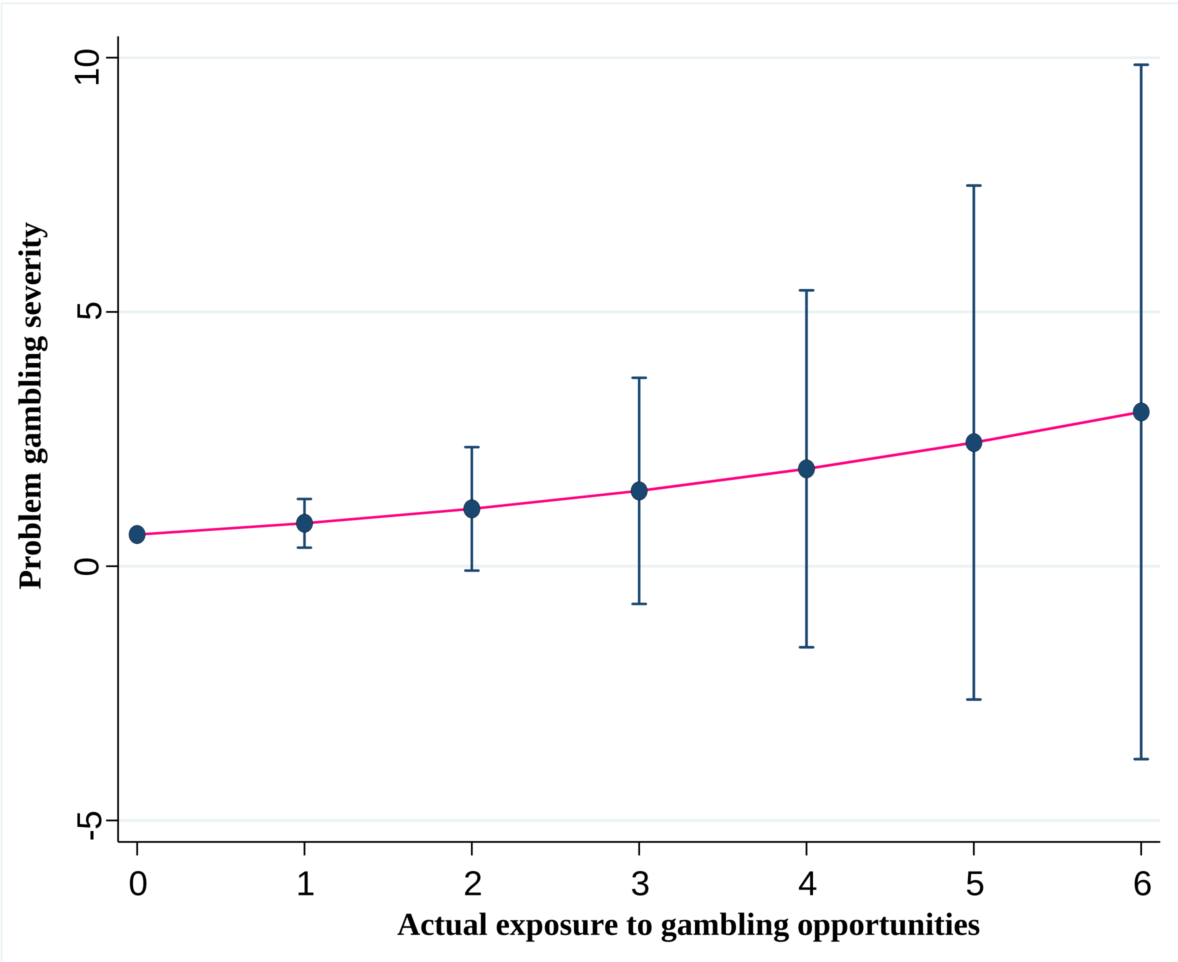

Figure 6: Relationship between actual exposure and problem gambling severity in emerging areas. This figure illustrates results from the Poisson the model in Table 25. Scores (1-27) on the PGSI and those on the actual exposure measure were used to create this graph.

The independent and relative effects of actual and perceived exposure on ARG and problem gambling severity in mature areas

ARG. The logistic Model I of Table 26 shows that the likelihood of being an ARG is associated with perceived (*OR* = 1.198, *p* = 0.037) and not with actual (*OR* = 0.905, *p* = 0.758) exposure in mature areas. Risk is 19.8% higher among gamblers who perceived themselves to be more exposed than in those who did not. These associations do not change in Model II after controlling for demographic characteristics.

Table 26. The independent and relative effects of actual and perceived gambling exposure on ARG and problem gambling severity in mature areas

	Logistic Section		Poisson Section	
	OR	*P-value*	*Coefficient (b)*	*P-value*
MODEL I				
Perceived exposure				
More exposed	1.198*	0.037	0.822**	0.001
Less exposed (*Ref.*)				
Actual exposure	0.905	0.758	-0.767**	0.001
MODEL II				
Perceived exposure				
More exposed	1.208*	0.047	0.776**	0.001
Less exposed (*Ref.*)				
Actual exposure	0.889	0.753	-0.782**	0.001
Gender				
Female	1.378**	0.001	-0.025	0.611
Male (*Ref.*)				
Age groups				
Young	0.798	0.219	0.033	0.724
Middle	1.050	0.775	0.339**	0.001
Older (*Ref.*)				
Marital status				
Married/Common	1.239	0.116	0.177*	0.025
Separated	0.451*	0.013	1.692**	0.001
Divorced	0.878**	0.001	0.328*	0.018
Widowed	1.465	0.184	-0.518	0.077
Single (*Ref.*)				
Education				

Diploma	1.203	0.092	-0.411**	0.001
Degree	1.550**	0.001	-0.091	0.196
≤High school (*Ref.*)				
Occupation				
Working	0.917	0.470	-0.149*	0.010
Not working (*Ref.*)				
Income	1.022	0.212	-0.034**	0.001

Note. Likelihood Ratio (LR) = 332.39; $p < 0.001$ for MODEL I. LR = 530.40; $p < 0.001$ for MODEL II. *OR* = odds ratio. Ref. = reference category. The outcome variable for the logistic models is dichotomous: ARG and non-problem gamblers (reference category). The outcome variable for the Poisson models is problem gambling severity (continuous variable). The analysis was performed on the sample from mature areas.

Problem gambling severity. In the Poisson Model I of Table 26, perceived ($b = 0.822$, $p < 0.001$) but not actual ($b = -0.767$, $p < 0.001$) exposure was strongly associated with changes in problem gambling rates in mature areas. Rates were 82.2% higher among adults who perceived themselves to be more exposed than in those who did not. However, rates decline by 76.7% (see Figure 7) for each unit increase in the actual exposure score. Most changes in problem gambling rates are accounted for by perception than actual exposure. Controlling for demographic characteristics in Model II does not change these associations.

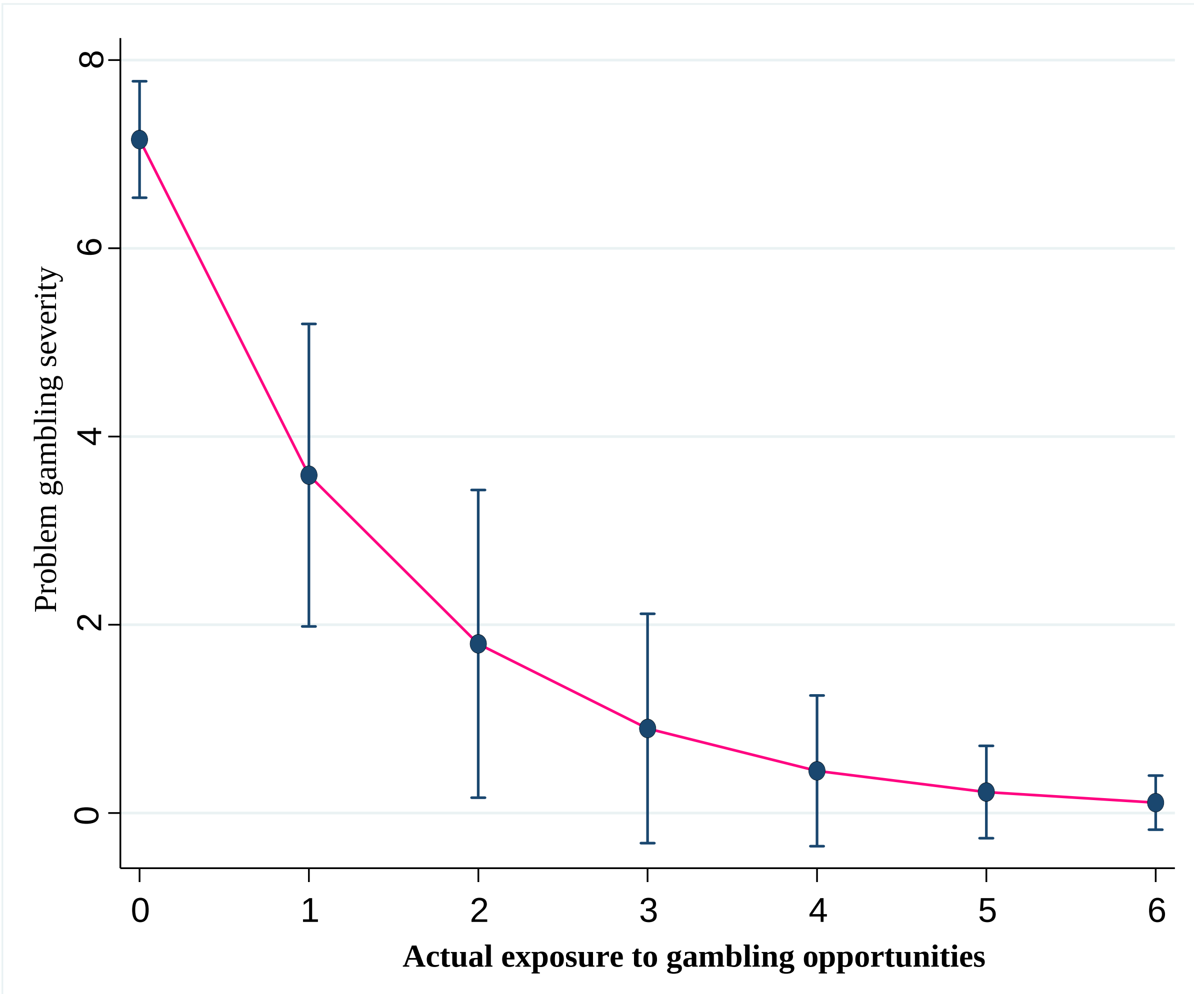

Figure 7: Association between actual exposure and problem gambling severity in mature areas. This figure illustrates results from the Poisson the model in Table 26. Scores (1-27) on the PGSI and those on the actual exposure measure were used to create this graph.

Interaction effects of actual and perceived gambling exposure on ARG and problem gambling severity in emerging and mature areas combined

In Table 27, actual and perceived opportunity have significant interaction effects on problem gambling rates (*b* = -0.296, *p* < 0.001) but not the likelihood of being an ARG (*b* = 0.927, *p* = 0.592). As the Poisson model shows, changes in the scores on the actual exposure lead to 29.6% increases in problem gambling severity for gamblers perceiving themselves to be not more exposed compared to those who are more exposed.

Table 27. Interaction effects of actual and perceived gambling exposure on ARG and problem gambling severity in emerging and mature areas combined

	Logistic Section		Poisson Section	
	OR	*P-value*	*Coefficient (b)*	*P-value*
MODEL I				
Perceived exposure				
More exposed	1.021	0.675	0.816**	0.001
Less exposed (*Ref.*)				
Actual exposure	0.921	0.457	0.298**	0.001
Actual*Perceived exposure				
More exposed*Actual	0.927	0.592	**-0.296****	**0.001**

Note. Likelihood Ratio (LR) = 1209.46; *p* < 0.001 for MODEL I. *OR* = odds ratio. Ref. = reference category. The outcome variable for the logistic models is dichotomous: ARG and non-problem gamblers (reference category). The outcome variable for the Poisson models is problem gambling severity (continuous variable). The analysis was performed on the sample from emerging and mature areas combined.

A decomposition analysis is used to examine how problem gambling rates change across different levels of actual exposure separately for gamblers who perceived themselves to be more exposed and those who did not (Table 28). The table shows that for gamblers with actual exposure scores of 0 to 3, rates are highest among those who perceived themselves to be more exposed than in those who did not (see also Figure 8). Among gamblers with actual exposure scores of 4 or more, rates are highest in those who perceived themselves to be less exposed than in those who did not.

Table 28. Problem gambling severity in gamblers who are more exposed to opportunities and those who are less exposed to opportunities at different values of the actual exposure measure

Actual exposure scores	**Perceived exposure**			
	Less exposed	***p*-value**	**More exposed**	***p-value***
0	0.519	*0.001*	**1.155**	*0.001*
1	0.742	*0.001*	**1.298**	*0.001*
2	1.060	*0.001*	**1.451**	*0.001*
3	1.513	*0.021*	**1.614**	*0.021*
4	**2.155**	*0.004*	1.784	*0.001*
5	**3.065**	*0.021*	1.961	*0.001*
6	**4.354**	*0.052*	2.142	*0.001*

Note. The outcome variable for this decomposition analysis is problem gambling severity (continuous variable). It was performed on the combined sample from emerging and mature areas. Bolded numbers show the points at which the association between actual exposure and gambling severity changes between gamblers who are more exposed and the less exposed.

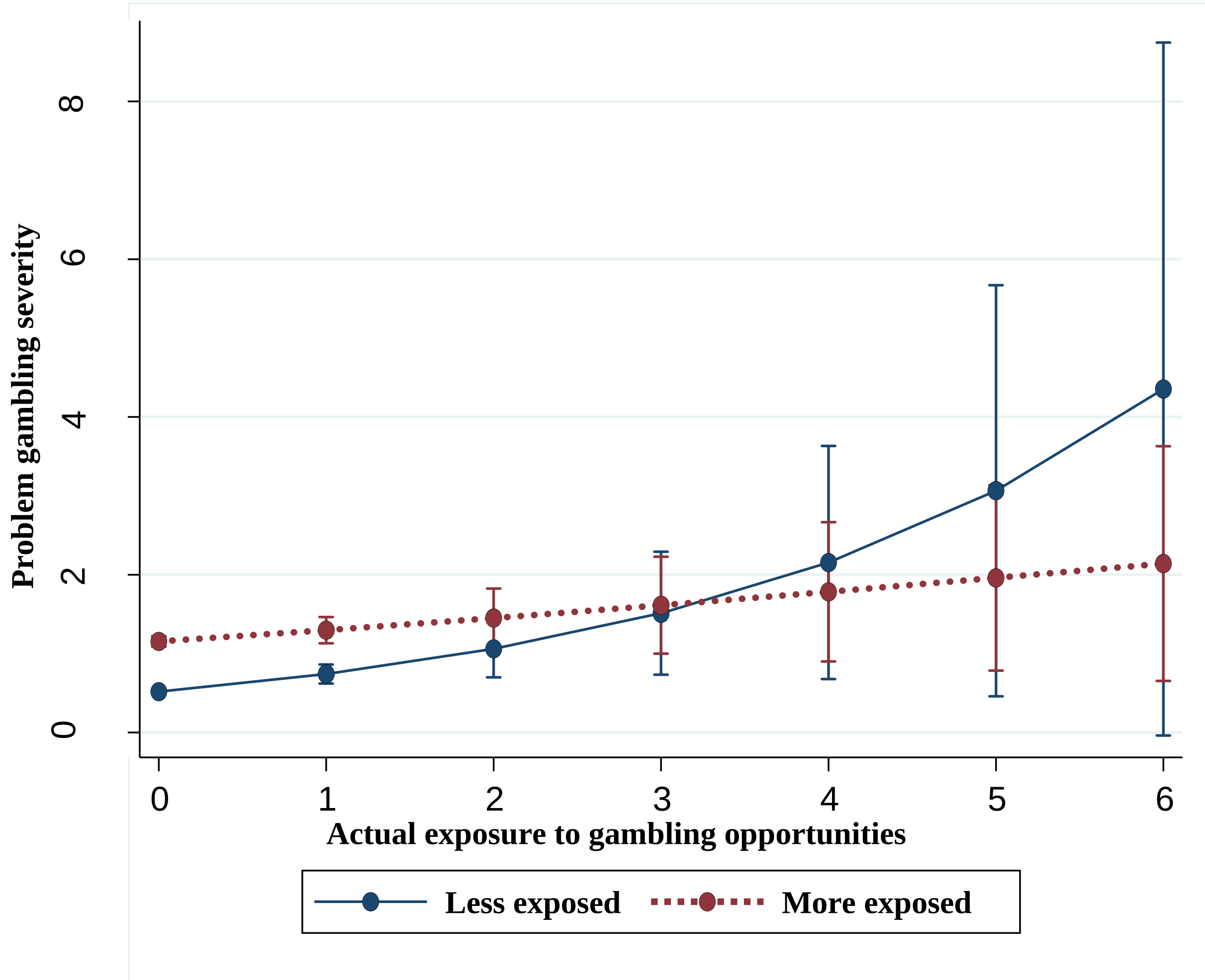

Figure 8: Interaction effects of actual and perceived exposure on problem gambling severity.

Discussion

The independent and relative contributions of actual and perceived gambling exposure on problem gambling risk and severity

The present study quantitatively examined the relative contributions of actual and perceived exposure to gambling opportunities on ARG and problem gambling severity. We estimated respondent's actual level of exposure to gambling opportunities based on the number of casinos, their per capita number of slot machines, and the travel distance to the nearest casino from home. Additionally, respondent's perceptions of exposure to gambling opportunities were assessed based on whether they believe they were more or less exposed to casinos and other gambling venues and in their communities. Both the actual and perceived measures of exposure were simultaneously correlated with problem gambling risk on one hand, and with problem gambling severity on the other hand.

We found that in the combined sample from emerging and mature areas, only actual exposure had a significant influence on the likelihood of being an ARG. The proportion of ARGs increased by 27.3% for each unit increase in the actual level of exposure. This risk further increased to 33.2% when respondents' demographic characteristics were controlled, suggesting that the influence of actual exposure on problem gambling risk cuts across demographic variables.

However, the association between perceived exposure and ARG was not significant in the combined sample when actual exposure is taken into account. This suggests that perceived exposure is not as important as actual exposure in predicting problem gambling risk among adult gamblers. More research is needed to provide a better understanding of the role of perception of exposure in the development of problematic gambling behaviour among adults.

Similarly, combined actual and perceived exposure measures were regressed against problem gambling severity. Both actual and perceived exposure predicted problem gambling severity in the combined sample. However, a stronger effect was found for perceived exposure compared to actual exposure. Although perceived exposure did not significantly predict problem gambling risk as indicated previously, it strongly predicts problem gambling severity among gamblers with PGSI scores of 1 or more. On the average, the problem gambling rate was 75.8% higher among gamblers who perceived themselves to be more exposed to gambling opportunities than those who did not.

The strong association between perceived exposure and problem gambling rates indicates a role for psychological processes in the development of problematic gambling behaviour among adults. Similar to the influence of erroneous beliefs about winning and other gambling fallacies on gambling behaviour (Ladouceur, Sylvain, Letarte, Giroux, & Jacques, 1998; Leonard & Williams, 2016; Morasco, Weinstock, Ledgerwood, & Petry, 2007; Rogers, 1998), the belief that gambling venues or machines are more available could be interpreted to mean that they are easily accessible or readily available. Such beliefs could lead some gamblers to regularly participate in gambling activities by decreasing concerns about barriers such as longer travel distance to gambling venues and not having the opportunity to use preferred gaming machines at a particular venue.

The independent and relative contributions of actual and perceived exposure separately for gamblers in emerging and mature areas

When both the actual and perceived exposure to gambling measures were examined simultaneously in emerging areas, neither of them significantly predicted the likelihood of being an ARG. These results suggest that among gamblers in areas where commercial gambling venues have recently been opened (for less than three years), gamblers' actual and perceived levels of exposure to gambling opportunities play the same role in influencing the likelihood of being an ARG.

However, in mature gambling areas, only perceived exposure predicted ARG. On average, the likelihood of being an ARG was 20.3% higher among gamblers who perceived themselves to be more exposed to gambling opportunities than the less exposed. For populations that have had access to gambling venues for three or more years, the likelihood of being an ARG greatly increases in response to perceptions of exposure to gambling opportunities rather than in response to the actual increases in gambling venues and machines.

We further assessed whether the relative effects of actual and perceived exposure on problem gambling severity differ for gamblers from emerging areas than those from mature areas. In emerging areas, problem gambling severity rates are associated with perceived and not with actual exposure. On average, problem gambling was 1.2-fold higher in gamblers who perceived that they were more exposed to opportunities than the less exposed. These findings corroborate those of the combined sample (*where problem gambling was 23.9% higher in gamblers who perceived themselves to be more exposed*), and both confirm the importance of perception as a predictor of problem gambling severity.

In mature areas, both actual and perceived exposure were associated with problem gambling severity. However, this association was a negative relationship. For example, a negative association was found between actual exposure and severity rates in mature areas such that severity rate decreased by 77.5% for each unit increase in the actual exposure score.

Similarly, compared to gamblers in emerging areas, perceived exposure was associated with a smaller increase in problem gambling severity in mature areas. Severity rates were 89.9%

higher (compared to 1.2-fold for those in emerging areas) in gamblers who perceived themselves to be more exposed to opportunities than in the less exposed gamblers. Overall, severity had a stronger association with perceived exposure than with actual exposure in emerging and mature areas.

Assessing the exposure and adaptation hypotheses with actual and perceived exposure measures

According to the exposure hypothesis (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012), ARG and severity rates increase as actual exposure to gambling opportunities increase. In contrast, proponents of the adaptation explanation argue that gamblers in mature areas are likely to adjust to the novelty of exposure and reduce their risk and rates of problem gambling even as their actual level of exposure increases (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012). We used the results for the association of actual and perceived exposure with problem gambling severity in emerging and mature areas to test these hypotheses. We are, however, unable to do so with the results for the likelihood of being an ARG, as neither the actual nor the perceived exposure demonstrated consistent associations with ARG among gamblers in emerging and mature areas.

This is the first study to use a perceptual measure of gambling exposure to test the exposure and adaptation hypotheses (Vasiliadis et al., 2013; Williams et al., 2012). In both emerging and mature areas, gamblers who perceive that they were more exposed to opportunities had higher overall gambling problems than those who did not have such a perception. However, when problem gambling severity in these areas is compared, the severity rate is higher in emerging areas than in mature areas among gamblers who perceive themselves to be more exposed. For example, problem gambling severity was 1.3-fold higher in emerging areas in gamblers who perceived themselves to be more exposed compared to 82.2% higher in the same sample from mature areas. In support of the adaptation hypothesis (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012), the finding indicate that problem gambling rates are 31.2% higher in emerging than in mature areas among gamblers who perceive themselves to be more exposed to opportunities.

Additionally, we tested both hypotheses with the actual exposure measure. In support of the exposure hypothesis (Williams et al., 2012), severity rates were positively associated with actual exposure in emerging areas, although this was not statistically significant. On the other hand, in support of the adaptation hypothesis (Williams et al., 2012), actual exposure had a negative association with problem gambling rates in mature areas (where gamblers have had access to casinos for three or more years). A unit increase in the actual exposure score led to a 76.7% decrease in problem gambling rates in mature areas. In line with the literature (Abbott, 2006; LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012), the actual exposure measure demonstrates that populations are likely to experience higher rates of gambling problems following the introduction of commercial gambling venues but rates are likely to decline as gamblers adjust to the novelty of gambling activities.

Interaction effects of actual and perceived gambling exposure on ARG and problem gambling severity

In the combined sample of emerging and mature areas, we found that the actual and perceived measures of gambling exposure had significant interaction effects on problem gambling rates but not on the likelihood of being an ARG. A decomposition analysis was performed to assess how the rates of problem gambling change across the scores on the actual exposure measure, separately for gamblers who perceived themselves to be more exposed and for those who did not. We found that the severity of problem gambling rates between those who perceive themselves to be more exposed and those who did not varied at different levels of their actual exposure. For gamblers with actual exposure scores of 0 to 3, rates were highest for those who perceived themselves to be more exposed and lowest for those who did not. For gamblers with 4 or more scores of actual exposure, the rates are highest for those who did not perceive they were more exposed to opportunities and lowest for those who did.

The interaction results suggest two possible patterns when there are increases in the numbers of venues or machines in an area. First, we expect a substantial increase in problem gambling rates among gamblers who perceive themselves to be more exposed to opportunities even when there is a small increase in the number of gambling venues and machines. Second, when there are large increases in the number of gambling venues and machines, the problem gambling rate is also likely to increase substantially among gamblers who perceive themselves to be not more exposed to opportunities.

Therefore, for gamblers who perceive themselves to be more exposed to gambling opportunities, any increases in the numbers of gambling venues and machines could result in more problem gamblers. On the other hand, among gamblers who perceive themselves to be not more exposed to opportunities, only large increases in the numbers of gambling venues and machines could result in greater increase in the number of problem gamblers. These interactions suggest that perceptions of gambling exposure increase problem gambling among gamblers with different levels of access to gambling venues and machines.

Strengths and limitations

A major strength of this study is the use of logistic and Poisson models of ZIP regression (Hall, 2000; Lambert, 1992; O'Hara & Kotze, 2010). This analysis performed two separate analyses simultaneously that allowed for the estimation of the importance of objective and subjective measures of gambling exposure. These simultaneous analyses allowed a comparison of the measures of exposure in terms of their ability to better explain problem gambling risk and severity. We identified that actual exposure has greater effects on problem gambling risk, while perceived exposure had stronger effects on problem gambling severity. Examining the relative effects of separate measures with count data in a single multivariate ZIP analysis produces more robust statistical results than doing so in separate conventional regression analyses, as explained previously in the analysis section (Famoye & Singh, 2006; Hall, 2000; Lambert, 1992; Rodriguez, 2007; Strawderman et al., 2006).

An important limitation of this study is that the ZIP regression requires that the data on the outcome variable is not overly dispersed (Famoye & Singh, 2006; Hall, 2000; Lambert, 1992; Ridout et al., 1998). Our analysis violated this assumption, as the variance (*6.0*) in the PGSI data was greater than the mean (*0.8*). The violation of this assumption has been found to bias results by either making it more or less statistically significant (Lambert, 1992; Ridout et al., 2001; Xiang, Lee, Yau, & McLachlan, 2007). However, the large sample size of the present study may have helped minimize potential bias from the overdispersion problem.

Additionally, the logistic component of the ZIP logistic regression cannot compare groups of respondents with non-zero scores such as low-risk, moderate, and problem gamblers. Since these gamblers have scores greater than 0 on the PGSI, the logistic component of ZIP combines them into a single group and compares them to those with a zero-total score. Thus, the logistic component of ZIP cannot compare, for example, low-risk or moderate-risk with problem gamblers. It can only identify factors that predict membership in the non-problem gambling group versus membership in the other gambling groups together.

Implications

The results from the logistic and Poisson models of the ZIP regression have practical relevance for the prevention and control of problem gambling risk and severity in the general population. In the combined and sub-samples from emerging and mature areas, actual exposure explained much of the problem gambling risk. This finding suggests that the risk of gamblers experiencing problems largely depends upon the number of gambling venues and machines accessible to them. Thus, reducing the number of gambling venues such as casinos and non-casino EGM outlets, and locating venues further away from residential areas could lead to lower problem gambling risk among gamblers.

Compared to actual exposure, perceived exposure has the greatest association with the severity of problem gambling in adult gamblers. Problem gambler severity rather than those at risk of problems increases as exposure increases. We are not aware of any preventive intervention for problem gambling that focuses on the perceptions of gamblers about their exposure to gambling opportunities. Since having the perception that there are more gambling venues increase the rates of problem gambling, activities that increase awareness of the availability of gambling venues in communities should be limited or reduced. These may include limiting the advertising of gambling products to the general public and locating gambling venues further away from residential areas and public places of gathering such as supermarkets and workplaces.

Theoretically, our findings provide support for the exposure and adaptation hypotheses (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012). Both actual and perceived exposure was associated with lower risk and severity of problem gambling as gamblers adjust to the novelty of gambling activities. Having three or more years of access to gambling venues appears to decrease problem gambling rates.

Conclusion

ARG and problem gambling severity are interrelated behaviours because increased risk typically leads to greater rates of problems. Past studies have not determined whether actual or perceived exposure to gambling opportunities has a greater influence on problem gambling risk or severity (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). Our findings address this unresolved question. While the logistic ZIP models identified actual exposure as an important predictor of ARG, the Poisson ZIP models identified perceived exposure as an important predictor of problem gambling severity.

The associations of actual and perceived exposure with ARG and problem gambling severity of problem gambling are different for gamblers in emerging and mature areas. Neither actual nor perceived exposure has a significant influence on ARG in emerging areas, but severity rates are more influenced by perceived exposure. In mature areas, perceived exposure has a greater impact on both ARG and the severity of problem gambling. Additionally, the interaction analysis indicates that the association between actual exposure and problem gambling severity differs by adult's perceptions of exposure.

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Chapter Seven: A mixed-methods examination of the PGSI gambler types and their differences in access to casino and non-casino EGM venues in Alberta and Tasmania.

A version of this chapter will be submitted to the *Journal of Gambling Studies* as: "Dei, S. M. O., Christensen, D. R., Awosoga, O., Lee, B. K., & Jackson, A. C. (to be submitted). A mixed-methods examination of the PGSI gambler types and their differences in access to casino and non-casino EGM venues in Alberta and Tasmania."

Abstract

The casino and non-casino EGM venues provide access to a wide range of gambling activities, and they account for the largest gambling involvement in many parts of the world following lotteries. The goal of this study was to quantitatively and qualitatively compare the four Problem Gambling Severity Index (PGSI) subtypes on access to casino and non-casino EGM venues, and whether their differences are related to their demographic characteristics, childhood adversities, and intimate relationship experiences. Mixed methods were used to achieve this objective using data from Tasmania and Alberta. Quantitative data were obtained from 4,991 Albertans and 2035 Tasmanians of the Social and Economic Impact of Gambling Surveys conducted in 2008/2009 and 2011, respectively. A purposive sample of 10 Albertans and 14 Tasmanians aged 18 years and older were interviewed. Descriptive statistics were used to analyze the quantitative data, and qualitative interviews were analyzed thematically. The quantitative results show that non-problem, low-risk, moderate-risk, and problem gamblers differ in their physical access to casino and non-casino EGM venues and their differences vary by gender and age. Qualitative data revealed that travel distance to casinos and its surrounding social opportunities strongly influence gamblers' choice of casinos, and gamblers with childhood adversities and intimate relationship problems gamble more regularly when living closer to a casino. The findings suggest that

proximity to a gambling venue plays an important role in influencing the gambling behaviour of individuals with childhood adversities and intimate relationship problems.

Keywords: PGSI gambler types, access to casinos, demographics, childhood adversity, intimate relationship problems.

Introduction

The PGSI identifies four subtype of gamblers: non-problem (PGSI = 0), low-risk (PGSI = 1-2), moderate-risk (PGSI = 3-7), and problem gamblers (PGSI = 8 or more) (Ferris & Wynne, 2001). About 95% of adult gamblers meet the non-problem, low-risk, and moderate-risk gambling criterion (Currie et al., 2010; Orford et al., 2010; Williams et al., 2012). Of these gamblers, non-problem gamblers represent about 85%, while low-risk and moderate-risk gamblers represent roughly 10% each. Problem gamblers generally constitute less than 5% of the adult gambling population (Currie et al., 2010; Williams et al., 2012). Research on the PGSI has found these subtypes to differ on demographics, histories of childhood adversities, and intimate relationship problems (Currie, Hodgins, & Casey, 2013; Dowling, Suomi, Jackson, & Lavis, 2015; Gainsbury, Russell, Blaszczynski, & Hing, 2015; Loo, Oei, & Raylu, 2011; Nower, Martins, Lin, & Blanco, 2013; Petry & Steinberg, 2005; Williams et al., 2012). The PGSI subtype differences in access to casinos have not been determined empirically (Adams et al., 2007; Doran, Marshall, & Mcmillen, 2007). The present study used quantitative and qualitative data to examine how PGSI subtype differences are associated with accessibility, and demographic, childhood, and intimate relationship characteristics.

Casino accessibility and PGSI subtypes

Casino and non-casino EGM venue are currently epicenters for gambling activities in many parts of the world. For example, government-regulated casinos were opened in the states of Nevada and New Jersey in 1931, and by 1993, they had become available in every state except for Utah and Hawaii (Thalheimer & Ali, 2003). In Australia and Canada, a number of location had casinos accessible to the public prior to the 1990s (Cosgrave & Klassen, 2009; Henriksson, 1996; Markham, Doran, & Young, 2014b). A national survey of 2630 Americans showed that casino gambling has the largest number of patrons in the United States (Thalheimer & Ali, 2003). In Canada and Australia, casinos have the highest number of gambling patrons following lotteries (Cosgrave & Klassen, 2009; Henriksson, 1996; Markham et al., 2014b).

Casinos provide access to a wide range of games, including EGMs, poker, and table games (Currie, Casey, & Hodgins, 2010; Orford, Wardle, Griffiths, Sproston, & Erens, 2010; Williams et al., 2012). However, casinos are not uniformly distributed within countries, so they are physically more accessible to some people than others (Marshall, 2005; Marshall & Baker, 2001; Williams, Belanger, & Arthur, 2011). A gambler's proximity to a casino has been measured mostly as the travel distance between the gambler's place of residence and the nearest casino (Pearce et al., 2008; Sévigny et al., 2008). Researchers have used different cutoffs to categorize the travel distances between residential areas and casinos into groups of proximity. Some have used cutoffs of 0-5 km, 5.1-10 km, and more than 10 km to group gamblers into different proximities to casinos (Storer, Abbott, & Stubbs, 2009; Vasiliadis, Jackson, Christensen, & Francis, 2013; Welte, Wieczorek, Barnes, Tidwell, & Hoffman, 2004; Williams et al., 2012). Others have used longer travel distance cutoffs such as 0-30 km or more for the categorization (Rush, Veldhuizen, & Adlaf, 2007; Welte, Barnes, Tidwell, Hoffman, & Wieczorek, 2016; Williams et al., 2011).

The proximity of a casino to the gamblers influences casino gambling. Gamblers located close to casinos tend to gamble more frequently and have higher gambling expenditures (Doran et al., 2007; Ofori Dei, Christensen, Awosoga, Lee, & Jackson, 2020; St-Pierre, Walker, Derevensky, & Gupta, 2014; Storer, Abbott, & Stubbs, 2009; Vasiliadis, Jackson, Christensen, & Francis, 2013; Williams et al., 2012; Young, 2010). Research has mainly described the proximities of problem gamblers to casinos (Adams et al., 2007; Pearce et al., 2008; Sévigny et al., 2008; Welte et al., 2004). For example, Ofori et al. (2020) found that problem gamblers relative to the other gambler types increase in numbers by 4%, with each unit reduction in travel distance to the nearest Albertan casino. In some studies, most problem gamblers have been found to gamble in casinos located 5 km from their home (Stone et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012), while very few gamblers travel to casinos located farther than 10 km from home (Stone et al., 2014; Vasiliadis et al., 2013; Williams et al., 2012).

In the province of Ontario in Canada, Rush, Veldhuizen, and Adlaf (2007) found that problem gamblers were more likely to cluster in neighbourhoods that have casinos, a finding that suggests that problem gamblers tend to be located close to gambling venues. A similar finding is reported by a study conducted in the Australian capital territory. Using geographical information systems data, Marshall (2004) performed a spatial analysis of the distribution of gambling expenditure and found higher expenditure in gamblers who gamble in their local areas. Additionally, Gerstein et al. (1999) compared the rate of pathological gambling in gamblers who lived 80 km from a casino to those living farther away and found a higher rate in the former group. Another study found that the percentage of gamblers drops from 78% for those who live within 30 miles to 74% for those who live farther away (Welte et al., 2016). Frequent and problem gamblers mostly gambled at casinos within 30 miles from home (Welte et al., 2016). These research findings show that regular and problem gamblers might have closer geographical proximity to a casino.

Characteristics of casino gamblers and PGSI subtypes

A higher number of at-risk gamblers gamble at casinos, and demographically, they are mostly males and older, though younger people are also more involved (Currie et al., 2010; Welte et al., 2002; Williams et al., 2012). Most low-risk, moderate-risk, and problem casino gamblers have childhood histories of parental neglect, abuse, and trauma (Felsher et al., 2010; Grant & Kim, 2002; Hodgins et al., 2010; Imperatori et al., 2017; Petry & Steinberg, 2005). Intimate relationship problems such as breakups, assaults, abuse, distress, and others are also common in at-risk casino gamblers (Afifi, Brownridge, MacMillan, & Sareen, 2010; Dowling et al., 2014; Dowling et al., 2016; Hodgins, Shead, & Makarchuk, 2007; Keen, Pickering, Wieczorek, & Blaszczynski, 2015; Korman et al., 2008; Steinberg, 1993; Suomi et al., 2013). These childhood adversities and intimate relationship problems are more prevalent in problem than in low-risk and moderate-risk casino gamblers (Afifi, Brownridge, et al., 2010; Dowling et al., 2016; Felsher et al., 2010; Keen et al., 2015; Petry & Steinberg, 2005). However, previous research has not examined whether the PGSI subtype differences in access to casinos may reflect their differences in their demographic, childhood adversities, and intimate relationship characteristics.

The purpose of the study

There is no research comparing the four PGSI subtypes on their travel distances to the nearest casino and non-casino EGM venues, and by their demographic characteristics, childhood adversities, and intimate relationship problems. It is possible that low-risk, moderate-risk, and problem gamblers may live closer to casinos than non-problem gamblers. Similarly, people with childhood adversities and intimate relationship problems might use gambling to cope with negative emotions, and as a result, may live closer to a gambling venue (Afifi, Brownridge, et al., 2010). Additionally, since men, younger people, and residents of disadvantaged areas gamble more frequently (Afifi, Brownridge, et al., 2010; Afifi, Cox, Martens, Sareen, & Enns, 2010b; Petry & Steinberg, 2005), they may live closer to gambling venues. The following research questions are addressed:

1) To what extent do non-problem, low-risk, moderate-risk, and problem gamblers differ in their proximity to the nearest casino and non-casino EGM venues, and do their differences vary by demographic characteristics?
2) What accessibility factors influence gamblers' decisions with access to a casino, and how do experience with childhood adversities and intimate partner relationship problems impact the gambling behaviours of gamblers who live close to casino and non-casino EGM venues compared to those living farther away?

Methods

Mixed methods research design

Both quantitative and qualitative data from Alberta in Canada and Tasmania in Australia were used to compare the PGSI subtypes on casino accessibility. The quantitative data describe the PGSI subtype differences in proximity to casino and non-casino-EGM venues, and by their demographic characteristics. Quantitative data on participants PGSI scores, demographic characteristics, and travel distance to the nearest casino were obtained from the Social and Economic Impact of Gambling Surveys conducted in Alberta in 2008 and 2009 (Williams, Belanger, & Arthur, 2011), and in Tasmania in 2011/2012 (ACG; The Allen Consulting Group, 2011). A naturalistic qualitative descriptive method (Lincoln, 2007; Sandelowski, 2000) was used identify the issues that the PGSI subtypes consider when accessing gambling venues in their communities, and whether those decisions are influenced by childhood and intimate relationship experiences. A descriptive qualitative research design explores participants' experiences with an event through interviews but the interpretations of experiences are less detailed (Sandelowski, 2000, 2009).

Study participants

In the quantitative study, a total of 4,991 Albertans (Williams et al., 2011) and 2035 Tasmanians (ACG, 2011) aged 18 years and older participants with PGSI scores of 0 or higher and complete data on all variables used in the quantitative study were analyzed. The Albertans were recruited with posters at gambling venues and other public places and advertisement on the Kijiji website in 2018. Albertan qualitative participants were not part of the 2008 and 2009 SEIGA surveys. The Tasmanian qualitative participants were part of the 2011 SEIGT survey but interviews were conducted with selected participants in 2015. The present study used data on participants recruited from the eight Tasmanian LGAs. For both the Albertan and Tasmanian surveys, a random digital dial telephone call was placed to households to recruit adult gamblers. Details of the design and measures of the Albertan and Tasmanian surveys are described elsewhere (ACG, 2011; Williams et al., 2011).

A purposive sample of 10 Albertan and 14 Tasmanian gamblers aged 18 years and older were interviewed for the qualitative study. Participants were screened with the nine-item PGSI questionnaire to determine their problem gambling severity levels. Albertan participants received $50 gift cards for participation, while Tasmanian participants received no honorarium.

Procedure

The quantitative study administered a questionnaire via telephone to the Alberta and Tasmania survey participants by trained personnel. A small supplementary sample of Albertans received the questionnaire via email. Survey questions covered characteristics such as age, gender, place of residence, problem gambling behaviour, and travel distance to the nearest casino. Gender was defined as male or female, and age, initially measured as a continuous variable, was categorized into young (18 to 39 yrs.), middle-aged (40 to 64 yrs.), and older (65 yrs. and above). Albertan respondents were recruited from four divisional census areas, while Tasmanians were recruited from eight local government areas (LGAs). Participants with PGSI scores of 0 are referred to as non-problem gamblers, 1-2 as low-risk gamblers, 3-7 as moderate-risk gamblers, and a score of 8 or higher as problem gamblers (Ferris & Wynne, 2001). Participants' travel distances to the nearest casinos from home were assessed in kilometers and categorized into those living less than 5km from a venue, 5 km to 10 km, and more than 10 km.

In the qualitative study, semi-structured interviews used open-ended questions to explore participants' experiences with gambling behaviour, access to casinos, childhood adversities, and intimate relationships (see Appendix B). These questions were created by the first author as no validated questions were available that examined the adverse childhood adversities and intimate relationship experiences in gamblers. Each interview lasted about an hour, and were audio recorded. Albertan interviews were conducted by the first author of this study, and Tasmanians were interviewed by the University of Melbourne research team that conducted the 2011 survey. All participants signed informed consent (Appendix D) form before the interviews. Information on demographics such as gender, age, and place of residence were collected. Data were collected over 14 months in Alberta and 12 months in Tasmania, with studies approved by the University of Lethbridge (ethics #: 2016-061) and the University of Melbourne (ethics #: 1340411.1). Only participants who reported availability and adverse experience data were included in the qualitative analysis.

Data analysis

Descriptive statistics such as percentages and frequencies were used to analyze the quantitative data. First, participant's gender, age, place of residence, gambling behaviours, and access to the nearest casino were described in percentages. A series of cross-tabulation analyses were performed to examine the PGSI subtype differences in proximity to casino and non-casino-EGM venues (*henceforth gambling venue*), and by their gender, age, and place of residence. All analyses were descriptive and did not examine statistical significance. Weighted categorical data were analyzed with SPSS version 26.

Interview data analysis followed the thematic analysis procedures of Braun and Clarke (2006): familiarization with data by reading transcripts multiple times, coding participants' responses into categories, and reviewing and refining categories into themes that accurately reflect participants' narratives. All recorded audio interviews were first transcribed verbatim. Transcribed data were managed and coded manually using MS-word. Prior to the coding process, participants' transcripts were verified with their audiotapes to ensure their accuracy. Each transcript was read many times to gain greater insight into participants' responses, and notes were made. Patterns in participants' interview responses were identified and organized into categories of similarities. Categories of patterns were compared, first, within each transcript, and second, across transcripts to identify similarities in responses. An inductive approach was used to identify and refine categories of responses into sub-and major themes that describe participants' experiences with access to casinos and other issues studied.

Findings

Quantitative results

Participants' demographic characteristics

Table 29 shows that most Albertan and Tasmanian quantitative participants were, respectively, female (*52.5% versus 51.6%*), middle-aged adults (*54.4% versus 43.9%*), residents of the Edmonton area (*40.8%*) and the Launceston LGAs (*29%*), non-problem gamblers (*81.9% versus 86.1%*), non-problem gamblers (*81.9% versus 86.1%*), and live more than 10 km from the closest casino and non-casino-EGM venues (*50.5% versus 43.3%*).

Table 29. Descriptive characteristics of Albertan and Tasmanian respondents of quantitative study

Variables	Alberta (Unweighted sample = 4991)	Tasmania (Unweighted sample = 2035)
	Percentage (%)	
Gender		
Female	52.5	51.6
Male	47.5	48.4
Age groups		
Young adults (*18 to 39 yrs.*)	12.1	38.2
Middle-aged adults (*40 to 64 yrs.*)	54.4	43.9
Older adults (*65 yrs. and above*)	33.5	17.9
Place of residence (Alberta)		
Southern Alberta	8.1	
Calgary areas	37.3	
Edmonton areas	40.8	
Northern Alberta	13.8	
LGAs (Tasmania)		
Brighton		5.4
Break O’Day		2.7
Glenorchy		21.5
Devonport		11.9
Circular Head		3.2
Launceston		29.0
Sorell		5.4

Clarence		20.8
Types of gamblers		
Non-problem	81.9	86.1
Low-risk	10.4	10.0
Moderate-risk	5.7	2.5
Problem	2.0	1.3
Access to gambling		
0-5km	23.5	39.8
5.1-10km	26.0	16.9
More than 10km	50.5	43.3

Note. Reported percentages are from weighted data.

PGSI subtypes and travel distance to the nearest gambling venue

In Table 30 (values not in parentheses are for Albertan participants), most Albertan low-risk (35%), moderate-risk (38%), and problem (36%) gamblers lived within 5km of the nearest gambling venue. A higher proportion (34%) of non-problem gamblers lived more than 10 km from a venue. Overall, moderate-risk and problem gamblers had the closest gambling venue proximity compared to low-risk and non-problem gamblers. The values in the parentheses show that in Tasmania, more problem (50.60%) and low-risk (50%) gamblers lived within 5 km of a gambling venue, moderate-risk gamblers (41%) are more likely to live more than 5 km, and non-problem gamblers (37%) lived more than 10 km. The Tasmanian distribution differs slightly from that of Alberta, where moderate-risk and problem gamblers have the closest gambling venue proximity.

Table 30. Albertan and Tasmanian PGSI subtypes differences in proximities to a gambling venue

	Non-problem gambler	Low-risk gambler	Moderate-risk gambler	Problem gambler
Proximity to venue	Percentage (%)			
0-5 km	32.7 (29.0)	34.9 (50.2)	37.6 (28.0)	36.2 (50.6)
5.1-10 km	33.4 (34.4)	33.0 (25.8)	32.9 (41.0)	34.3 (36.6)
>10 km	33.9 (36.6)	32.1 (24.0)	29.5 (31.0)	29.5 (12.8)

Note. Reported percentages are from weighted data. Tasmania percentage values are in parentheses.

PGSI subtype differences in access to the nearest gambling venue by demographics

Table 31 shows that a large proportion of Albertan male (47.5%) and female (41.1%) problem gamblers, respectively, lived within 5 km of and more than 10 km from the nearest gambling venue. Both male and female moderate-risk gamblers lived 5 km from a gambling venue, while low-risk gamblers of both genders mostly live within 5 km (38%) and between 5.1 km and 10 km (35.7%), respectively. Non-problem gamblers of both genders mostly live more than 10 km from a gambling venue (34.2% for males and 33.6% for females). For Tasmania, most male (*50.1% versus 49%*) and female (*49.7% versus 77.4%*) low-risk and problem gamblers lived within 5km of a gambling venue. Among moderate-risk gamblers, females (50.0%) lived mostly within 5 km, and males (43.05%) lived between 5.1km and 10km. Non-problem gamblers of both genders (36.97% for males and 35.98% for females) mostly live more than 10 km away.

Table 31. The distribution of Alberta PGSI subtypes at three proximities to a gambling venue by gender

		Non-problem gambler	Low-risk gambler	Moderate-risk gambler	Problem gambler
Proximity to venue		Percentage (%)			
0-5 km	Male	32.0 (29.5)	38.0 (50.1)	34.5 (22.8)	47.5 (49.0)
	Female	33.4 (28.4)	29.7 (49.7)	40.7 (50.0)	20.1 (77.4)
5.1-10 km	Male	33.9 (33.5)	31.3 (25.4)	31.9 (43.1)	31.1 (38.9)
	Female	33.0 (35.7)	35.7 (27.0)	33.9 (19.9)	38.8 (0.0)
>10 km	Male	34.2 (37.0)	30.7 (24.5)	33.7 (34.1)	21.3 (12.1)
	Female	33.6 (36.0)	34.6 (23.3)	25.4 (30.2)	41.1 (22.6)

Note. Reported percentages are from weighted data. Tasmania percentage values are in parentheses.

In Table 32, young Albertans with low-risk (39.2%), moderate-risk (39.4%), and problem (40.1%) gambling behaviour mostly live within 5 km from a gambling venue, while their middle-aged counterparts mostly lived between 5.1 km and 10 km. Older low-risk (41.5%) and moderate-risk (49.8%) gamblers are more concentrated between 5.1 km and 10 km from a gambling venue, but older problem gamblers (73.3%) mostly live more than 10 km. Non-problem gamblers of all age groups are distributed almost evenly across the proximities. In contrast, Tasmanians of all age groups mostly live within 5km from a gambling venue (52.6% for young, 47.4% for middle-aged, and 100% for older adults). Most (or over 33%) non-problem gamblers of all age groups lived more than 10 km from a gambling venue. Moderate-risk and low-risk gamblers of all age groups are widely distributed within each study area.

Table 32. The distribution of Alberta PGSI subtypes at three proximities to a gambling venue by age

		Non-problem gambler	Low-risk gambler	Moderate-risk gambler	Problem gambler
Proximity to venue		Percentage (%)			
0-5 km	Young	31.3 (23.8)	39.2 (71.3)	39.4 (10.0)	40.1 (52.6)
	Middle age	33.4 (31.7)	31.5 (33.9)	34.3 (54.4)	36.2 (47.4)
	Older	33.8 (33.5)	27.3 (33.4)	39.4 (13.6)	20.4 (100.0)
5.1-10 km	Young	35.3 (37.5)	28.7 (5.4)	22.7 (63.5)	36.4 (36.9)
	Middle age	32.5 (31.8)	34.8 (43.5)	41.7 (18.0)	37.7 (38.6)
	Older	32.8 (33.5)	41.5 (37.4)	49.8 (0.0)	6.3 (0.0)
>10 km	Young	33.3 (38.7)	32.1 (23.3)	37.9 (24.6)	23.5 (10.5)
	Middle age	34.1 (36.5)	33.7 (22.6)	24.1 (27.6)	26.1 (14.0)
	Older	33.4 (33.5)	31.3 (29.2)	22.7 (86.5)	73.3 (0.0)

Note. Reported percentages are from weighted data. Tasmania percentage values are in parentheses.

Differences between the PGSI subtypes in their proximity to gambling venues by place of residence were examined (see Tables 1 and 2 in Appendix F). In both Alberta and Tasmania, all problem gamblers are more concentrated closer to gambling venues. Across the Albertan census areas and Tasmanian LGAs, problem gamblers mostly live within 5 km of a gambling venue. All the other PGSI subtypes were spread out across the areas.

Qualitative results

Descriptive characteristics of participants

Ten Albertan (seven males) and fourteen Tasmanian (nine males) gamblers were analysed. The Albertans had an average age of 45 years and 50 years for Tasmanians. For Albertan participants, there were three non-problem gamblers, two low-risk gamblers, one moderate-risk gambler, and four problem gamblers. For Tasmanians, there were five non-problem gamblers, five low-risk gamblers, four moderate-risk gamblers, and there were no problem gamblers. Non-problem and low-risk gamblers were called occasional gamblers, and moderate-risk and problem gamblers were called regular gamblers. This classification was made because the PGSI subtypes are not proportionally distributed across the study areas. Albertans and Tasmanians, respectively, travel 1km to 240km and 1km to 34km to the nearest gambling venue. Gamblers had easier access to gambling venues when they travel up to 10km and difficult access when travel distances are over 10 km.

There were five Albertan and seven Tasmanian, respectively, regular and occasional gamblers each. Regular gamblers in each area gambled at least 70 times in the past year (see Tables 3 and 4 in Appendix F). Regular Albertan and Tasmanian gamblers had easier access to gambling venues than occasional gamblers. In both areas, gambling expenditure is higher in gamblers with easier access to gambling venues and they gamble more than $60 weekly (see Tables 5 and 6 in Appendix F).

Some of the participants revealed through interviews that they were abused, felt lonely, used drugs, and experienced stressors as children (see Tables 7 and 8 in Appendix F). Other experienced problems such as abuse, drug use, instability, and feelings of isolation in their intimate relationships.

Emerging categories of themes

The Albertan and Tasmanian gamblers revealed that their experiences with access to gambling venues covered issues such as travel distance, number of gambling machines, location of a gambling venue, and the internal attractions of a gambling venue (see Table 33). Their childhood and intimate relationship experiences shape gambling behaviours of gamblers with easier and difficult access differently. Pseudonym identifications are used to identify participants.

Table 33. Categories of gamblers' experiences with access to a gambling venue

Major categories	Sub-categories
Distance to a venue	Travel time Multiple means of transportation
Number of machines	More machines Varieties of machines
Location of a venue	Close to shopping centers Close to city center Close to public transit Close to other entertainment centers
Venue attraction	Clean venue Lights and sound Free drink and food Friendly attitudes of staff

Distance to a venue (shorter and more convenient journey). Both Tasmanians and Albertans gambled at gambling venues that had shorter travel time and reachable by multiple means of transportation. Gamblers relying on public transport prefer venues close to transit lines and within walking distances, whereas those with personal transport could gamble at venue at any distance. One participant explained that he rarely gambles at gambling venues because they are usually located outside the city boundaries. Gambling venues with shorter travel time are preferred by most gamblers.

> "It is easy for me because I can easily get on the highway and it is straight down. I also spend a lot of time on the south side where the casino is, so I am close location wise (**Ca, Female, Alberta**)."

> "Yes [distance] it does. I think the further it is, for instance me I don't drive, because it is close I can go….It will not be motivating as it would be when you are 3 to 4 blocks away. When you are around those places, it is always on your mind (**Cl, Male, Alberta**)."

Number of machines (Having more choices). Some gamblers prefer gambling venues with more gambling machines, but others were less concerned about this. Poker players from Alberta and Tasmania explained that they sometimes must wait for several minutes to play poker at casinos with fewer machines. Venues with more machines increase choices for gambling and reduce waiting time for some games, making the venue more accessible to gamblers with different gambling preferences. No gambler mentioned that not having adequate machines in a casino had constrained their gambling.

…that is why you go to the casino because you have a lot more selection. It is the only place in town I can play the card games. If you are bored with one, you can just go for a different one. There is much flexibility (**Au, Male, Alberta**).

"When I want to play poker I go to the casino. However, there is not always a seat available at the poker table. So I have spent my time waiting for someone to leave before I start to play and that is the time I really wish there was a lot of other stuff around (**Th, Male, Alberta**)."

Location of a venue (killing many birds with one stone). Gambling venues located close to shopping centers, city centers, public transit, entertainment centers, and other public are preferred. Gamblers referred to gambling venues close to these facilities as "advantageous venues" because they could gamble and carry out other activities such as shopping at the same time. They were less concerned with travel distance if the gambling venue is in an advantageous location. Such casinos offered gamblers the opportunity to 'kill many birds with one stone' (do other things together with gambling).

"Where I live is an hour to the closest casino. It also got one of the largest trading center in the area. So there other reasons to go to the trading center. Consequently, you can shop and do groceries. You might have to go there to do some banking, you might have to get loyal change or local Walmart, everything like this. Every time you do that on your way home, you stop at that casino because it is close and is entertainment for us (**To, Male, Alberta**)."

"[I end up going to the casino because] I would be going that direction anyway to do my shopping (**Cr, Female, Alberta**)."

"….Crown casino has a movie theater and a shopping center so. Like you can go there and not spend any money and still have a great day and so we have a lot of people going there. So you can go there for shopping and end up playing poker. It is right in the middle of the city with easy public transport (**Ma, Male, Alberta**)."

Venue attraction (Beauty and incentives). Gamblers were mostly attracted to gambling venues with a clean floor, friendly staff, flashing lights and sounds, and that offers free drink and food. They felt excited and alive when lights flash, and when they hear sounds that accompany wins on EGMs. One gambler explained that "lights and sounds have a psychological impact because they increase interest and make the game more attractive (**Cr, Female, Alberta**)." Another explained that he "is more active when gambling in venues that pump oxygen onto the floor (**Cl, Male, Alberta**)."

"Those running this place are not stupid. For instance, you sometimes get free pops, and you end up spending money on the machines… People that don't gamble don't see all the flashing light and stuff like that. People that do gamble they will go out their way to look for it (**Cl, Male, Alberta**)."

Venues with friendly staff and those that provide free drinks or food attract more gamblers. One female gambler mentioned that she liked "being served with a free drink when gambling (**Tc, Female, Alberta**)." For most gamblers, large casinos in places like Toronto, Las Vegas and Melbourne were more attractive because most offer free drinks and sometimes food.

"Even if you are tired from your work, you just feel like going to the casino. The casino staff are very friendly, and you get a drink for free anytime you want. It feels so comfortable being at the casino (**Es, Female, Alberta**)."

"I go to a local casino, about an hour drive. They have best food, the best chefs, and the best innovative menus. So that is a plus. The particular atmosphere in the casino with the staff is restrained polite. Sometimes they call my name because I played the card there (**To, Male, Alberta**)."

Childhood adversities and intimate relationship problems. Some gamblers were abused, used drugs, were neglected, had stressors, and had unstable parenting during childhood. These adversities were common in gamblers who were raised in violent and unstable homes.

> “Yes, [I] experienced something like that [abuse]. I experienced that with my mother. I was quite type of a person and she used to beat us. My brother and my sister, she used to beat us. We grew up in a family, where every day you see your parents fighting each other. These were traumatic when I was a child. So, when I grew up, I had in my mind that someday I will marry a guy who will fight my mom (**Es, Female, Alberta**).”

> “It was very, very sad. My father was a basher and he used to bash my mum. And we all suffered **(Ta, Male, Tasmania**).”

> “It wasn’t good. My father left home when I was about five and a half. He was a violent man; a drinker, a gambler, a robber. He stole money. He stole goods. He was a nasty piece of work (**Ti, Male, Tasmania**).”

> “I spent three years in a prison. I started going to the casino after jail. Before that I was doing alcohol and drugs in circle. The casino was a harm reduction because if I am not doing drugs; this is good. It (gambling) was harmless (**Ta, Male, Alberta**).”

Additionally, a number of gamblers had a partner die, a breakup, were abused, felt isolated, had an unstable relationship, and other stressors in their intimate relationships.

> “I was having a troubled relationship at the time and in particular my partner at the time I guess we both had a crack at gambling and had a small win.... So the main stressor was the relationship difficulty (**Tg, Male, Tasmania**).”

> “I just finished up the divorce now. Actually, it was tough. I felt she did not contribute, and I was always working, and she sat at home and I almost got envious. It felt like she

> won’t help me. That was why I went gambling because I wanted an extra cash that she did not. It was a way to get away too (**Au, Male, Alberta**).”

Many of the gamblers with childhood and intimate relationship problems gambled regularly and had easier access to gambling venues. Childhood and intimate relationship problems seem to increase problematic gambling in gamblers who lived close to gambling venues than in those who live farther away.

Discussion

Quantitative data from Alberta and Tasmania were used to determine differences between non-problem, low-risk, moderate-risk, and problem gamblers in their proximities to gambling venues and by their demographic characteristics. Interviews were conducted with these four PGSI subtypes from Alberta and Tasmania to identify the specific accessibility issues they considered to be more important when accessing community gambling venues and determined whether childhood adversities and intimate relationship experiences impacted differently the gambling behaviours of those gamblers with shorter and those with longer travel distances to the nearest gambling venues.

Both the quantitative and qualitative findings confirm that moderate-risk and problem gamblers tend to live closer to gambling venues than low-risk gamblers and non-problem gamblers. Moreover, in the two study areas and for both the quantitative and qualitative participants, problem gamblers tend to have the closest proximity to gambling venues. The quantitative data from both Alberta and Tasmania indicated that male and young gamblers mostly live closer to gambling venues. However, interviews with the gamblers revealed that although male and young gamblers acknowledged the influence of proximity on gambling participation, they believed it had little impact on their gambling frequency.

PGSI subtype differences in access to gambling venues

Although the Albertan gamblers have longer travel distances than Tasmanians, the four PGSI subtypes in both areas showed almost similar proximity to gambling venues. In both areas, non-problem gamblers live farthest away from gambling venues compared to the other subtypes. A higher percentage of low-risk, moderate-risk, and problem gamblers (*referred to as any-risk* *gamblers*) live within 10km of a gambling venue in both Alberta and Tasmania. Variations in travel distance to gambling venues were observed in these any-risk gamblers.

Generally, problem gamblers in Alberta and Tasmania have the closest proximity to gambling venues, followed by moderate-risk and low-risk gamblers. A higher percentage of Albertan problem gamblers live within 5 km of a gambling venue than Tasmanians, and this may be due to the differences in the geographic distribution of population in these areas. Some researchers have argued that problem gamblers tend to be frequent gamblers, and for this reason, may prefer to live closer to gambling venues for the purpose of ease of access (Abbott, 2006; Vasiliadis et al., 2013; Volberg, 1994; Williams et al., 2012).

PGSI subtype differences in proximity to gambling venues by gender, age, and place of residence

In Alberta, male low-risk, moderate-risk, and problem gamblers tend to live within 5km of the nearest gambling venues. Their female low-risk and moderate-risk gamblers mostly live more than 5km away. Surprisingly, most female problem gamblers were located farthest away. A slightly different pattern was observed in Tasmania, where any-risk gamblers of both genders were more concentrated within 5km of a gambling venue. In both areas, male and female non-problem gamblers lived farther than 10km from a gambling venue. The findings suggest that with one exception (female problem gamblers) any-risk gamblers of both genders in Alberta and Tasmania live closer to gambling venues than non-problem gamblers.

In Alberta, only young problem gamblers lived closer to gambling venues. Their middle-aged and older adults with the same gambling behaviour were likely to live farther than 5km. A slightly different distribution is observed in Tasmania, where problem gamblers of all age groups lived closer to gambling venues. Similarly, non-problem gamblers of all age groups in both areas live farthest from a gambling venue. For low-risk and moderate-risk gamblers, their proximity to gambling venues does not vary clearly by age groups.

Gambling venue accessibility differences in non-problem, low-risk, moderate-risk, and problem gamblers were examined to determine whether there were geographical patterns in Alberta and Tasmania. In Alberta, the PGSI subtypes differences in gambling venue access were compared across northern, Edmonton, Calgary, and southern census geographic areas. For Tasmanians, their differences were across eight LGAs. For all comparisons, only problem gamblers showed a clear geographical distribution pattern in their proximity to the nearest gambling venue. Generally, most problem gamblers in the five Albertan census and eight Tasmanian residential areas live within 5km of the nearest gambling venues. Comparatively, moderate-risk, low-risk, and non-problem gamblers differences in proximity to gambling venues do not a clear distribution pattern across the residential areas.

Gamblers experiences with access to the nearest gambling venues

As reported in previous studies (Abbott, 2006; Vasiliadis et al., 2013; Volberg, 1994; Williams et al., 2012), gambling venues tend to be more accessible to gamblers when located close to home, the workplace, and public places of gathering. Gambling venues in these locations could be reached by different means of transportation, including walking, driving, and travelling by public transit. Both shorter travel times and multiple means of transportation make gambling venues more accessible to gamblers with diverse socioeconomic backgrounds.

Gamblers acknowledged the importance of the location of a gambling venue in their experiences with access. gambling venues that are located close to shopping malls, city centers, public transit lines, and other entertainment facilities are preferred by most gamblers. For example, gambling venues located close to a shopping mall attract more female gamblers regardless of travel distance and other concerns. Similarly, male gamblers also seem to be more attracted to gambling venues close to other sources of entertainment.

The shopping or entertainment opportunities offered by the surrounding environments of a gambling venue minimize gamblers' concerns about travel distance because they could engage in other equally important activities (*e.g., getting groceries*). This finding may be one of the reasons why some gamblers gamble at venues farther away from home or workplace, as found in several other studies (Abbott, 2006; Vasiliadis et al., 2013; Volberg, 1994; Williams et al., 2012). A gambler may decide to gamble at a distant gambling venue because other opportunities are present in the surroundings of the venue.

The number of machines and the internal attractions of a gambling venue is not of greater importance to gamblers as compared to travel distance and venue location. For example, gamblers prefer venues with more machines, but they tend to also gamble in gambling venues with fewer machines. This might be explained by the fact that most gambling venues in western countries tend to have longer operating hours, making it possible for venues with fewer machine to accommodate patrons at different times of the day. Similarly, the gambling venue 's interior features such as free food or drink, lights, sounds, and friendly staff, attract gamblers but have a lesser influence on access to gambling venues. Although good reception by the staff of gambling venues and other incentives provided to gamblers, may not strongly motivate gamblers to choose one venue over another.

Gamblers with adverse childhood adversities and intimate partner relationship problems tend to gamble problematically if they live close to a gambling venue. As found in earlier studies (Felsher et al., 2010; Grant & Kim, 2002; Hodgins et al., 2010; Imperatori et al., 2017; Petry &

Steinberg, 2005), most regular gamblers had histories of childhood adversities, including abuse, neglect, drug use, and unstable parenting. Few gamblers reported having problems in their intimate relationships, but the majority of such gamblers gambled regularly when they live close to gambling venues. Gamblers with childhood adversities are more likely to gamble regularly when located close to gambling venues than those with intimate relationship problems. Several studies have consistently found high gambling frequency in gamblers with childhood adversities (Felsher et al., 2010; Grant & Kim, 2002; Hodgins et al., 2010; Imperatori et al., 2017; Petry & Steinberg, 2005).

As found in previous studies, some individuals use gambling to cope with childhood adversities and intimate relationship problems. Therefore, gamblers with histories of adversities and live closer to a gambling venue may gamble regularly as a means to deal with negative emotions from life adversities (Felsher et al., 2010; Grant & Kim, 2002; Hodgins et al., 2010; Imperatori et al., 2017; Petry & Steinberg, 2005).

Conclusion and implications

The contributions of this study to the literature are many. The quantitative results from Alberta and Tasmania show that low-risk, moderate-risk, and problem gamblers have closer proximity to gambling venues than non-problem gamblers. These PGSI subtypes differences in proximity to gambling venues vary by gender and age but not by place of residence. For example, males and young low-risk, moderate-risk, and problem gamblers are more concentrated close to gambling venues than non-problem gamblers. When the subtypes are compared across Albertan residential areas and Tasmanian LGAs, only problem gamblers live closer to gambling venues, while other subtypes are spread out.

Travel distance and the location of a gambling venue are important issues considered by gamblers who access gambling services provided by gambling venues. A preferred venue is the one located close to home, or the workplace, and can be reached by different means of transportation, and located close to other opportunities such as shopping malls. The surrounding neighbourhoods of a gambling venue could make gambling venues more attractive regardless of how close or far away they are from a gamblers' home or workplace.

Gamblers decision to access gambling venues are impacted by their past and current social life experiences. Many gamblers who had histories of childhood and intimate relationship problems gamble regularly, particularly when they live close to gambling venues. These findings are collaborated by the data from both Alberta and Tasmania, and they overlap with the literature that argues that gamblers are more likely to gamble close to home (Abbott, 2006; Vasiliadis et al., 2013; Williams et al., 2012). Our findings also align with studies that have reported higher problem gambling in gamblers with childhood adversities and marital problems (Abbott, 2006; Vasiliadis et al., 2013; Williams et al., 2012).

A major limitation of this study is that the quantitative data from Alberta are ten years old. As is the case in other parts of Canada and several western countries, the gambling venue industry has seen continued expansion over the last ten years, and this includes the issuing of more licenses for the opening new venues and the expansion of existing ones. These developments have made gambling venues more accessible physically than they were ten years ago. Albertan and Tasmanian (whose data are also seven years old) gamblers may be currently located more physically close to gambling venues than they were years ago. Additionally, the four gambler types interviewed were not adequately proportional, as non-problem gamblers were more numerous. This made it difficult to organize the qualitative findings around the four gambler types, as was done in the quantitative analysis. Consequently, a stronger conclusion could not be drawn with both the quantitative and qualitative findings. Finally, the open-ended questions were developed to examine childhood adversities and intimate relationship problems in the gamblers. These questions have yet to be validated.

The findings on the distributional patterns of the four PGSI subtypes in areas with gambling venues can be used to plan and implement primary and secondary interventions for problem gambling prevention. As an implication for future research, using longer travel distance cut-offs runs the risk of collapsing dissimilar clusters of gamblers into a single category. This practice may obscure important geographic distinctions in how different types of gamblers are distributed around gambling venues. Longer travel distance cut-offs may be more appropriate for the examination of the proximity differences in gamblers at the national level or in jurisdictions where populations are widely dispersed.

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Chapter Eight: General discussion and conclusions

Discussion of main findings and recommendations for future research

PGSI subtype differences in gambling accessibility and reasons for their differences. Different types of gamblers (*defined by the PGSI*) are likely to differ in their accessibility to gambling opportunities (Storer et al., 2009; Vasiliadis et al., 2013). We used both quantitative and qualitative data from Alberta and Tasmania to describe the differences in non-problem, low-risk, moderate-risk, and problem gamblers in their access to the closest casinos. Consistent with previous research (Marshall, 2005; Storer et al., 2009; Vasiliadis et al., 2013), our quantitative data showed that most moderate-risk and problem gamblers gamble close to home compared to low-risk and non-problem gamblers. Moderate-risk and problem gamblers mostly use casinos located 5 km from home. Similarly, in our qualitative study, most moderate-risk and problem gamblers mentioned that they gambled close to home or workplace.

Interviews with participants revealed two main reasons why moderate-risk or problem gamblers, referred to us regular gamblers in the qualitative study, gamble close to home. These include convenience and easy commuting (*gamblers are able to walk, bike, and drive to a venue*). Compared to non-problem gamblers, low-risk gamblers gamble close to home for the same above-mentioned reasons. The overall differences in accessibility among non-problem, low-risk, moderate-risk, and problem gamblers appear graded. This is because gamblers with highest levels of problems are more concentrated close to casinos.

The gamblers provided several other reasons why they consider some gambling venues more accessible over others. They are the location of a venue, number of machines per venue, and the internal attractions of a venue. As suggested by previous studies (Hing & Nisbet, 2010;

Wood & Griffiths, 2007), these issues impact gamblers decisions to choose one venue over another. For example, gamblers consider casinos close to shopping centers (e.g., shops and grocery stores) and entertainment facilities (e.g., cinema halls) to be more accessible than those in areas without such opportunities. Many gamblers mentioned that travel distance is not an issue if a casino is close to other opportunities. Further, the number of gambling machines per venue is mentioned in most quantitative studies as an important accessibility issue for gambling (Shaffer et al., 2004; Storer et al., 2009; Vasiliadis et al., 2013). However, interviews with the gamblers in our qualitative study showed that most rarely factor into account whether there are more or less machines when choosing a venue for gambling.

We examined whether childhood adversities and intimate relationship experiences shape the behaviours of gamblers that live close and those that live farther from casinos differently with qualitative data. As found in previous studies (Dowling et al., 2016; Hodgins et al., 2010; Keen et al., 2015), some of the gamblers were neglected, abused, used drugs, and had unstable parenting as children. Others felt isolated, stressed, and instability in their intimate relationships. Compared to occasional gamblers (non-problem and low-risk gamblers combined), most regular gamblers had these childhood and relationship problems and the majority lived close to casinos. For example, most regular gamblers who lived closer to casinos mentioned that they gambled regularly to cope with past childhood and intimate relationship problems. Past adversities tend to encourage regular gambling among gamblers who have easier access to gambling venues, suggesting that some gamblers seem to use gambling to modify negative emotions from past life experiences. Consequently, further research investigating the relationship between availability/accessibility and problem gambling needs to include measures of mental health, substance use, and adverse experiences.

Is gambling accessibility a multidimensional construct? Gambling accessibility is considered a multidimensional construct that involves geographical, social, and cognitive dimensions (Moore et al., 2011). However, previous research mostly measure gambling accessibility with few dimensional measures (Storer et al., 2009; Vasiliadis et al., 2013). Commonly used accessibility measures are the number of gambling venues, number of gaming machines, and proximity to a venue (Storer et al., 2009; Vasiliadis et al., 2013). A multidimensional measure of accessibility was constructed in the second manuscript by combining data on the number of gambling venues, machines, and gambler's proximity to the nearest venue into a composite measure. The multidimensional gambling accessibility construct was compared to availability (the number of machines per venue) and proximity (travel distance from home to the nearest casino) measures of accessibility in predicting an MRPG risk and problem gambling severity.

The multidimensional accessibility measure had a stronger association with an MRPG risk and problem gambling severity compared to the availability and proximity measures alone. For example, the multidimensional measure explained 32% and 38% of the likelihood of being an MRPG gambler and having a severe gambling problem, respectively. The availability and accessibility measures alone explained less than 7% of the MRPG risk and problem gambling severity.

The results presented above support the argument that gambling accessibility is not a unidimensional but rather a multidimensional construct, as suggested by the Productivity Commission and several other researchers (Productivity Commission, 2001; Shaffer et al., 2004; Williams et al., 2012). The multidimensional (composite) accessibility measure has the strongest association with both an MRPG risk and the severity of problem gambling compared to the two individual measures (*availability and proximity measures*). It seems that a multidimensional measure of accessibility is better able to predict an MRPG risk and problem gambling severity than unidimensional accessibility measures.

The results on the multidimensional accessibility measure suggests that the inconsistencies in the literature about the association between accessibility and problem gambling prevalence may be due in part to how accessibility is often measured (Storer et al., 2009; Vasiliadis et al., 2013). Almost all studies on this association have measured accessibility with the availability or proximity only measures. We recommend future research into the association between accessibility and problem gambling with a multidimensional accessibility measure.

Relative importance of the availability and proximity measures of accessibility. Most studies have reported higher prevalence of problem gambling in gamblers from areas with higher concentration of gambling venues and higher per capita machines (Storer et al., 2009; Vasiliadis et al., 2013; Williams et al., 2012). Similarly, gamblers who live close to venues have more gambling problems than those living farther away (Storer et al., 2009; Vasiliadis et al., 2013). In the second manuscript, the relative importance of the availability and proximity measures of accessibility are compared on their performance in predicting an MRPG risk and problem gambling severity in a multivariate regression model that controlled for demographic characteristics of the respondents, an important issue that has not been addressed in previous studies.

We found that an MRPG risk has a stronger association with the availability of gambling venues and machines than with a gambler’s proximity to a venue. This means that non-problem and low-risk problem gamblers are more likely to be moderate-risk or problem gamblers if more gambling venues and machines become accessible to the public. For example, the likelihood of being an MRPG risk increases by 6% when one more slot machine is installed in a casino. Risk increases by only 1% when the distance travelled to a gambling venue decreases by 1 km. Overall, compared to the number of machines per venue, gambler's proximity to the nearest venue has a lesser impact on the risk of being an MRPG.

In contrast, problem gambling severity is more strongly predicted by a gambler's proximity to a gambling venue than by the number of machines per venue. For every 1 km decrease in travel distance to the nearest casino, the severity of problem gambling increases by 0.5%. However, problem gambling severity does not increase significantly when there is 1 unit increase in the number of machines per casino. For example, there may not be a significant number of gamblers that would transition from being a non-problem or a low-risk problem gambler to a moderate-risk or a problem gambler when one more slot machine is installed in a casino in a community of about 1000 residents.

Overall, while the proximity measure of accessibility has the strongest association with problem gambling severity, the number of machines per venue has the strongest association with the risk of being an MRPG. The public health implication of these results is that at the community level, problem gambling severity might be effectively reduced by locating gambling venues farther away from residential areas and places of public gathering such as shopping areas and workplaces. On the other hand, efforts to prevent non-problem and low-risk gamblers from transitioning to moderate-risk and problem gamblers should aim at limiting the number of gambling venues and capping the number of machines per venue.

Testing exposure and adaptation hypotheses with a multidimensional accessibility measure. Two common theoretical explanations of the association between gambling accessibility and problem gambling prevalence are the exposure and the adaptation hypotheses (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Vasiliadis et al., 2013; Williams et al., 2012). Problem gambling would increase when more gambling venues and machines become available, according to the exposure explanation (LaPlante & Shaffer, 2007; Williams et al., 2012). In contrast, the adaptation explanation suggests that as gamblers become familiar with new gambling opportunities, they usually reduce their gambling when interest wanes, leading to decreased problem gambling (LaPlante & Shaffer, 2007; Williams et al., 2012). Our statistical analysis in the second manuscript showed that both hypotheses were better explained by the multidimensional than by the individual accessibility measures.

In testing the exposure hypothesis, we examined the associations of the multidimensional accessibility measure with an MRPG risk and problem gambling severity in gamblers exposed to casinos for less than three years. Among these gamblers, both an MRPG risk and problem gambling severity increased with increased access to gambling opportunities, supporting the exposure hypothesis (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012). In contrast, and in support of the adaptation hypothesis (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012), among gamblers who had more than three years of exposure to casinos, the risk and severity both decrease even when access to gambling opportunities increases.

The above reported associations between accessibility and problem gambling suggest that gamblers may adapt to the novelty of new gambling opportunities after three years of continued exposure, from which time they reduce their gambling participation rate and in turn problem gambling. As suggested by the exposure and adaptation hypotheses (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012), the association between accessibility and problem gambling is complex, involving an increasing effect during the early stages of increased opportunities, and stable or declining trend following a period of continued exposure.

Perceptions of accessibility as a predictor of problem gambling severity. Consistent with the literature on substance use and healthy practices (Hoehner, Brennan Ramirez, Elliott, Handy, & Brownson, 2005b; Kuntsche et al., 2008b; Warren et al., 2015), gamblers perceptions of access to casino and non-casino opportunities predicted their problem gambling severity in the first manuscript. Perceptions of whether gambling opportunities were too widely available or not had a stronger association with problem gambling severity. For example, gamblers who perceived that gambling opportunities were too widely available had about twice the rate of problem gambling. Severity rate did not change significantly even after controlling for respondents' demographic, behavioural, and psychosocial characteristics, suggesting that the association might be independent of commonly identified correlates of gambling behaviour (Afifi, Cox, et al., 2010b; Tavares et al., 2010).

The strong reported association between perceived accessibility and problem gambling severity suggests that how adult gamblers perceive their access to casino and non-casino gambling opportunities can make them gamble more or less. As the results indicate, some gamblers are unable to control their gambling behaviour when they perceive that they could easily access gambling venues and machines. One possible reason for this is that gamblers who believe that they could easily access gambling opportunities may have fewer concerns about accessibility issues, which may include the money and time its take to access a gambling venue in a given community. Additionally, such gamblers might live close to a gambling venue.

The moderating role of demographic characteristics, alcohol use, and depression in the association between perceived accessibility and problem gambling was examined. Effects were found for age, gender, place of residence, and psychosocial problems. Among gamblers who perceived gambling opportunities to be too widely available, being a male, being an older adult, living in less populated areas, and having problems with substances increases problem gambling. However, these moderating characteristics do not increase problem gambling severity substantially among gamblers who did not perceive gambling opportunities as too widely available.

This is the first study to determine the moderators of the association between perceptions of gambling accessibility and problem gambling. The moderating results on depression demand further attention considering the fact that depression has been strongly associated with problem gambling in almost every population (Blaszczynski & McConaghy, 2009). The moderating effects of depression suggest that gamblers who perceive that they have easier access to casino and non-casino EGM venues might use gambling to cope with depression. Several studies have found that some problem gamblers use gambling to deal with mental health problems including depression (Beaudoin & Cox, 1999; Lesieur & Blume, 1990). Our results add to the literature by indicating that depression has a stronger association with problem gambling in gamblers who perceive gambling opportunities to be too widely available than in those who do not hold such a perception. Public health intervention that modify gambler's perceptions of access might reduce problem gambling among gamblers with depressive problems.

***Comparing actual and perceived measures of gambling accessibility*.** In the third manuscript, it was examined whether actual and perceived gambling exposure measures were independently associated with ARG and problem gambling severity. The results indicate that actual and perceptual measures of gambling exposure represent different aspects of gambling accessibility. The actual measure indicates how the objective gambling environment influence gambling behaviour, and the perceived measure shows how gambler's cognitive views of the physical gambling environment influence their behaviour. It was found that gamblers' perceptions of accessibility had greater association with their likelihood of being an ARG, while their actual accessibility is strongly associated with problem gambling severity.

Venue-based gamblers need to make decisions about travelling time and cost. Such decisions can impact their gambling behaviour positively or negatively. The results for perceived accessibility indicate that a gambler may not gamble regularly and experience problems when gambling opportunities are perceived to be not too widely available or accessible. Similarly, the thoughts that one may have difficulty accessing a preferred gambling activity at a particular time can also discourage problem gambling. These concerns are likely to be higher among gamblers who perceive gambling opportunities to be not too widely available. Therefore, the low prevalent of ARG and problem gambling severity among gamblers who perceived gambling opportunities not to be too widely available, may be explained by the above-mentioned concerns.

On the other hand, it is likely that gamblers who perceive gambling opportunities to be too widely available might gamble regularly and experience problems when they believe that there are more opportunities accessible to them. Although, more research is needed to clarify the association between perceived accessibility and problem gambling, studies on alcohol have reported findings that support the above explanation (Kuntsche et al., 2008a; Paschall et al., 2012).

Are actual and perceived measures of gambling accessibility interchangeable? Some scholars argue that actual and perceived accessibility might not be distinctly different in their associations with health and social behaviours (McCormack et al., 2004; Moore et al., 2011). A few studies on substance use have found support for this argument, while others have not (Ball et al., 2008; Rabow et al., 1982; Warren et al., 2015). Differences between actual and perceived accessibility of gambling were examined in the third manuscript. Our correlation analysis found no significant association between them. Their poor correlation suggests that gamblers perceptions of gambling accessibility do not completely overlap with their actual level of accessibility. Our results suggest that some gamblers are likely to overestimate their perceived level of accessibility, while others are likely to underestimate it. Overall, the results demonstrate that actual and perceived measures of gambling accessibility are not the same, and thus represent different dimensions of accessibility.

Additionally, some studies on alcohol and other substances have argued that actual and perceptual measures of accessibility are similar in their association with substance use (Kuntsche et al., 2008a; Warren et al., 2015). However, the regression analysis performed in the third manuscript of this dissertation showed that actual and perceived accessibility measures have differing associations with gambling behaviour, suggesting that one measure cannot be used to represent the other.

Are there interaction effects of actual and perceived gambling accessibility? This is the first study to examine possible interactions between actual and perceived measures of gambling accessibility. Since actual and perceive accessibility were poorly correlated, their interaction effects on ARG and problem gambling severity were examined in the third manuscript. A significant interaction was found for problem gambling severity but not the likelihood of being an ARG. For example, the association between actual and problem gambling severity is different for gamblers who perceived gambling opportunities to be too widely available and those who perceived it to be not too widely available. Among gamblers who live in areas with few gambling venues and machines, the severity rate tends to be higher in those who perceive opportunities to be too widely available than in the group that do not have such a perception. However, among gamblers in areas with high density of gambling machines and venues, the rate is low in those who perceive opportunities to be too widely available than in the group that do not have such a perception.

The interaction effects results suggest that problem gambling severity in adults may be more driven by both the environmental and cognitive dimensions of gambling exposure. Both components intersect to influence problem gambling severity but not the likelihood of being ARG. Being an ARG does not depend on both actual and perceived accessibility, suggesting that gamblers' perceptions or actual level of accessibility can independently influence problematic gambling.

Policy implications of findings

One of the key findings of this dissertation concerns the relative importance of actual and perceived accessibility as predictors of problem gambling. When perceptual and actual measures of accessibility are correlated individually with problem gambling, the former had the strongest association. Problem gambler's perceptions of accessibility account for much of their problem gambling behaviour than do the actual measures of accessibility such as the number gambling venues and machines, and proximity to a venue. This finding directs attention to preventive interventions that dealt with gambler's perceptions of accessibility. Gambler's perceptions of accessibility may be changed or modify by limiting advertising of gambling activities online and in print media. Although there was a weak association between actual and perceived accessibility, problem gambling could be minimized if gambling venues are located outside places of public gathering and there is limited advertising of gambling activities.

Additionally, the association between actual accessibility and problem gambling suggests that responsible gambling messages may be used in gambling venues to warn against the temptations of regular gambling for gamblers who live close to venues. Such responsible gambling messages could help prompt regular gamblers attention to reflect on their gambling activities and minimise them. Additionally, gamblers who live close to a venue should regularly be informed in person about the harm of regular gambling. Future research should use qualitative research method to explore gamblers views about the best ways to prevent problem gambling in gamblers who live close to venues.

Supply focused interventions can also be used to prevent gambling harm. For example, EGMs can be allowed in pubs, lounges, and hotels in locations that are more difficult to reach physically. For example, in most communities' in the United States and Canada, casinos are located outside city boundaries or farther away from residential areas (Williams et al., 2012). Further travelling constraints could be imposed by placing casinos and non-casino EGM venues in areas where public transit service is limited and far from other sources of entertainment or shopping centers.

EGMs are placed in places such as clubs, pubs, hotels, and lounges. Since ease of access increases problem gambling, EGMs can be placed in venues located outside residential areas and places of public gathering. EGMs are very addictive, and for that reason, where they are located can impact efforts to control problem gambling in communities. Additionally, internet gambling has increased access to gambling (Wood & Routledge, 2012), suggesting that in addition to restrictive measures applied to venue-based gambling, similar interventions may be needed for online gamblers. Future research should identify the extent to which ease of access is associated with problem gambling in online gamblers and identify ways to use time-bound restrictions to minimize such harm.

When actual and perceived accessibility were examined to determine their interactive effects on problem gambling severity, the results showed that severity rate tends to be higher in gamblers who perceive gambling opportunities to be too widely available than in those who did not hold that perception. In areas with fewer gambling venues and machines, gamblers who perceive that they have easier access to gambling opportunities have the highest risk of problem gambling. In contrast, in areas where there are more gambling venues and machines, gamblers who perceived opportunities to be too widely available have higher risk of problem gambling. These findings suggest that special preventive measures may be required to minimize problematic gambling in gamblers who perceive themselves to have easier access to gambling opportunities, while those who perceive themselves to be less exposed be targeted with similar interventions or different interventions. One recommendation is that although both gamblers need attention in the prevention of problem gambling, those who perceive themselves to have easier access to opportunities might need greater attention.

Additionally, the mixed-methods study revealed that regular gamblers with childhood adversities and intimate relationship problems gamble more regularly when they live closer to a gambling venue. An implication of this finding for problem gambling prevention is that gamblers who present with complaints about childhood abuse and intimate relationship problems at counseling centers, health facilities, and treatment centers should be screened for gambling related problems and refer those with problems for treatment. Those without gambling problems can be provided with information and education on the harms of gambling to prevent potential future gambling problems.

When compared to the individual constituent measures (e.g., the combined measure of number of venues and machines, and proximity to the nearest venue), the multidimensional (composite) accessibility measure had the strongest association with problem gambling risk and problem gambling severity before and after adjustment for demographic characteristics. The composite accessibility better predicted both problem gambling risk and severity than did the individual measures. This finding confirms that accessibility is a multidimensional construct (Max Abbott, 2006; Commission Productivity, 2001), and that a more complex estimation method such as that presented in this paper is needed to investigate the role of accessibility in the prevalence of problem gambling. Future research should consider using our proposed method for creating a multidimensional (composite) measure for gambling accessibility.

Conclusion: Summary of key findings

The findings of the four manuscripts addressed important research gaps about the link between accessibility and problem gambling. Hundreds of studies have been devoted to explaining the nature of this association, yet several issues remain unresolved. Some of those issues addressed in this dissertation are: (1) how different measures of accessibility predict problem gambling prevalence; (2) the exposure and adaptation hypotheses of accessibility; (3) accessibility differences between different types of gamblers; (4) perceptual measure of gambling accessibility and its association with problem gambling; and (5) relative and interactive effects of actual and perceived accessibility. These issues are briefly discussed below.

Accessibility to gambling opportunities was measured with three commonly used measures: the number of gambling venues, the number of machines, and proximity to the nearest venue. Unlike previous research, the present study constructed an accessibility measure, called a composite (multidimensional) accessibility, by combing above mentioned measures using a formula described in the second manuscript. When compared, the multidimensional measure correlated strongly with the risk of being an MRPG and problem gambling severity, while the number of machines per venue and proximity to the nearest venue showed weak correlation with both outcomes. The finding confirmed that gambling accessibility is a multidimensional construct, and that it better predicts an MRPG risk and problem gambling severity when compared to a unidimensional measure of accessibility.

The exposure and adaptation hypotheses are the two widely used frameworks for explaining and understanding the relationship between accessibility and problem gambling. The exposure hypothesis suggests a linear association between accessibility and problem gambling, while the adaptation hypothesis suggests that the relationship changes over time following a period of continued exposure. There is mixed empirical support for these explanations, which warrant the need to be reexamined in the present dissertation with a multidimensional and the two unidimensional measures (*the number of machines per venue and proximity to a venue*) of accessibility. The results showed that both hypotheses are better empirically supported by the multidimensional accessibility measure than by the unidimensional ones, a finding that reaffirms the need for research to conceptualize and measure gambling accessibility as a multidimensional construct.

An alternative measure of gambling accessibility that has received less research attention are perceptions of accessibility. Given the importance of perceptions of accessibility in explaining addictive behaviours such as substance use, we examined it possible role in the prevalence of problem gambling severity. Gamblers who perceived that casino and non-casino gambling opportunities were too widely available were about two times more likely to be problem gamblers than those who did not hold such a perception. Various factors such as age, gender, place of residence, and depression moderate the association between perceived accessibility and problem gambling severity. The moderating results suggest that the direction and strength of the perceived accessibility and problem gambling association might depend on the demographic, behavioural, and psychosocial characteristics of individuals.

A multivariate analysis was used to compare the actual (accessibility measured by the number of machines per venue and gambler's proximity to the nearest venue) and perceived accessibility in predicting an ARG and problem gambling severity. Actual accessibility predicted both outcomes, while perceived accessibility predicted only problem gambling severity. Although it is significantly associated with both, problem gambling severity has a stronger association with perceived than with actual accessibility. This finding suggests that problem gambling severity is accounted for more by gambler's perceptions of their gambling accessibility than by their actual levels of accessibility.

This thesis examined whether actual and perceived accessibility measures are interchangeable. In other words, whether one measure could be used to represent the other. A correlational analysis was used to address this issue by examining the strength of the correlation between the actual and perceived accessibility measures. The measures have a weak and non-significant correlation, suggesting that they represent different dimensions of gambling accessibility. For this reason, it seems that one measure cannot be used as a proxy for the other. Because of the poor correlations between actual and perceived accessibility, we examined whether they have interaction effects on an ARG and problem gambling severity. There were interaction effects on problem gambling severity but not on an ARG risk.

The four PGSI subtypes (non-problem, low-risk, moderate-risk, and problem gamblers) were found to differ in their accessibility to gambling opportunities using both quantitative and qualitative data. Both the quantitative and qualitative results confirm that low-risk, moderate-risk, and problem gamblers usually live close to gambling venues than non-problem gamblers. The qualitative data revealed the specific range of issues that impact gamblers decision on access to gambling. They include travel distance to a venue, the density of machines per venue, location of a venue, and the internal attractions of a venue. Our qualitative finding adds an importance information to the literature by identifying that living closer to a gambling venue can motivate regular gambling in gamblers with histories of childhood adversities and intimate relationship problems.

Overall, the findings suggest that the relationship between accessibility and problem gambling is complex, as indicated by previous studies (LaPlante & Shaffer, 2007; Shaffer et al., 2004; Williams et al., 2012). However, the nature of this association is better captured when examined with a multidimensional measure of accessibility than with a unidimensional measure. Further, an alternative measure that seems promising for understanding the association between accessibility and problem gambling is gambler's perceptions of their access to gambling opportunities. Correlational analysis showed that a perceptual and an actual measure of gambling accessibility are independent of each other, implying that both could be used to better understand the association between accessibility and problem gambling in the general adult population. Interestingly, a multivariate analysis showed that gambler's perceptions of their access to opportunities have stronger impact on their problem gambling behaviour than their actual level of access to opportunities. More future research is needed to understand the role of perceptions of gambling opportunities in the prevalence of problem gambling. The findings of the manuscripts provide important data for the development of effective preventive measures for problem gambling. They suggest that one of the best ways to control problem gambling in the general population is by using both supply and demand focused interventions.

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Appendix A: Recruitment poster for Alberta

Do you Gamble?

I am interested in talking with you about your gambling

- The purpose of this research study is to understand how the distribution, distance, and density of gambling venues impact the way people (like you) gamble.

- You are invited to participate in two interviews to share your thoughts and experiences about gambling behaviours and problems. The interviews are expected to last approximately one and a half hours.

Participants will be compensated

To learn more about this study or want to participate, you are welcome to contact **Samuel @ phone** or **email: oforidei@uleth.ca**.

Appendix B: Qualitative study interview guide

My name is Samuel Ofori, a doctoral student at the University of Lethbridge in Canada. I am conducting this study to learn about your gambling behaviours. In this interview, I will ask you questions about how various dimensions of gambling accessibility have influenced the way you gamble, and how these factors were also associated with you becoming a problem gambler. Your participation in this study is entirely voluntary and you may also withdraw from the study at any time. There is no consequence if you decide not to participate. If you agree to participate in the study, your interview responses or information will be kept anonymous and confidential.

Summary of qualitative interview questions

The following research questions seek to gather information from non-problem and problem gamblers to provide better understanding of how various dimensions of gambling accessibility impact participation in gambling and the development of problem gambling. The questions look specifically at the impact of gambling opportunities (e.g., distance to gaming venues, the spatial distribution of the venues, and the density of gambling products at a venue) on gambling behaviours and problem gaming in Alberta, Canada, and Tasmania in Australia.

Participant's responses to these questions will be used to qualitatively validate a yet be developed multifactor model, which seeks to uncover the mechanisms underlying the relation between gambling accessibility, gambling involvement, and problem gambling in Tasmania and Alberta. Although several attempts have been made by existing gambling models to provide a better understanding of these relationships, none of these models have been developed using qualitative data. As a result, these models fail to account for the qualitative characteristics of accessibility of gambling opportunities that influence participation in gambling and problem gambling. Answers to the questions below address this knowledge gap in the literature and to gather qualitative data to test the utility of the multifactor model in examining the complex relationships between gambling accessibility, gambling behaviours, and problem gambling.

A. Primary questions 1

1) Can you tell me a) the days and times that you typically gamble, (b) the average amount of money per week that you spend on gambling, c) the number of times a year that you gamble, d) the particular activity you gamble most on, and e) the other gambling activities available at the venue where you most often gamble?
2) Please estimate the distance in kilometers from your home to the venue where you most often gamble.

B. Primary questions 2

1) Can you tell me how (a) the location of where you gamble, (b) the opening hours of the venue where you gamble, and (c) the money you spend gambling daily contributed to you becoming a problem gambler?
2) Would you say that you became a gambler as result of (a) the availability of gaming venues at where you live or something else? How these happened?
3) Would you say that you became a problem gambler as result of (a) the number of times you gamble, (b) the particular activity you often gamble on, and (c) the availability of several other activities at the same venue? How these happened?
4) Can you explain how (a) the distance from where you live to where you gamble and (b) the amount of money you spend or win gambling affect the way you gamble on EGMs and others?

C. Other questions

1) Were there any (a) major stressors just before or during your gambling (loss, major illness, divorce, job loss, financial problems, major relocation etc.) or (b) life transitions (e.g. marriage, transition to parenthood, divorce, retirement, death etc.)? If so, what were they?
2) How would you describe your relationship with your intimate partner and other family members? Please state the person(s) you are referring to.
3) Do you use gambling to modify your mood? If so, how does gambling affect your mood?
4) How would you describe your childhood? Did you suffer any adverse events during your childhood (e.g. abuse, neglect, abandonment/loss of caregiver)? If so, what were they?

Detailed (*probing*) interview questions

A. Gambling behaviours and problems

1) Can you please tell me why you participate in gambling? For example: Lotteries, EGMs, sport betting, bingo, and others?
   a) Do you gamble on any of these activities frequently, and if so, why do you do so?
   b) If not, why do you gamble, but not frequently?
   c) Which gambling activity do you spend the most time on at a gaming venue?
   d) Why do you like playing that particular game?
   e) Have you ever developed gambling related problems in your life, and if so how did this happen?

B. Distance or proximity to gambling venues or machines

1) Can you tell me whether the venue where you often gamble is close or far from where you live?
    a) How close (in terms of kilometers) is your residence to where you often go to gamble?
    b) Do you often gamble at gaming venues close to where you live, and if so, why?
    c) Do you gamble often because you live close to or have convenient access to gaming venues?
    d) How often per day or week do you gamble at gaming venues close to where you live?
    e) How often per day or week do you gamble at gaming venues far from where you live?
    f) Can you explain further how the distance of the venue influences the way you gamble? Or how it encourages you to go participate in gambling?
    g) Would reducing the number of gaming venues in your neighbourhood be likely to increase, decrease, or otherwise affect the rate at which you gamble? If so, why do you think so?
2) Would you say that you spend more or less money on gambling when you gamble at gaming venues close to where you live? If you spend more, can you explain why?
    a) On average, how much money do you spend on gambling per day or week at gaming venues close to where you live and those far from where you reside?
    b) Would reducing the number of gaming venues in your neighbourhood be likely to increase or decrease the amount of money you spend on gambling?

3) Have you ever or do you currently have gambling related problems?
    a) Can you tell me how you became a problem gambler?
    b) Would you say that you became a problem gambler because you live(d) close to a gaming venue? If so, why do you think it happened that way?
    c) How did the closeness of gaming venues to your house cause you to develop this problem?
    d) Do you think that you would not have developed these gambling problem(s) if you had lived further away from the gaming venue? Why do you think so?

C. Spatial distribution of gambling venues or machines

1) How has the clustered distribution of gaming venues in your neighbourhood affected your gambling behaviour?
    a) How has it impacted the rate at which you gamble per day or week?
    b) How has it impacted the amount of money you spend on gambling per day or week?
    c) Do you spend more or less money on gambling because of the distribution?
2) How many times per day or week would you have gambled if gaming venues had been spread out? Why?
3) Would you have spent more or less money on gambling if venues were to be spread out?
    a) How much money would you have spent if gaming venues were to be spread out? Why?
4) In what way has the clustering of gambling venues in your neighborhood caused you to become a problem gambler?

5) Do you think you would not have developed this gambling problem if gaming venues were spread out? Can you explain to me why this would have happened?

D. Density of gambling activities at gaming venues

1) What kind of influence does the availability of a wide variety of gambling products at a gaming venue have on your gambling behaviour (such as the number times you gamble)?
2) Can you tell me more about the reasons why you prefer gambling at venues that have a wide variety of gambling products (e.g., EGMs, bingo, keno, and others)?
3) Do you find it more convenient to gamble at venues with a variety of gambling products?
    a) What makes it convenient to gamble at such gaming venues?
4) Can you explain your gambling behaviour at venues with a variety of gambling products?
    b) On average, how many times do you gamble per day or week at such venues?
    c) On average, how much money do you spend on gambling per day or week at such venues?
    d) Do you gamble on one or more games (e.g., EGMs and bingo) at a venue with a variety of products?
5) How has the availability of a wide variety of gambling products at gaming venues caused you to develop gambling problems?
    a. What forms of gambling problems do you often experience at venues with a wide variety of gaming products?

b. Why do you think the availability of a wide range of activities at gambling venues caused you develop the problem?

c. What gambling activities influenced you the most in developing the problem?

d. And why do you think it happened this way?

E. Participants demographics for qualitative study

1) What is your age in years? (Write it here) ....

2) What is your gender?

   a) Male

   b) Female

3) Can you tell me your residential address (write the name of the area, not the full address) ……………………………?

4) Which of the following best describes your household?

   a) Couple with no children

   b) Couple with children still at home

   c) Couple with children not living at home

   d) Single person household (no children)

   e) Single with children still at home

   f) Single with children not living at home

   g) Group or shared household

   h) In some other arrangement (write it here………………………………)

   i) (Don't know)

5) What is your current occupational status?

a) In paid employment full time (35 hours/week or more)

b) In paid employment part time/casual

c) Primarily household duties

d) Student

e) Retired

f) Looking for work

g) Unable to work / pension

h) Other (Specify…………………………....)

i) Don't know

6) Could you please tell me your approximate annual PERSONAL income BEFORE TAX.?

a) Less than $25,000

b) $25,000 to $39,999

c) $40,000 to $64,999

d) $65,000 to $79,999

e) $80,000 to $129,999

f) $130,000 or more

g) Don't know

7) What is the highest level of education or trade qualifications you have completed?

a) Primary school only

b) Secondary school

c) Grade 12

d) Trade qualifications

e) Tertiary education / University undergraduate degree

f) Post graduate qualification

g) Other (Specify……………………………………….)

h) Don’t know

Appendix C: Ethics application form for Tasmania qualitative study

FORM 1

THE UNIVERSITY OF MELBOURNE

HUMAN RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF MELBOURNE

APPLICATION FOR APPROVAL OF A PROJECT INVOLVING HUMAN PARTICIPANTS

PROJECT REFERENCE DETAILS

Enter the Ethics ID number assigned by Themis Research to this ethics application.	1340411.1
Enter the title of the Project as recorded in Themis Research	Social and Economic Impact Study of Gambling in Tasmania and Assessment of Gambling Harm Minimisation Measures
Enter the name of the Responsible Researcher as recorded in Themis Research	Dr Nicole Andrea Dowling

Appendix D: Informed consent

(Faculty Letterhead)

Dear Participant:

You are invited to take part in a research study on the influences of the distribution, proximity, and density of gambling venues on gambling behaviours and problems among Albertans. This study is being conducted by Samuel Mantey Ofori Dei, a graduate student at the University of Lethbridge in Canada, and under the supervision of Dr. Darren Christensen of the Faculty of Health Sciences.

Before you agree to join this study, I would like you to read and understand the following statements about the study procedure. Below are detailed explanations about the purpose, procedure, benefits/risks and safety measures associated with this study. Please feel free to ask questions of the study investigator on anything you do not understand before signing this form.

<u>Purpose</u>

The purpose of this study is to gain a more in-depth understanding of how the distance to gaming venues, distribution of venues, and density of gambling products or activities at a venue impact the way people (like you) gamble and develop gambling related problems (e.g., financial, social, and health problems). The study is part of my doctoral degree requirements at the University of Lethbridge.

<u>Procedure</u>

Your participation in this study will involve two interviews lasting approximately one and a half hours each. The interviews will be conducted by me and a research assistant who will assist with the recording of the interviews. The focus will be your perceptions and experience about how the distribution, proximity, and density of gambling venues influence your gambling behaviours and problems. The two interviews will take place at any location of your choice and will be digitally recorded and transcribed.

<u>Risk</u>

Although there are no known risks for taking part in this study, some of the questions may be sensitive and uncomfortable, in particular talking about unpleasant gambling experiences. But note that if you feel uncomfortable you may refuse to answer any question or discontinue the interview at any time. If you experience any form of emotional discomfort, I will provide you with information to help you decide on whether or not to seek professional counseling. However, all necessary steps will be taken to ensure your safety and comfort during the interview sessions.

<u>Benefits</u>

It is important to know that you may not directly benefit from this study as a participant; however, findings from this study may benefit other gamblers in the future. Also, at the end of the interviews, I will give you a gift card of $25 as an appreciation for participating in this study.

Confidentiality

All information gathered in this study will be kept confidential. It will be used for research and educational purposes only. The digital interviews and transcripts will be assigned pseudonyms or identification numbers and will be destroyed at the end of the study. No one will know that you participated in this study, because your name and address will not appear in the final report of the study.

Participation

Please be informed that your participation in this study is completely voluntary. The only financial or material compensation for participants is the $25 gift card. This gift card will be given to you at the end of the interview, not at the beginning please. If you agree to participate in this study, you can choose to withdraw at any time for any reason; however, I will still give you the gift.

Contact information

If you have any questions about this study, please contact Samuel Mantey Ofori Dei (PhD student and principal investigator) at phone number or Dr. Darren Christensen (Supervisor), Faculty of Health Sciences, University of Lethbridge at 403- 329-5124. Questions regarding your rights as participant in this study can be directed to the Office of Research Services, University of Lethbridge (phone: 403-329-2747 or email: research.services@uleth.ca).

I have read (or have been read) the above information regarding this study entitled " The relation of gambling accessibility with gambling behaviour and problems: A comparison, integration, and development of a multifactor model" and consent to participate in the study.

__________________________ _____________________ _______________

(Print Name) (Signature) (Date)

I further understand that this interview will be digitally recorded and transcribed.

__________________________ _____________________ _______________

(Print Name) (Signature) (Date)

A copy of this form is given to you for your records.

Appendix E: Extra tables Poisson and logistic regression analyses on weighted and unweighted normalized frequency data

Table 1. Non-normalized weight was applied to the exposure calculation and normalized to the analysis

	Gambling severity			MRPG risk		
Exposure Measures	b(95%CI)	SE	p-value	Odds ratio (95%CI)	SE	p-value
Composite	0.280 (0.20, 0.36)	0.04	0.0001	1.316 (1.14, 1.52)	0.08	0.0001
Availability	0.058 (0.04, 0.07)	0.01	0.0001	1.084 (1.04, 1.13)	0.02	0.0001

Table 2. Both the exposure measures and the analysis were not weighted

	Gambling severity			MRPG risk		
Exposure Measures	b(95%CI)	SE	p-value	Odds ratio (95%CI)	SE	p-value
Composite	0.810 (0.54, 1.09)	0.14	0.0001	2.056 (1.19, 3.56)	0.28	0.01
Availability	0.217 (0.12, 0.31)	0.05	0.0001	1.383 (0.97, 1.97)	0.18	0.071
Accessibility	-0.001 (-0.001, -0.0005)	0.0002	0.0001	0.998 (0.995, 1.001)	0.001	0.134

Table 3. Exposure measures were not weighted but the analysis was weighted

	Gambling severity			MRPG risk		
Exposure Measures	b(95%CI)	SE	p-value	Odds ratio (95%CI)	SE	p-value
Composite	0.785 (0.62, 0.95)	0.08	0.0001	2.723 (1.90, 3.91)	0.18	0.0001
Availability	0.205 (0.15, 0.26)	0.03	0.0001	1.387 (1.17, 1.64)	0.09	0.0001
Accessibility	-0.001 (-0.001, -0.0009)	0.0001	0.0001	0.998 (0.997, 0.999)	0.0006	0.001

Table 4. Non-normalized weight was applied to the exposure calculation and not the analysis

	Gambling severity			MRPG risk		
Exposure Measures	b(95%CI)	SE	p-value	Odds ratio (95%CI)	SE	p-value
Composite	0.251 (0.14, 0.37)	0.06	0.0001	1.268 (0.99, 1.63)	0.13	0.065
Availability	0.062 (0.14, 0.37)	0.01	0.0001	1.092 (1.00, 1.19)	0.04	0.047

Table 5. Used unweighted exposure measures and ran analysis on unweighted data

	Gambling severity			MRPG risk		
Exposure Measures	b(95%CI)	SE	p-value	Odds ratio (95%CI)	SE	p-value
Composite	0.810 (0.54, 1.09)	0.14	0.0001	2.056 (1.19, 3.56)	0.28	0.01
Availability	0.217 (0.12, 0.31)	0.05	0.0001	1.383 (0.97, 1.97)	0.18	0.071
Accessibility	-0.001 (-0.001, -0.0005)	0.0002	0.0001	0.998 (0.995, 1.001)	0.001	0.134

Table 6. Used unweighted exposure measures and ran analysis on weighted data

	Gambling severity			MRPG risk		
Exposure Measures	b(95%CI)	SE	p-value	Odds ratio (95%CI)	SE	p-value
Composite	0.37 (0.11, 0.63)	0.13	0.005	1.34 (1.14, 1.56)	0.08	0.0001
Availability	-0.04 (0.12, 0.31)	0.03	0.149	1.06 (1.02, 1.10)	0.02	0.005
Accessibility	-0.004 (-0.01, 0.003)	0.0005	0.0001	0.99 (0.99, 1.00)	0.0001	0.044

Appendix F: Extra tables for manuscript four

Table 1. The distribution of Alberta PGSI gambler types at three proximities to a casino by four census areas

		Non-problem gambler	Low-risk gambler	Moderate-risk gambler	Problem gambler
Proximity to casino		Percentage (%)			
0-5 km	Northern	32.60%	32.60%	41.73%	52.38%
	Edmonton	34.01%	32.77%	31.23%	16.70%
	Calgary	30.13%	43.79%	48.78%	45.54%
	Southern	33.42%	23.36%	32.49%	58.09%
5.1-10 km	Northern	34.49%	31.00%	22.50%	17.18%
	Edmonton	32.77%	34.42%	37.80%	36.34%
	Calgary	34.68%	29.17%	24.33%	36.84%
	Southern	32.27%	35.56%	51.57%	27.43%
>10 km	Northern	33.39%	36.39%	35.77%	30.45%
	Edmonton	33.22%	32.81%	30.96%	46.96%
	Calgary	35.19%	27.04%	26.90%	17.61%
	Southern	34.31%	41.08%	15.93%	14.48%

Note. Reported percentages are from weighted data.

Table 2. The distribution of Tasmanian PGSI gambler types at three proximities to a casino by LGA

		Non-problem gambler	Low-risk gambler	Moderate-risk gambler	Problem gambler
Proximity to casino		Percentage (%)			
0-5 km	Brighton	27.94%	28.85%	48.40%	100.00%
	Break O'Day	32.51%	0.00%	62.59%	100.00%
	Glenorchy	29.73%	39.42%	25.47%	63.72%
	Devonport	32.82%	29.18%	31.82%	100.00%
	Circular Head	32.15%	32.57%	100.00%	100.00%
	Launceston	23.69%	74.47%	17.11%	37.29%
	Sorell	32.06%	18.74%	23.59%	78.53%
	Clarence	32.55%	46.82%	0.00%	0.00%
5.1-10 km	Brighton	37.52%	27.13%	28.08%	0.00%
	Break O'Day	39.19%	0.00%	0.00%	0.00%
	Glenorchy	26.39%	43.52%	66.96%	14.41%
	Devonport	31.02%	32.10%	68.18%	0.00%
	Circular Head	31.04%	55.84%	0.00%	0.00%
	Launceston	37.13%	16.37%	0.00%	62.71%
	Sorell	37.20%	35.74%	0.00%	0.00%
	Clarence	30.83%	0.00%	0.00%	0.00%
>10 km	Brighton	34.54%	44.02%	23.52%	0.00%
	Break O'Day	28.30%	100.00%	37.41%	0.00%
	Glenorchy	43.88%	17.06%	7.58%	21.87%
	Devonport	33.31%	38.72%	0.00%	0.00%
	Circular Head	36.81%	11.59%	0.00%	0.00%
	Launceston	39.18%	9.16%	82.89%	0.00%
	Sorell	30.73%	45.52%	76.41%	21.47%
	Clarence	31.41%	53.18%	100.00%	0.00%

Note. Reported percentages are from weighted data.

Table 3. Albertan regular and occasional gamblers frequency of gambling by access to a casino

	Had difficult access to casino	Had easier access to casino
Regular gambler		Gambled over 360 times a year
		Gambled over 360 times a year
		Gambled 104 times a year
		Played online poker over 360 times
		Gambled over 100 times a year
Occasional gambler	Gambled 48 times a year	
	Gambled 52 times a year	
	Gambled 24 times a year	
	Gambled 52 times a year	
	Gambled 26 times a year	

Table 4. Tasmanian regular and occasional gamblers frequency of gambling by access to a casino

	Had difficult access to casino	Had easier access to casino
Regular gambler		Gambled 96 times a year
		Gambled 70 times a year
		Gambled 240 times a year
		Gambled 160 times a year
		Gambled 104 times a year
		Gambled 208 times a year
		Gambled 150 times a year
Occasional gambler	Played lotter 52 times a year	Gambled 10 times a year
	Gambled 26 times a year	Gambled 36 times a year
	Gambled 20 times a year	Gambled 6 times a year
	Gambled 52 times a year	

Table 5. Albertan gamblers gambling weekly expenditure by access to a casino

	Had difficult access to casino	Had easier access to casino
Spent more	Spent $100 a week	Spent $150 a week
	Spent $130 a week	Spent $170 a week
	Spent $80 a week	Spent $200 a week
Spent less	Spent $40 a week	Spent $20 a week
	Spent $20 a week	
	Spent $20 a week	

Table 6. Tasmanian gamblers gambling weekly expenditure by access to a casino

	Had difficult access to casino	Had easier access to casino
Spent more	Spent $100 a week	Spent $60 a week
		Spent $200 a week
		Spent $200 a week
		Spent $300 a week
Spent less	Spent $25 a week	Spent $25 a week
	Spent $25 a week	Spent $45 a week

Table 7. Childhood and intimate relationship problems in regular and occasional gamblers by access to a casino in Alberta

	Difficult access & regular gambler	Difficult access & occasional gambler	Easier access & regular gambler	Easier access & occasional gambler
Childhood	Used drugs (Ta)		Lonely & depressed (Ka)	
			Abused (Cl)	
			Abused (Es)	
			Abused (Re)	
			Stressors (Th)	
Intimate relationship		Used drugs (To)	Unstable (Cl)	
		Unstable (Cr)	Unstable (Es)	
			Unstable & isolated (Re)	
			Unstable (Th)	

Table 8. Childhood and intimate relationship problems in regular and occasional gamblers by access to a casino in Tasmania

	Difficult access & regular gambler	Difficult access & occasional gambler	Easier access & regular gambler	Easier access & occasional gambler
Childhood		Abused (Ta)	Unstable (Te)	Unstable (Ti)
		Unstable (Tb)	Unstable (Tf)	
		Lonely (Tc)	Unstable (Tg)	
Intimate relationship		Isolated (Tc)	Abused (Th)	
		Partner died (Td)	Isolated (Tf)	
			Stressors (Tg)	
			Unstable (Ti)	