# Raising the Odds?

## Gambling behaviour and neighbourhood access to gambling venues in New Zealand

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# Foreword

Gambling-related harm is a significant social and health issue for New Zealanders. Excessive gambling can lead to negative consequences for the gamblers, and their family/whānau and community.

Under the Gambling Act 2003, the Ministry of Health has responsibility for minimising and preventing gambling-related harm. To address this, the Ministry of Health has developed a strategic plan, *Preventing and Minimising Gambling Harm: Strategic Plan 2004–2010*. One of the key objectives in this strategic plan is to encourage supportive environments to minimise gambling harm.

A key part of the local gambling environment is the availability and accessibility of gambling venues to local residents. However, little research has been carried out on the link between accessibility to gambling venues, and gambling-related harm.

This report, *Raising the Odds?*, presents the findings from a study which investigated whether there were any associations between people's gambling behaviour, and their local gambling environment. This report focuses on particular aspects of the neighbourhood gambling environment, including the distance to the nearest gambling venue, and the number of gambling venues in the neighbourhood.

This report is a joint project between Public Health Intelligence (PHI) (the epidemiology group of the Ministry of Health) and the GeoHealth Laboratory (a partnership between PHI and the University of Canterbury).

Comments on this report are welcome. They should be sent to Public Health Intelligence, Ministry of Health, PO Box 5013, Wellington.

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# Contents

## List of Figures

# List of Tables

# Executive Summary

## Background

The Gambling Act 2003 has defined problem gambling as a public health issue in New Zealand, and the Ministry of Health is now responsible for preventing and minimising gambling-related harm. Part of the general public health approach is to encourage healthy, supportive environments. Before the current study, however, research on the association between gambling behaviour and a key aspect of the environment for gamblers – that is, the accessibility of gambling venues – has been limited. Using a population-based approach, this study investigated whether the gambling behaviour of individuals in New Zealand is associated with how accessible gambling venues are from their neighbourhood.

## Methods

This study analysed the 2002/03 New Zealand Health Survey, which had 12,529 respondents aged 15 years and over. Information about gambling accessibility was collected by mapping the geographical locations of the following types of gambling venues in New Zealand: casinos, outlets for track and sports betting (Totalisator Agency Board – TAB – venues) and non-casino gaming machine (NCGM) venues.

Three different types of gambling accessibility were then measured from the population-weighted centroid of each neighbourhood (meshblock) in New Zealand: the travel distance via the road network to the nearest gambling venue, the number of gambling venues within a straight-line distance of 800 m (approximate comfortable walking distance) and the number of venues within a straight-line distance of 5 km (close driving distance). Gambling accessibility for every neighbourhood in New Zealand was measured using a Geographic Information System (GIS). Neighbourhoods were then sorted by gambling accessibility, categorised into four groups of equal size (quartiles) and the gambling accessibility variable linked to each respondent in the survey, based on the neighbourhood in which the respondent lived at the time of the survey.

Multilevel logistic regression models were used to examine the association between neighbourhood access to gambling venues and the gambling behaviour of individuals. These models controlled for other individual characteristics and features of an area that might affect gambling behaviour and therefore potentially confound the results. For this reason, the models were consecutively adjusted for study design variables and demographic variables, the socioeconomic status of both the individual and the area in which they lived (with areas categorised on the basis of New Zealand Index of Deprivation, or NZDep2001, quintiles) and whether a person lived in a rural or urban area.

## Results

The study found some significant associations between gambling accessibility and gambling behaviour, when controlling for other possible confounding variables. The key findings include the following.

- Compared with those who lived in neighbourhoods **furthest** from gambling venues, people who lived in neighbourhoods **closer** to gambling venues were significantly more likely to:
  - have gambled at a gambling venue in the last year
  - be a problem gambler who had gambled at a gambling venue in the last year.
- People who lived in a neighbourhood closer to an NCGM venue were significantly more likely to:
  - have gambled on an NCGM in the last year
  - be a problem gambler who had gambled on an NCGM in the last year.
- Gambling behaviour was more strongly associated with the distance to the nearest gambling venue, than with the number of gambling venues within walking distance.
- The more gambling venues there were within 5 km of a person's neighbourhood centre, the more likely it was that the person had gambled at a gambling venue in the last year.
- If people had at least some NCGMs within 800 m of their neighbourhood centre, they were more likely to have gambled on an NCGM in the last year.
- Gambling more generally on **any** type of gambling activity in the last year was not associated with the accessibility of gambling venues.

Specifically, people who lived in the three quartiles of neighbourhoods closer to a gambling venue were significantly more likely to have gambled at a gambling venue in the last year, compared with those who lived in the quartile of neighbourhoods furthest from gambling venues (fully adjusted model, closest quartile: odds ratio = 1.51; 95% confidence interval: 1.22–1.87).

These results were also specific to gambling at NCGM venues and TAB venues, and the accessibility of these types of venues. For example, people who lived in the three quartiles of neighbourhoods closer to NCGM venues were more likely to have gambled on an NCGM in the last year, compared with those who lived in the quartile of neighbourhoods furthest from an NCGM venue (fully adjusted model, closest quartile: odds ratio = 1.67; 95% confidence interval: 1.28–2.18). In general, the odds of gambling in the past year did not seem to increase progressively as the distance to the nearest gambling venue reduced (in what would be an exposure–response relationship), except in the TAB analysis.

Gambling more generally on **any** type of gambling activity (such as Lotto or Instant Kiwi) in the last 12 months was not associated with either the distance to the nearest gambling venue, or the number of gambling venues or NCGMs within walking distance (800 m) or close driving distance (5 km).

Being a problem gambler was significantly associated with living closer to gambling venues. For example, people who lived in the two quartiles of neighbourhoods closest to gambling venues were significantly more likely to be a problem gambler who had gambled at a gambling venue in the last year, compared with those who lived in the furthest quartile from venues (adjusting for individual-level variables and area-level socioeconomic deprivation, closest quartile: odds ratio = 1.60; 95% confidence interval: 1.01–2.53).

In the association between problem gambling and distance to the nearest gambling venue, the odds ratios were similarly higher for the two closest distance quartiles. This suggests a possible threshold effect, whereby living anywhere within a certain distance of a gambling venue increased the odds of being a problem gambler to a similar level. There also appeared to be a possible exposure–response relationship, as the odds ratios reduced for the furthest two distance quartiles.

People who had at least some gambling venues within 5 km of their neighbourhood centre were significantly more likely to have gambled at a gambling venue in the last year. In the fully adjusted model, this relationship appeared to show a possible exposure–response effect, with the odds of having gambled at a gambling venue in the last year increasing with an increasing number of gambling venues within 5 km. The number of NCGMs within 5 km of a person's neighbourhood centre was associated with whether the person had gambled on an NCGM in the last year. However, this association was not consistently significant, and did not show a consistent exposure–response relationship.

People who had at least some NCGMs within either 800 m or 5 km of their neighbourhood centre, or at least some gambling venues within 5 km, were more likely to be problem gambler. However, these associations were generally not statistically significant, and did not show a clear exposure–response effect with more NCGMs or more venues.

## Conclusions

The results from this study show that gambling behaviour in New Zealand is significantly associated with the accessibility of gambling venues.

In particular, these results suggest that living in a neighbourhood closer to a gambling venue increased the odds that a person (a) had gambled at a gambling venue, and (b) was a problem gambler. Furthermore, people who had more gambling venues within 5 km of their neighbourhood centre may have been more likely to have gambled at a gambling venue in the past year.

This is one of the first national studies to clearly show these associations. The findings are broadly consistent with previous research results that have suggested possible associations between gambling accessibility and gambling behaviour.

These findings suggest that policies aimed at preventing and minimising gambling-related harm could focus on environmental modifications, which increase people's distance to gambling venues. Examples of such modifications include limiting the number of gambling venues in areas, in particular in vulnerable communities, and reducing the geographical dispersal of gambling venues in the community. This study also lends support to policies that attempt to control the expansion of gambling.

These results will be of interest to local authorities, who are responsible for policies on Class 4 gambling venues (non-casino gaming machine venues) in their area and for urban planning and zoning issues.

# 1 Introduction

## 1.1 Objective

The objective of this study was to investigate the association between individual-level gambling behaviour and neighbourhood access to gambling venues. The study used multilevel modelling to control for both individual-level and area-level variables.

## 1.2 The gambling context

Gambling is generally defined as risking something of value on the outcome of an event when the probability of winning or losing is determined by chance (Korn and Shaffer 1999). Legal gambling has become increasingly accessible in New Zealand over the last 20 years (Department of Internal Affairs 2007b). As a result, there has been a growth in the number and variety of gambling venues available in New Zealand, and in participation in and expenditure on gambling activities. Gambling activities now available in New Zealand include electronic gaming machines, casinos, track betting, sports betting, Lotto, Instant Kiwi (scratch tickets), Daily Keno, housie (bingo) and Internet gambling. Electronic gaming machines, also known as 'pokies', are found throughout New Zealand – in casinos, and in approximately 2000 pubs, clubs and bars, which are referred to as non-casino gaming machine (NCGM) venues in this report. Totalisator Agency Betting (TAB) venues are venues for track and sports betting in New Zealand.

The 2002/03 New Zealand Health Survey showed that, overall, 69.4% (95% confidence interval: 68.2–70.6) of New Zealanders aged 15 years and over had participated in at least one of the following gambling activities in the last 12 months: Lotto, Instant Kiwi, non-casino gaming machines, track or sports betting, casino games or gaming machines, Daily Keno, housie, 0900 phone gambling and Internet gaming.

The gambling activities in which people most commonly participated were:

- Lotto, in which 58.7% (57.5–60.0) of New Zealanders aged 15 years and over had participated in the previous year
- Instant Kiwi (29.2%; 27.8–30.6)
- non-casino gaming machines (12.8%; 12.0–13.6)
- track betting (11.3%; 10.5–12.1)
- casino gambling (8.3%; 7.2–9.2) (Ministry of Health 2006b).

In 2003 approximately NZ$1.871 billion was spent on gambling in New Zealand. Of this total, approximately 50.3% ($941 million) was spent on non-casino gaming machines, 24.4% ($457 million) at casinos, 12.8% ($239 million) on lotteries and 12.5% ($234 million) on racing. After 2003 annual gambling expenditure continued to increase to $2.027 billion in 2005, but reduced slightly to $1.977 billion in 2006 (Department of Internal Affairs 2007a).

## 1.3 Problem gambling

Although gambling is generally considered a form of entertainment, it can cause problems for some people. Gambling behaviour lies on a continuum that ranges from no problems through to severe problems. Problem gambling has been defined as 'gambling behaviour that results in any harmful effects to the gambler, his or her family, significant others, friends, co-workers' (National Research Council 1999: 21). Symptoms of problem gambling include needing to bet more and more to get the same feeling, and lying to people about the extent of gambling. The most severe form of problem gambling, pathological gambling, is defined in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) as 'persistent and recurrent maladaptive gambling behaviour ... that disrupts personal, family or vocational pursuits' (APA 2000: 671).

National gambling prevalence studies in New Zealand have estimated that the prevalence of current problem gambling (including probable pathological gambling) among the adult population (aged 18 years and over) was 3.3% (2.6–4.3) in 1991 (Abbott and Volberg 1991), dropping to 1.3% (0.9–1.8) in 1999 (Abbott and Volberg 2000), according to the SOGS-R gambling screen. Using a different measure of problem gambling, the 2002/03 New Zealand Health Survey found problem gambling behaviour among 1.2% (1.0–1.5) of people aged 15 years and over (Ministry of Health 2006b).

## 1.4 Associations with problem gambling

Problem gambling affects people from all types of backgrounds, although most studies have found demographic and socioeconomic risk factors for problem gambling. In the 2002/03 New Zealand Health Survey, key risk factors for problem gambling included being aged 25–34 years, being of Māori or Pacific ethnicity, being employed, being less educated and living alone (Ministry of Health 2006b). These risk factors were consistent with those for current problem gambling found in 1999, which included being of Māori or Pacific ethnicity, being employed and being less educated (Abbott and Volberg 2000). However, these results represent a shift since 1991, when risk factors included being male and unemployed, as well as being under 30 years old, and of Māori or Pacific ethnicity (Abbott and Volberg 1991).

Furthermore, the 2002/03 New Zealand Health Survey showed that problem gambling rates were significantly higher for people living in the quintile of most socioeconomically deprived areas (1.9%; 1.3–2.4) compared with people living in the quintile of least deprived areas (0.8%; 0.3–1.3) (Ministry of Health 2006b). However, regression analysis also suggested that area-level deprivation was not significant once ethnicity was taken into account (Ministry of Health 2006b). The survey showed that problem gambling rates did not differ between urban and rural areas, although people who lived in rural areas were significantly more likely to have gambled in the last year (75.1%; 71.9–78.3) compared with people living in urban areas (68.4%; 67.1–69.8) (Ministry of Health 2006b).

Problem gambling can have substantial negative impacts on many aspects of a person's life. One of the main negative impacts from problematic gambling can be experiencing financial problems. For example, over 40% of new clients at face-to-face problem gambling counselling services in 2003 had lost $1,000 or more on gambling in the four weeks prior to their first counselling assessment (Paton-Simpson et al 2004).

Problem gambling has also been shown to be associated with smoking (Abbott 2001; Ministry of Health 2006b; Petry and Oncken 2002; SERCIS 2001), alcohol problems and dependency (Abbott 2001; Ministry of Health 2006b; Toneatto et al 2002; Welte et al 2004a; Welte et al 2004b), and drug use and dependency (Abbott 2001; Volberg et al 1999). Studies have also shown gambling problems are associated with worse self-rated health (Ministry of Health 2006b; SERCIS 2001; Volberg et al 1999) and with experiencing more mental health issues (SERCIS 2001; Volberg et al 1999).

Furthermore, as well as affecting the gambler, problem gambling can harm other people in the gambler's life, including their family and whānau, friends and the wider community. It has been estimated that between 7 and 17 people are affected by each problem gambler (Productivity Commission 1999).

According to research findings, electronic gaming machines, track betting and casino games are more addictive and cause more problems than other types of gambling such as lotteries, as they are forms of gambling that allow people to gamble continuously without stopping (Abbott and Volberg 2000). Indeed, electronic gaming machines have been described as the 'crack cocaine of gambling' (Marshall and Wynne 2003: 9). At New Zealand face-to-face problem gambling counselling services in 2003, almost all new clients cited non-casino gaming machines (76.7%), casino gaming machines (9.9%), track betting (4.7%) or casino tables (4.6%) as their primary mode of problematic gambling (Paton-Simpson et al 2004).

## 1.5 Public health approach to problem gambling

Problem gambling can be considered as a public health issue, because of the above mentioned associations with poor health and health behaviours, and because it both occurs within and is influenced by the context of the society and the environment in which the gambler lives (see Korn and Shaffer 1999). Furthermore, gambling problems can affect not only the gambler, but also their family/whānau, friends, work colleagues, and wider community.

In New Zealand, the Gambling Act 2003 identified problem gambling as a public health concern, and passed responsibility for the prevention and treatment of problem gambling to the Ministry of Health. As a result, the Ministry of Health has developed a strategic plan for taking a public health approach to minimising the harm caused by gambling in New Zealand (Ministry of Health 2005).

One of the seven key objectives of this strategic plan is to encourage supportive environments to minimise gambling harm, which includes promoting environments and gambling settings that minimise gambling harm or the risk of gambling harm. A key aspect of the gambling environment is the accessibility of gambling. It is the issue of accessibility that is the focus of this report.

## 1.6 Accessibility of gambling

The Gambling Act 2003 has limited the locational accessibility of gambling, by restricting the number of casinos in New Zealand to the current six, and by limiting the numbers of non-casino gaming machines allowed at each venue, generally to either 9 or 18 depending on when the licence was granted. Furthermore, the Gambling Act requires each local authority to establish a policy around limits on non-casino gaming machine venues, such as the number of venues permitted in an area.

Various researchers have expressed concern that the higher accessibility of gambling opportunities exacerbates the prevalence of problem gambling (Middleton and Latif 2007; Mitka 2001; Volberg 2000). Despite such concerns, however, to date there has been little research evaluating the impact of the availability and/or the accessibility of gambling venues on gambling participation and problem gambling.

In terms of measuring accessibility, it has been suggested (Productivity Commission 1999) that the accessibility of gambling has several components, including:

- location of venues
- number of venues
- number of opportunities to gamble at each venue
- opening hours
- conditions of entry
- ease of use
- initial outlay
- social accessibility.

The few studies that have investigated the relationship between problem gambling and accessibility of gambling venues have generally focused on the first three of these components of accessibility.

There have been mixed findings from research into the relationship between gambling accessibility and gambling behaviour. In an ecological study, Marshall (2005) investigated the association between the number of electronic gaming machines (EGMs) per capita and gambling participation in several communities in New South Wales, Australia. This study found that centres with the greatest concentration of EGMs per capita also tended to have the highest rates of participation in EGMs. Gambling participation in this study was measured with a non-random survey of residents from seven different locations, and analysis did not take into account clustering in the survey design, or control for any confounding variables. Furthermore, the researchers only considered gambling, rather than problem gambling.

In a national study in the United States, problem gambling was found to be significantly associated with living close to casinos (Welte et al 2004b). This cross-sectional random digit dial survey found that people living within a straight-line distance of 10 miles (approximately 16.1 km) from a casino were significantly more likely (odds ratio: 1.90; 95% confidence interval: 1.11–3.24) to be a problem or pathological gambler but were not more likely to have gambled in the past year (odds ratio: 0.96; 0.69–1.34). These analyses controlled for the individual-level factors of ethnicity and socioeconomic status (income, education, occupation) and the neighbourhood-level factors of neighbourhood disadvantage, the block percentage of people living in urban areas, and the number of legal types of gambling within the state.

Problem gambling has also been shown to be marginally significantly associated with the straight-line distance to the nearest casino and/or racetrack with gaming machines, in a logistic regression analysis of survey data in Ontario, Canada from 2002 (Rush et al 2007). In another Canadian study, the opening of a casino appeared to increase the prevalence of problem gambling (Ladouceur et al 1999). However, in New Zealand, a replication study of national prevalence surveys in 1991 and 1999 showed a decrease in the prevalence of problem gambling, despite a large increase in the number of gambling opportunities in New Zealand over that time (Abbott and Volberg 2000).

Other studies have explored whether there is greater access to gambling in deprived areas. Gilliland (2005) used an ecological study to show that in Montreal, Canada, gaming machines ('video lottery terminals') were more likely to be located in more distressed neighbourhoods (as defined by area-based unemployment, low educational attainment and sole parenthood). This study showed that the proportion of liquor establishments with on-site liquor licences that also had gaming machines steadily increased with greater neighbourhood distress.

In New Zealand, there are more non-casino gaming machines in more socioeconomically deprived areas than would be expected if machines were evenly distributed (Ministry of Health 2006a; Wheeler 2003). This over-representation remains the case even when the ethnic composition of each area is taken into account (Wheeler et al 2006). Higher percentages of Māori and Pacific populations in an area were associated with lower odds of being in proximity to a venue. By contrast, areas of higher deprivation and with higher percentages of Asians were associated with greater probability of being within 250 m of a non-casino gaming machine venue.

Major reviews have generally concluded from these types of findings that the evidence is consistent with the theory that increased accessibility of gambling leads to higher participation rates and gambling-related problems (Abbott 2007; National Research Council 1999; Productivity Commission 1999). There remain, however, debates about the nature of this relationship. For example, there are two differing theories on how accessibility influences gambling behaviour: the exposure hypothesis (greater accessibility increases participation and problems) and the adaptation hypothesis (the relationship between accessibility and problems attenuates over time) (for further discussion, see Abbott 2006; 2007; Shaffer and Kidman 2004). Generally, however, it is accepted that both problem gambling and the accessibility of gambling are complex and multifaceted issues, and that assessing the relationship between them can pose challenges for researchers.

## 1.7 Multilevel modelling

In recent years, the technique of multilevel modelling has been used more to explore the effect of neighbourhood-level characteristics on the health of people living within that community (Blakely and Woodward 2000; Diez-Roux 2003). Multilevel modelling is a key technique used to simultaneously examine the relative effects of both individual-level and area-level characteristics (Rasbash et al 2004). It can be used to allow the consideration of neighbourhood effects, having controlled for individual-level factors, and vice versa.

Using multilevel modelling, studies have shown that neighbourhood context can influence the health of individuals (Pickett and Pearl 2001). For example, studies have found that living in deprived neighbourhoods is significantly associated with higher prevalence of coronary heart disease (Diez-Roux et al 1997; Lawlor et al 2005), worse oral health (Turrell et al 2007) and poor self-rated health (Kavanagh et al 2006), after controlling for a range of potentially confounding individual-level characteristics. Living in neighbourhoods with worse physical quality of residential environment has been found to be associated with higher odds of reporting fair to very bad health (Cummins et al 2005).

Multilevel modelling has also been used to examine the effects of availability and proximity on health behaviours. For example, drinking norms and the amount of alcohol consumed have been found to be associated with neighbourhood-level alcohol outlet density, when adjusting for individual-level and neighbourhood-level correlates (Scribner et al 2000). A recent New Zealand study found little evidence for associations between travel time to the nearest convenience store and adequate consumption of fruit and vegetables (Pearce et al 2008a). However, few multilevel studies have investigated the impact of the neighbourhood gambling environment on gambling behaviour.

## 1.8 Overview of this study

The evidence to date suggests that there may be an association between gambling behaviour and the accessibility of gambling venues. This study explores further the association between gambling accessibility and gambling behaviour in New Zealand, while controlling for related demographic, socioeconomic and neighbourhood factors that are thought to influence gambling behaviour.

This study considers the following research questions.

- Is living closer to gambling venues associated with a greater likelihood of gambling, after controlling for other individual-level and area-level factors?
- Is living closer to gambling venues associated with a greater likelihood of having gambling problems, after controlling for other individual-level and area-level factors?

This study's investigation of gambling behaviour in the past year focused specifically on gambling at particular types of gambling venues. It also investigated general past-year gambling behaviour (gambling on **any** gambling activity in the last year, such as Lotto and Instant Kiwi), to examine whether the accessibility of certain types of gambling venues affected participation in not only that particular type of gambling, but all types of gambling.

For this study, neighbourhood gambling accessibility was measured in three ways:

- distance from the neighbourhood centre to the nearest gambling venue
- number of gambling venues within walking distance of the neighbourhood centre (800 m)
- number of gambling venues within close driving distance of the neighbourhood centre (5 km).

The analyses examined three different types of gambling: electronic gaming machines, track betting and casinos. These three types were selected as they have been most commonly reported as problematic by clients at gambling counselling services (Paton-Simpson et al 2004).

In order to examine the dimensions of accessibility and their associations with gambling behaviour, it was necessary to control for individual- and neighbourhood-level factors that had the potential to confound the results. Individual-level factors included risk factors for gambling behaviour that may also be associated with the accessibility of gambling venues (such as socioeconomic status); neighbourhood-level factors were socioeconomic deprivation and urban/rural classification, which previous analyses have suggested may be associated with gambling behaviour and gambling accessibility (Ministry of Health 2006b; Wheeler et al 2006). A multilevel modelling approach was used to control for all these factors.

### Audience

This bulletin may be of interest to the health sector, the Department of Internal Affairs, and the wider gambling sector. The results may also be of interest to local authorities, who are responsible for developing policies on Class 4 (non-casino gaming machine) venues in their area.

# 2 Data Sources and Methods

The data sources for this multilevel modelling project included the 2002/03 New Zealand Health Survey, area-level factors based on data from the 2001 Census, and the locations of three main types of gambling venues in New Zealand, which were used to calculate accessibility of gambling venues for neighbourhoods using a Geographic Information System (GIS).

This chapter provides summary details about the data sources and methods for this project. More detailed information on the methodology and analysis is available in Appendix A.

## 2.1 2002/03 New Zealand Health Survey

The 2002/03 New Zealand Health Survey (NZHS) was a national survey of people aged 15 years and over living in New Zealand. Carried out between September 2002 and January 2004, it involved face-to-face interviews with 12,529 respondents. The target population for the survey was all non-institutionalised people aged 15 years and over living in permanent private dwellings. The survey population excluded people who did not live on the North Island, the South Island or Waiheke Island, due to difficulties and cost in getting to people on other islands.

A multistage stratified clustered sample design was used. First, all meshblocks (primary sampling units or PSUs) within the sample frame were divided into strata according to the ethnic composition within the meshblock, based on 2001 Census data. Meshblocks were randomly selected from strata with probability proportional to size. The second stage involved going to the selected meshblocks, and using systematic sampling to select every *k*th household from a random starting point. The third stage involved going to the selected households, and selecting one eligible person from the household to complete the survey questionnaire.

Two different stratification methods were used, as the sample design was changed partway through the survey due to low sample numbers. In the initial stratification, there were four strata based on the percentage of Māori, Pacific peoples and Asian peoples living in the PSU. In the latter stratification, there were only two strata, based on the percentage of Māori in the meshblock. The survey included over 1000 PSUs, and the number of respondents in each PSU ranged from 1 to more than 80, although the number of PSUs with only one respondent was small (n = 27) and over half of the PSUs had between 7 and 12 respondents.

The questionnaire for the 2002/03 NZHS included questions about gambling behaviour, problem gambling, demographic factors and socioeconomic status, as well as about chronic diseases, health status and health service utilisation.

Further details about the survey methodology for the 2002/03 NZHS are available in *A Portrait of Health: Key results of the 2002/03 New Zealand Health Survey* (Ministry of Health 2004).

## 2.2 Gambling accessibility

### 2.2.1 Calculating gambling accessibility for meshblocks

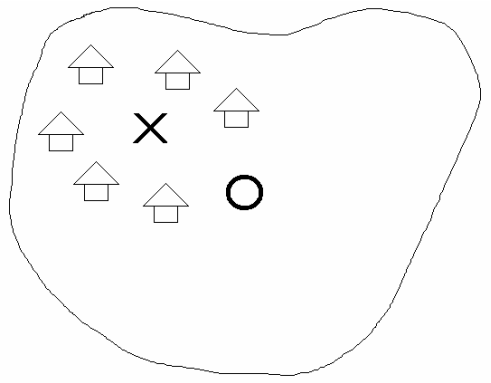
This study considered locational accessibility of three types of gambling venues in New Zealand: non-casino gaming machine (NCGM) venues, Totalisator Agency Board (TAB) venues and casinos. These three types were selected as they are the main gambling venues where one can gamble for extended periods, and they have been identified as the most problematic modes of gambling in New Zealand, according to problem gambling counselling statistics (Paton-Simpson et al 2004). Lottery outlets were not included due to the difficulty in obtaining the locations of these gambling outlets, their proliferation in New Zealand, and the small proportion of problem gamblers seeking help for lotteries as their primary mode of gambling problems.

Address data for all 2121 non-casino gaming machine venues (which had in total 22,417 machines) as at 31 March 2003 were obtained from the Department of Internal Affairs (Department of Internal Affairs 2005). The locations of the 579 TAB venues were obtained from the TAB website (as at 4 January 2005) (TAB 2005). Casino addresses for the six casinos in New Zealand were located from their websites. Addresses of these gambling venues were geocoded using the software GeoStan (Critchlow).

The accessibility of gambling venues was measured for all 38,350 meshblocks across New Zealand. Meshblocks are the smallest contiguous area units available for the collection and dissemination of Census data, and each one contains on average 100 people. Meshblocks range in size from about 1000 $m^2$ to 2200 $km^2$.

The accessibility analysis used population-weighted meshblock centroids to represent the location of survey respondents within their meshblock, as the residential addresses of respondents were not available due to confidentiality requirements. Population-weighted centroids were used rather than geometric centroids, as the former more accurately represent the geographical distribution of households within the meshblock. Figure 1 demonstrates this difference between the two kinds of centroid.

**Figure 1:** Schematic diagram of the population-weighted centroid (marked by X) and the geometric centroid (marked by O) of an area with six houses in it



Key:
X = population-weighted centroid
O = geometric centroid

In this analysis, two aspects of gambling accessibility were measured for each meshblock. The first measure of gambling accessibility was the distance to the nearest gambling venue, via the road network. Distances were measured from the population-weighted centroid of each meshblock to the nearest casino, non-casino gaming machine venue and TAB venue. Network analysis and a least-cost travel method were used to find the shortest path to the nearest gambling venue, while taking into account the road network. For this analysis, travel distance was used rather than travel time because, when calculating travel time, there are too many variables that cannot be accounted for, such as mode of transport and traffic levels.

The second type of gambling accessibility measure was to calculate the density of gambling venues in the local area. These were calculated using the number of (a) gambling venues and (b) non-casino gaming machines, within a typical walking (800 m) and driving (5 km) straight-line (Euclidean) distance from each meshblock population-weighted centroid. These distances are consistent with previous studies, which have used 800 m to approximate a comfortable 10-minute walk (such as Zenk and Powell 2007), and 5 km to approximate the distance that neighbourhood access to resources is likely to influence (Austin et al 2005; Donkin et al 2000) and also the distance of a short car trip. The straight-line distance was used rather than the distance via the road network for this analysis, due to the extremely long computational time required to calculate distance using the road network analysis, and to standardise the density measurement units. Furthermore, straight-line distance has been shown to be correlated with network distance (Apparicio et al 2008). Associations with the number of TAB venues and casinos within these distances were not investigated due to the low numbers of these types of venues.

The analysis was carried out with Network Analyst functionality in ESRI ArcGIS 9.1 software, using similar methodology to that previously documented for measuring neighbourhood access to health-related community resources (Pearce et al 2007a; Pearce et al 2006; Pearce et al 2007b).

### 2.2.2 Deriving gambling accessibility variables

These analyses resulted in seven variables relating to neighbourhood measures of the accessibility of gambling venues. These were:

- distance to the nearest gambling venue
- distance to the nearest NCGM venue
- distance to the nearest TAB venue
- number of gambling venues within 800 m
- number of gambling venues within 5 km
- number of NCGMs within 800 m
- number of NCGMs within 5 km.

Once the gambling accessibility variables had been calculated for each meshblock in New Zealand, the meshblocks were categorised into four groups for each variable, using the following methods.

For those variables measuring the distance to the closest gambling venue, meshblocks for the whole country were ranked from the nearest to furthest distance from a gambling venue. Due to confidentiality requirements, the meshblocks were then divided into four equally sized groups (quartiles), based on these distances.

For those variables measuring the number of gambling venues within 800 m and 5 km, meshblocks were sorted in order from the fewest to the most venues. Meshblocks were then split into four groups for each variable based on these numbers of venues; however, these four groups did not necessarily have the same number of meshblocks, due to the skewed distributions of these variables. This process was repeated for the variables concerned with the number of NCGMs within 800 m and 5 km.

The grouped gambling accessibility variables were then attached to the 2002/03 New Zealand Health Survey dataset, according to the meshblock in which each respondent lived. This step meant that each respondent was assigned to one of the four groups for each of the neighbourhood gambling accessibility variables.

Further information on how the gambling accessibility variables were derived, and the definitions of the groups for each gambling accessibility variable, is available in Appendix A.

## 2.3 Statistical methods

Multilevel logistic regression models with a random intercept were then fitted to the 2002/03 New Zealand Health Survey data. The data had a two-level structure, with respondents as level 1 and meshblocks as level 2. This structure allowed the study to take into account the clustered nature of the data. Unweighted data were used in analysis, but survey design variables were included in all models to take into account the sample design. All analyses were carried out in the multilevel software package MLwiN (version 2.02) (Rasbash et al 2004). In general, the estimation technique used in analyses was second order penalised or predictive quasi-likelihood (PQL) (see Appendix A for further details).

The dependent variable for each model was past-year gambling behaviour (Table 1). The independent variable of interest for each model was gambling accessibility (Table 2). The models investigated the association between a particular aspect of past-year gambling behaviour and each neighbourhood measure of gambling accessibility, controlling for potentially confounding factors at both individual and area levels (Table 3).

For all independent variables included in the model, categorical variables were fitted rather than continuous variables, to satisfy confidentiality requirements. The final dataset included 12,467 respondents, as a small number of respondents (62 respondents, or 0.5% of the sample) were excluded because they had missing data for one or more of the analysis variables.

### 2.3.1 Dependent variables – gambling behaviour

In the 2002/03 New Zealand Health Survey, respondents were asked which of the following gambling activities they had participated in during the last 12 months:

- Lotto
- Instant Kiwi
- Daily Keno
- casinos
- gaming machines (pokies not in casinos)
- TAB horses/dogs
- overseas horse and dog races
- track horse and dog races
- TAB sports
- overseas sports betting
- Housie
- 0900 (telephone) gambling games
- Internet gambling.

The past-year gambling behaviour of respondents was classified from their answers, to derive the variables presented in Table 1. General gambling behaviour was analysed on the basis that it involved a respondent's participation in any of the gambling activities listed above in the last 12 months. Also examined in separate analyses were past-year gambling at gambling venues (NCGM venues, TAB venues and casinos), NCGM gambling and TAB gambling.

Problem gambling status was measured with a 10-question gambling screen in the 2002/03 New Zealand Health Survey (Ministry of Health 2006b) (see Appendix A for more details). The analysis involved three different measures of problem gambling, based on the type of gambling activities that the respondent had also participated in during the previous year. This approach limited problem gamblers to only those who had used each particular type of gambling venue (Table 1).

**Table 1:** Dependent variables about gambling behaviour included in models

| Analysis | Gambling behaviour dependent variables |
|---|---|
| Gambling at gambling venues in the last year | Gambled at a gambling venue in the last 12 months<br>Gambled on an NCGM in the last 12 months<br>Gambled at a TAB venue in the last 12 months |
| General gambling behaviour in the last year | Gambled on any type of gambling activity in the last 12 months |
| Problem gambler who gambled at a gambling venue in the last year | Problem gamblers who gambled at a gambling venue in the last 12 months<br>Problem gamblers who gambled on an NCGM in the last 12 months<br>Problem gamblers who gambled at a TAB venue in the last 12 months |

### 2.3.2 Independent variables of interest – gambling accessibility

Gambling accessibility was measured at the neighbourhood (meshblock) level as described above. Each gambling accessibility variable had four categories, ranging from the meshblocks with the most access to gambling (closest distances or most venues/NCGMs) to the meshblocks with the least access to gambling (furthest distance or fewest venues/NCGMs).

In analysis, the reference category for each gambling accessibility variable was the category that had the least access to gambling venues. For example, the reference category would be the group of meshblocks that were the furthest distance from a gambling venue, or had the fewest gambling venues or NCGMs within the set distance.

The seven gambling accessibility variables used in analyses are described in Table 2. Further information about the gambling accessibility variables is available in Appendix A.

**Table 2:** Gambling accessibility variables included as independent variables in models

| Analysis | Gambling accessibility independent variables |
|---|---|
| Distance to nearest gambling venue | Distance to nearest gambling venue<br>Distance to nearest NCGM venue<br>Distance to nearest TAB venue |
| Number of gambling venues within walking distance | Number of gambling venues within 800 m<br>Number of NCGMs within 800 m |
| Number of gambling venues within close driving distance | Number of gambling venues within 5 km<br>Number of NCGMs within 5 km |

### 2.3.3 Controlling for potential confounding factors

As well as including a gambling accessibility variable in each model, the modelling procedure controlled for potential confounding factors at various levels. To do so, it produced models at the following four different stages: (a) a baseline model, (b) an individual socioeconomic status (SES) model, (c) a New Zealand Index of Deprivation (NZDep) model and (d) an urban/rural model.

The baseline model controlled for the key demographic variables of sex, age and prioritised ethnicity. It also included the survey design variables of stratum, number of respondents in the PSU, and the number of adults in the household, to account for the sample stratification and oversampling of ethnic minorities in the 2002/03 NZHS.

The second stage of analysis controlled for individual SES, by adding at least one of the following variables into the baseline model: education, household income, social class, working status and receiving benefits. A backwards elimination of individual SES variables was carried out, using a modified change-in-estimate criterion procedure (Greenland and Rothman 1998; Mickey and Greenland 1989). This method controls for confounding, by including possible confounding variables in the model if removing them from the model changes the odds ratio of the gambling accessibility variable by a certain amount (in this study, 10% or more). Further information about the model selection process is available in Appendix A.

The third stage of analysis controlled for area-level socioeconomic deprivation. It involved adding the NZDep2001 quintile variable to the individual SES model.

The fourth stage controlled for urban/rural status, by adding the urban/rural variable to the NZDep model from the third stage. The urban/rural category was taken from the Statistics New Zealand variable from the 2001 Census, which classified meshblocks as being in a main urban area, secondary urban area, minor urban area or rural area, depending on the population size of the town/city (Department of Statistics 1992) (see Appendix A for more details).

Area-level socioeconomic deprivation and rurality were included irrespective of the proportion that they changed the estimate or their significance, on the basis that this information would be of theoretical importance and of interest to the reader for comparison with related studies. Studies have demonstrated that living in a more deprived neighbourhood has an independent effect on a range of health-related behaviours (Pickett and Pearl 2001), so it was necessary to control for neighbourhood socioeconomic deprivation during analysis. Similarly, if the access measure was patterned by urban/rural status, it would be necessary to control for that status, so that the results showed the independent effect of gambling accessibility, over and above urban/rural status. A final point to note is that small numbers generally meant that it was not possible to explore specific population groups and interaction effects.

Table 3 summarises the variables included in the individual stages of each model.

**Table 3:** Summary of variables included in the four stages of logistic regression, controlling for various levels of confounding

| **Baseline model** | **Individual SES model** | **NZDep model** | **Urban/rural model** |
|---|---|---|---|
| Gambling accessibility variable | Gambling accessibility variable | Gambling accessibility variable | Gambling accessibility variable |
| Stratum<br>Number of respondents in PSU<br>Number of adults in household<br>Sex<br>Age group<br>Prioritised ethnic group | Stratum<br>Number of respondents in PSU<br>Number of adults in household<br>Sex<br>Age group<br>Prioritised ethnic group | Stratum<br>Number of respondents in PSU<br>Number of adults in household<br>Sex<br>Age group<br>Prioritised ethnic group | Stratum<br>Number of respondents in PSU<br>Number of adults in household<br>Sex<br>Age group<br>Prioritised ethnic group |
| – | *At least one individual SES variable, selected from:*<br>Education<br>Household income<br>Social class (occupation)<br>Benefits<br>Work status | *Individual SES variable(s) included in individual SES model* | *Individual SES variable(s) included in individual SES model* |
| – | – | NZDep2001 quintiles | NZDep2001 quintiles |
| – | – | – | Urban/rural status |

More detailed information about the data and methods is available in Appendix A, including the definitions of all variables in the analysis, and details of the model selection procedure.

Full details of the individual SES variables included in each of the models in the results section are given in Appendix B.

## 2.4 Presentation of results

The main body of this report includes the results for the key variables of interest – namely, those concerning the accessibility of gambling venues. The example below explains how these results are presented in the chapters that follow. Appendix C gives an example of a full model (Models 1A–1D), and all full models are available on request from Public Health Intelligence.

## How to interpret tables in Chapters 3–5: an example

The table title describes the models shown in the table

The baseline model controls for survey design variables, sex, age and ethnicity

The individual SES model controls for all the variables in the baseline model, and selected individual SES variable(s)

The NZDep model controls for all the variables in the individual SES model, and NZDep

The urban/rural model controls for all the variables in the NZDep model, and rurality

The model number can be used to look up more information about the model in Appendix B

**Table X:** Odds ratios of having gambled at specific types of gambling venues in the last 12 months, by quartiles of neighbourhood distance to the nearest gambling venue

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence intervals) | | | |
|---|---|---|---|---|---|
| | | **Baseline model** | **Individual SES model** | **NZDep model** | **Urban/rural model** |
| **Gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months** | **Quartiles of distance to nearest gambling venue (NCGM venue, TAB venue or casino)** | *Model 1A* | *Model 1B* | *Model 1C* | *Model 1D* |
| | Quartile 1 (<698 m) | 1.41 (1.21–1.66)* | 1.50 (1.27–1.75)* | 1.45 (1.23–1.71)* | 1.51 (1.22–1.87)* |
| | Quartile 2 (698–1260 m) | 1.29 (1.10–1.50)* | 1.35 (1.16–1.58)* | 1.33 (1.13–1.56)* | 1.38 (1.12–1.71)* |
| | Quartile 3 (1261–2965 m) | 1.36 (1.16–1.58)* | 1.43 (1.22–1.67)* | 1.41 (1.21–1.65)* | 1.47 (1.19–1.80)* |
| | Quartile 4 (2966 m +) | 1 | 1 | 1 | 1 |

Note: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant.

The first column gives the dependent variable for the model

The second column shows the categories for the gambling accessibility variable in the model

1 indicates the reference category for the gambling accessibility variable

The first number is the odds ratio; the 95% confidence interval is given in brackets

* shows that the confidence interval does not include 1 and therefore the result is statistically significant

## Odds ratios and 95% confidence intervals

An odds ratio is the ratio of the odds of having an outcome, for two different groups of people. For example, the odds ratios presented in Table X show the odds of having gambled at a gambling venue, for people living in Quartiles 1, 2 and 3, compared with the reference group of people living in Quartile 4 (where the odds ratio is 1).

For all analyses in this report, odds ratios are presented with 95% confidence intervals. The 95% confidence intervals give an estimate of the degree of accuracy of the result. If the 95% confidence interval does not include 1, the result is statistically significant.

# 3 Distance to Nearest Gambling Venue

## Key results

This study found that the distance from a neighbourhood centre to the nearest gambling venue is significantly associated with past-year gambling behaviour.

These results suggest that, compared with living in the quartile of neighbourhoods **furthest** from gambling venues (non-casino gaming machine (NCGM) venues, Totalisator Agency Board (TAB) venues and casinos), living in neighbourhoods **closer** to gambling venues was:

- significantly associated with having gambled at a gambling venue in the last year
- significantly associated with being a problem gambler who had gambled at a gambling venue in the last year
- not associated with having gambled on **any** type of gambling activity in the last year.

Living in a neighbourhood closer to an NCGM venue was significantly associated with:

- having gambled on an NCGM in the last year
- being a problem gambler who had gambled on an NCGM in the last year.

Living in a neighbourhood closer to a TAB venue was significantly associated with having gambled at a TAB venue in the last year.

There did not generally appear to be an exposure–response relationship in the association between past-year gambling and distance to the nearest venue. The exception was in the TAB analysis, where the relationship became stronger with closer distances to TAB venues.

In the association between problem gambling and distance to the nearest venue, the results were similar for the two closest quartiles, indicating higher odds of being a problem gambler in both cases. The similarity of these results suggests a possible threshold effect, whereby living anywhere within a certain distance increases the odds of being a problem gambler to a similar level. There also appeared to be a possible exposure–response relationship, as the odds ratios reduced for the furthest two distance quartiles.

## 3.1 Introduction

This chapter examines the associations between individual-level gambling behaviour and the distance from a neighbourhood centre to the nearest gambling venue. For these analyses, neighbourhood distance was measured from the population-weighted centroid of the meshblock (neighbourhood) in which each respondent lived, to the nearest gambling venue, via the road network.

For each section, key results are presented for three models, considering:

1. access to all gambling venues (TAB venues, NCGM venues and casinos)
2. access to NCGM venues specifically
3. access to TAB venues.

For each model, the odds ratios for gambling accessibility are presented, controlling for baseline variables (A), then adding the following variables in a stepwise manner:

individual selected socioeconomic status (SES) variable(s) (B), New Zealand Index of Deprivation (NZDep) 2001 quintiles (C) and urban/rural status (D).

Table 4 summarises the three analyses presented in this chapter, identifying in particular the dependent variable(s) used in the models in each section.

**Table 4:** Outline of analyses included in Chapter 3

| Section | Dependent variables |
|---|---|
| 3.2 | • Gambled at a gambling venue in the last 12 months<br>• Gambled on an NCGM in the last 12 months<br>• Gambled at a TAB venue in the last 12 months |
| 3.3 | • Gambling on any type of gambling activity in the last 12 months |
| 3.4 | • Problem gamblers who gambled at a gambling venue in the last 12 months<br>• Problem gamblers who gambled on an NCGM in the last 12 months<br>• Problem gamblers who gambled at a TAB venue in the last 12 months |

## 3.2 Gambling at gambling venues in the last 12 months

Table 5 presents the associations between having gambled at a gambling venue in the last 12 months and the neighbourhood distance to the nearest gambling venue. In this analysis, the dependent variable identified whether the individual had gambled at specific types of gambling venues in the last 12 months.

This analysis found that people living in neighbourhoods closer to a gambling venue (NCGM venues, TAB venues and casinos) (Quartiles 1–3) were significantly more likely to have gambled at a gambling venue in the last 12 months than people living in neighbourhoods furthest from a gambling venue (Quartile 4), after controlling for the baseline variables (Model 1A). This association remained significant after adjustment for individual-level socioeconomic status, neighbourhood deprivation (NZDep) and neighbourhood urban/rural status (Models 1B–1D), although there appeared to be no clear exposure–response relationship in this association.

This relationship remained relatively consistent for the separate analyses of NCGM venues and TAB venues. People living in neighbourhoods closer to an NCGM venue (Quartiles 1–3) were significantly more likely to have gambled on an NCGM in the past year than people in the furthest distance quartile (Quartile 4) (Models 2A–2D). For example, in the NZDep model (Model 2C), people living in the closest quartile to an NCGM venue (Quartile 1) were significantly more likely (odds ratio = 1.54; 95% confidence interval: 1.26–1.88) to have gambled on an NCGM in the last 12 months than people living in the furthest quartile (Quartile 4).

People living in neighbourhoods closer to a TAB venue (Quartiles 1–2) were also significantly more likely to have gambled at a TAB in the last year than people living in neighbourhoods furthest from a TAB venue (Quartile 4) (Models 3A–3D). There appeared to be a possible exposure–response relationship, as the relationship became stronger with closer distances to TAB venues.

The strength of the associations was somewhat stronger in the analysis of NCGM venues (Models 2A–2D) than in the analysis of all gambling venues (Models 1A–1D) and TAB venues (Models 3A–3D).

For some models, the odds ratio for one quartile was higher than for a quartile with greater access to a gambling venue. However, the overlapping confidence intervals generally suggest that there was no significant difference in the odds ratios for the two quartiles.

**Table 5:** Odds ratios of having gambled at specific types of gambling venues in the last 12 months, by quartiles of neighbourhood distance to the nearest gambling venue

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence intervals) | | | |
|---|---|---|---|---|---|
| | | Baseline model | Individual SES model | NZDep model | Urban/rural model |
| Gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months | **Quartiles of distance to nearest gambling venue (NCGM venue, TAB or casino)** | *Model 1A* | *Model 1B* | *Model 1C* | *Model 1D* |
| | Quartile 1 (<698 m) | 1.41 (1.21–1.66)* | 1.50 (1.27–1.75)* | 1.45 (1.23–1.71)* | 1.51 (1.22–1.87)* |
| | Quartile 2 (698–1260 m) | 1.29 (1.10–1.50)* | 1.35 (1.16–1.58)* | 1.33 (1.13–1.56)* | 1.38 (1.12–1.71)* |
| | Quartile 3 (1261–2965 m) | 1.36 (1.16–1.58)* | 1.43 (1.22–1.67)* | 1.41 (1.21–1.65)* | 1.47 (1.19–1.80)* |
| | Quartile 4 (2966 m +) | 1 | 1 | 1 | 1 |
| Gambled on an NCGM in the last 12 months | **Quartiles of distance to nearest NCGM venue** | *Model 2A* | *Model 2B* | *Model 2C* | *Model 2D* |
| | Quartile 1 (<734 m) | 1.53 (1.26–1.86)* | 1.60 (1.31–1.95)* | 1.54 (1.26–1.88)* | 1.67 (1.28–2.18)* |
| | Quartile 2 (734–1316 m) | 1.54 (1.28–1.87)* | 1.63 (1.34–1.97)* | 1.58 (1.30–1.92)* | 1.72 (1.32–2.24)* |
| | Quartile 3 (1317–3076 m) | 1.42 (1.17–1.72)* | 1.49 (1.23–1.80)* | 1.47 (1.22–1.79)* | 1.60 (1.24–2.07)* |
| | Quartile 4 (3077 m +) | 1 | 1 | 1 | 1 |
| Gambled at a TAB venue in the last 12 months | **Quartiles of distance to nearest TAB venue** | *Model 3A* | *Model 3B* | *Model 3C* | *Model 3D* |
| | Quartile 1 (<1052 m) | 1.36 (1.10–1.68)* | 1.44 (1.17–1.78)* | 1.42 (1.15–1.76)* | 1.60 (1.20–2.15)* |
| | Quartile 2 (1052–1854 m) | 1.28 (1.04–1.58)* | 1.35 (1.10–1.67)* | 1.34 (1.08–1.66)* | 1.52 (1.14–2.04)* |
| | Quartile 3 (1855–5490 m) | 1.17 (0.96–1.43) | 1.22 (1.00–1.49) | 1.22 (1.00–1.49) | 1.38 (1.04–1.81)* |
| | Quartile 4 (5491 m +) | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

## 3.3 Gambling on any type of gambling activity in the last 12 months

Table 6 presents the associations between general gambling behaviour in the last 12 months and the neighbourhood distance to the nearest gambling venue.

The definition of people who participated in general gambling behaviour includes all those who had gambled on at least one type of gambling activity listed in the survey in the last 12 months. These activities were:

- Lotto
- Instant Kiwi
- Daily Keno
- casinos
- gaming machines (pokies not in casinos)
- TAB horses/dogs
- overseas horse and dog races
- track horse and dog races
- TAB sports
- overseas sports betting
- Housie
- 0900 (telephone) gambling games
- Internet gambling.

Thus, for example, people who had gambled only on Lotto in the previous year were included in the group of people who had gambled in the last 12 months.

Table 6 shows that there were no significant associations between living in a neighbourhood closer to a gambling venue and general gambling behaviour. These results were consistent for access to all gambling venues (Models 4A–4D), NCGM venues (Models 5A–5D) and TAB venues (Models 6A–6D).

**Table 6:** Odds ratios of having gambled in the last 12 months, by quartiles of neighbourhood distance to the nearest gambling venue

| **Dependent variable** | **Neighbourhood gambling accessibility variables** | **Odds ratio (95% confidence intervals)** | | | |
|---|---|---|---|---|---|
| | | **Baseline model** | **Individual SES model** | **NZDep model** | **Urban/rural model** |
| Gambled on any type of gambling activity in the last 12 months | **Quartiles of distance to nearest gambling venue (NCGM venue, TAB venue or casino)** | *Model 4A* | *Model 4B* | *Model 4C* | *Model 4D* |
| | Quartile 1 (<698 m) | 0.91 (0.78–1.07) | 0.98 (0.83–1.15) | 0.93 (0.79–1.10) | 0.90 (0.73–1.12) |
| | Quartile 2 (698–1260 m) | 1.00 (0.85–1.17) | 1.06 (0.90–1.24) | 1.03 (0.88–1.21) | 0.99 (0.80–1.23) |
| | Quartile 3 (1261–2965 m) | 1.05 (0.89–1.23) | 1.11 (0.95–1.31) | 1.10 (0.94–1.30) | 1.06 (0.86–1.30) |
| | Quartile 4 (2966 m +) | 1 | 1 | 1 | 1 |
| Gambled on any type of gambling activity in the | **Quartiles of distance to nearest NCGM venue** | *Model 5A* | *Model 5B* | *Model 5C* | *Model 5D* |
| | Quartile 1 (<734 m) | 0.92 (0.78–1.08) | 0.99 (0.84–1.16) | 0.94 (0.79–1.11) | 0.90 (0.72–1.12) |

| | | | | | |
|---|---|---|---|---|---|
| last 12 months | Quartile 2 (734–1316 m) | 0.99 (0.84–1.16) | 1.07 (0.91–1.26) | 1.04 (0.88–1.22) | 0.99 (0.80–1.22) |
| | Quartile 3 (1317–3076 m) | 1.03 (0.88–1.21) | 1.11 (0.94–1.30) | 1.10 (0.94–1.29) | 1.05 (0.85–1.29) |
| | Quartile 4 (3077 m +) | 1 | 1 | 1 | 1 |
| Gambled on any type of gambling activity in the last 12 months | **Quartiles of distance to nearest TAB venue** | *Model 6A* | *Model 6B* | *Model 6C* | *Model 6D* |
| | Quartile 1 (<1052 m) | 0.88 (0.75–1.03) | 0.93 (0.79–1.10) | 0.89 (0.75–1.05) | 0.86 (0.69–1.07) |
| | Quartile 2 (1052–1854 m) | 0.98 (0.83–1.15) | 1.04 (0.88–1.23) | 1.01 (0.86–1.19) | 0.97 (0.78–1.22) |
| | Quartile 3 (1855–5490 m) | 0.96 (0.83–1.12) | 1.00 (0.86–1.17) | 0.99 (0.85–1.16) | 0.95 (0.77–1.18) |
| | Quartile 4 (5491 m +) | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

## 3.4 Being a problem gambler who gambled at a gambling venue in the last 12 months

Table 7 presents the associations between the neighbourhood distance to the nearest gambling venue and being a problem gambler who had gambled at a gambling venue in the last year. This analysis was undertaken separately for all gambling venues (Models 7A–7D), NCGM venues (Models 8A–8D) and TAB venues (Models 9A–9D).

These results show that neighbourhood distance to the nearest gambling venue was significantly associated with being a problem gambler who gambled at those types of gambling venues in the last year, for all three categories of gambling venues. For all models presented in Table 7, there were elevated odds ratios for problem gambling for those people living closer to gambling venues, although only some results were statistically significant.

Table 7 shows that people living in neighbourhoods closer to gambling venues (Quartiles 1–2) were significantly more likely to be problem gamblers who had gambled at a gambling venue in the last year, compared with people living in the furthest quartile from venues (Quartile 4), after adjusting for individual-level and area-level factors (Models 7A–7D). The odds ratio for the three closest quartiles of gambling accessibility (Quartiles 1–3) were significantly higher than 1 when adjusting for rurality (Model 7D) and showed increases from the odds ratios in the NZDep model (Model 7C).

Similar associations were also found when examining NCGM venues (Models 8A–8D) and TAB venues (Model 9A–9D) separately. Living in neighbourhoods closer to NCGM venues (Quartiles 1–2) was significantly associated with being a problem gambler who had used an NCGM in the last year, compared with living in the furthest quartile (Quartile 4), for all models (Models 8A–8D). In the fully adjusted model (Model 8D), the odds ratios for all three closer quartiles (Quartiles 1–3) were significant, and had increased from the odds ratios in the model controlling for area-level deprivation (Model 8C).

People who lived in neighbourhoods closer to a TAB venue (Quartiles 1 and 3) were significantly more likely to be problem gamblers who had gambled at a TAB venue in the last year, compared with people living in the furthest quartile from a TAB venue (Quartile 4), in the fully adjusted model (Model 9D). For Models 9A–9C, the odds ratios for Quartile 1–3 were higher than 1, although these were not statistically significant, possibly due to small sample sizes.

In all three models (Models 7–9), controlling for rurality substantially increased the odds ratios for all three neighbourhood gambling accessibility categories (Quartiles 1–3).

**Table 7:** Odds ratios of being a problem gambler who had gambled at specific types of gambling venues in the last 12 months, by quartiles of neighbourhood distance to the nearest gambling venue

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | **Baseline model** | **Individual SES model** | **NZDep model** | **Urban/rural model** |
| Problem gambler who gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months | **Quartiles of distance to nearest gambling venue (NCGM venue, TAB or casino)** | *Model 7A* | *Model 7B* | *Model 7C* | *Model 7D* |
| | Quartile 1 (<698 m) | 1.60 (1.02–2.50)* | 1.67 (1.07–2.63)* | 1.60 (1.01–2.53)* | 2.05 (1.14–3.68)* |
| | Quartile 2 (698–1260 m) | 1.63 (1.04–2.55)* | 1.72 (1.10–2.70)* | 1.65 (1.05–2.59)* | 2.11 (1.18–3.78)* |
| | Quartile 3 (1261–2965 m) | 1.45 (0.92–2.27) | 1.53 (0.98–2.39) | 1.51 (0.96–2.37) | 1.88 (1.07–3.30)* |
| | Quartile 4 (2966 m +) | 1 | 1 | 1 | 1 |
| Problem gambler who gambled on an NCGM in the last 12 months | **Quartiles of distance to nearest NCGM venue** | *Model 8A* | *Model 8B* | *Model 8C* | *Model 8D* |
| | Quartile 1 (<734 m) | 1.84 (1.13–2.99)* | 1.91 (1.18–3.11)* | 1.84 (1.12–3.01)* | 2.71 (1.45–5.07)* |
| | Quartile 2 (734–1316 m) | 1.88 (1.16–3.04)* | 1.97 (1.22–3.20)* | 1.90 (1.17–3.09)* | 2.82 (1.51–5.27)* |
| | Quartile 3 (1317–3076 m) | 1.32 (0.80–2.16) | 1.37 (0.84–2.26) | 1.36 (0.82–2.24) | 1.96 (1.06–3.63)* |
| | Quartile 4 (3077 m +) | 1 | 1 | 1 | 1 |
| Problem gambler who gambled at a TAB venue in the last 12 months | **Quartiles of distance to nearest TAB venue** | *Model 9A* | *Model 9B* | *Model 9C* | *Model 9D* |
| | Quartile 1 (<1052 m) | 1.54 (0.79–3.00) | 1.69 (0.87–3.29) | 1.61 (0.82–3.18) | 2.70 (1.03–7.05)* |
| | Quartile 2 (1052–1854 m) | 1.09 (0.53–2.23) | 1.18 (0.58–2.41) | 1.17 (0.57–2.41) | 1.89 (0.70–5.08) |
| | Quartile 3 (1855–5490 m) | 1.54 (0.85–2.82) | 1.62 (0.89–2.96) | 1.65 (0.90–3.01) | 2.56 (1.07–6.11)* |
| | Quartile 4 (5491 m +) | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

# 4 Number of Gambling Venues and Non-Casino Gaming Machines within Walking Distance

## Key results

Having at least some non-casino gaming machines (NCGMs) within 800 m of the neighbourhood centre was associated with a small increase in the odds of having gambled on an NCGM in the last year.

There were no associations between having gambled on **any** type of gambling activity in the last 12 months and the number of gambling venues within 800 m of the neighbourhood centre.

There were no consistently significant associations between problem gambling and the number of NCGMs within 800 m of the neighbourhood centre.

## 4.1 Introduction

This chapter examines how gambling behaviour is associated with the number of gambling venues and non-casino gaming machines within walking distance of the neighbourhood centre. Separate analyses on the number of Totalisator Agency Board (TAB) venues and casinos within walking distance were not carried out due to the low numbers of these venues.

In this report, walking distance is defined as being within an 800 m straight-line buffer around the neighbourhood centre (population-weighted meshblock centroid) for the neighbourhood in which the respondent lived.

For each section, key results are presented for two models. The first considers all gambling venues (TAB venues, NCGM venues and casinos) within walking distance (800 m) and the second specifically examines the number of NCGMs within walking distance.

For each model, the odds ratios for gambling accessibility are presented, controlling for baseline variables (A), and then adding the following variables in a stepwise manner: individual selected socioeconomic status (SES) variable(s) (B), New Zealand Index of Deprivation (NZDep) 2001 quintiles (C) and urban/rural status (D).

Table 8 summarises the three analyses presented in this chapter. Section 4.2 explores whether gambling accessibility is associated with increased participation in gambling at gambling venues and on NCGMs. Section 4.3 investigates whether the accessibility of gambling is associated with an increase in overall gambling (having gambled on any gambling activity in the last 12 months). Section 4.4 investigates problem gamblers who have gambled on an NCGM in the last 12 months.

**Table 8:** Outline of analyses included in Chapter 4

| Section | Dependent variables |
|---|---|
| 4.2 | • Gambled at a gambling venue in the last 12 months<br>• Gambled on an NCGM in the last 12 months |
| 4.3 | • Gambled on any type of gambling activity in the last 12 months |
| 4.4 | • Problem gamblers who gambled on an NCGM in the last 12 months |

## 4.2 Gambling at gambling venues and on NCGMs in the last 12 months

Table 9 presents the results that examine whether the number of gambling venues and the number of NCGMs within walking distance of the neighbourhood centre were associated with having gambled at those venues or on an NCGM in the last year.

The results show that there was no significant association between the number of gambling venues within 800 m of the neighbourhood centre and having gambled at a gambling venue in the last year, in the urban/rural model (Model 10D).

Having at least some NCGMs within 800 m of the neighbourhood centre was significantly associated with a small increase in the odds of having gambled on an NCGM in the last year (Models 11A–11D). However, there did not appear to be an exposure–response relationship with the number of NCGMs within 800 m of the neighbourhood centre.

**Table 9:** Odds ratios of having gambled at gambling venues generally and on NCGMs in the last 12 months, by number of gambling venues and by number of NCGMs within 800 m of neighbourhood centre

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | Baseline model | Individual SES model | NZDep model | Urban/rural model |
| Gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months | **Number of gambling venues (NCGM venues, TAB venues and casinos) within 800 m** | *Model 10A* | *Model 10B* | *Model 10C* | *Model 10D* |
| | 11 or more venues | 1.12 (0.74–1.72) | 1.19 (0.77–1.82) | 1.14 (0.74–1.75) | 1.12 (0.73–1.73) |
| | 6–10 venues | 1.22 (0.97–1.53) | 1.27 (1.01–1.59)* | 1.22 (0.97–1.53) | 1.16 (0.92–1.47) |
| | 1–5 venues | 1.11 (1.00–1.23) | 1.13 (1.02–1.26)* | 1.12 (1.00–1.24) | 1.06 (0.95–1.19) |
| | No venues | 1 | 1 | 1 | 1 |
| Gambled on an NCGM in the last 12 months | **Number of NCGMs within 800 m** | *Model 11A* | *Model 11B* | *Model 11C* | *Model 11D* |
| | 37 or more machines | 1.32 (1.08–1.62)* | 1.35 (1.11–1.66)* | 1.30 (1.06–1.59)* | 1.25 (1.01–1.54)* |
| | 18–36 machines | 1.27 (1.07–1.52)* | 1.28 (1.07–1.53)* | 1.26 (1.05–1.50)* | 1.20 (1.00–1.45) |
| | 1–17 machines | 1.27 (1.06–1.51)* | 1.28 (1.08–1.53)* | 1.27 (1.07–1.51)* | 1.22 (1.02–1.46)* |
| | No machines | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

## 4.3 Gambling on any type of gambling activity in the last 12 months

Table 10 presents the associations between general gambling behaviour (that is, having gambled on **any** gambling activity listed in the survey in the last 12 months) and the number of gambling venues and NCGMs within walking distance (800 m) of the neighbourhood centre.

These results show that having gambled on **any** type of gambling activity in the last 12 months was not associated with having more gambling venues within 800 m of the neighbourhood centre (Models 12A–12D).

Similar results were found in the analysis of NCGMs. In particular, having more NCGMs within 800 m of the neighbourhood centre was not associated with overall past-year gambling participation in any type of gambling activity (Model 13A–13D).

**Table 10:** Odds ratios of having gambled on any gambling activity in the last 12 months, by number of gambling venues and by number of NCGMs within 800 m of neighbourhood centre

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | **Baseline model** | **Individual SES model** | **NZDep model** | **Urban/rural model** |
| Gambled on any type of gambling activity in the last 12 months | **Number of gambling venues (NCGM venues, TAB venues and casinos) within 800 m** | *Model 12A* | *Model 12B* | *Model 12C* | *Model 12D* |
| | 11 or more venues | 0.74 (0.49–1.12) | 0.77 (0.51–1.17) | 0.72 (0.48–1.09) | 0.76 (0.50–1.15) |
| | 6–10 venues | 0.97 (0.77–1.22) | 1.00 (0.80–1.27) | 0.95 (0.75–1.20) | 0.93 (0.73–1.17) |
| | 1–5 venues | 0.92 (0.83–1.03) | 0.95 (0.85–1.05) | 0.92 (0.83–1.03) | 0.91 (0.81–1.03) |
| | No venues | 1 | 1 | 1 | 1 |
| Gambled on any type of gambling activity in the last 12 months | **Number of NCGMs within 800 m** | *Model 13A* | *Model 13B* | *Model 13C* | *Model 13D* |
| | 37 or more machines | 0.98 (0.83–1.15) | 1.02 (0.87–1.21) | 0.97 (0.82–1.14) | 0.97 (0.82–1.15) |
| | 18–36 machines | 0.93 (0.81–1.08) | 0.95 (0.83–1.10) | 0.93 (0.81–1.08) | 0.93 (0.80–1.08) |
| | 1–17 machines | 0.96 (0.83–1.10) | 0.98 (0.85–1.13) | 0.97 (0.84–1.12) | 0.96 (0.83–1.11) |
| | No machines | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

## 4.4 Being a problem gambler who gambled on an NCGM in the last 12 months

Table 11 presents the associations between the number of NCGMs within walking distance (800 m) of the neighbourhood centre and being a problem gambler who had gambled on an NCGM in the last year.

There appeared to be a slight association between the number of NCGMs within 800 m of the neighbourhood centre and being a problem gambler who had used NCGMs in the last year (Models 14A–14D). However, this association did not appear to be consistently significant or to have a clear exposure–response relationship.

Results have not been presented for the association between problem gambling and the number of gambling venues within 800 m, due to low numbers for this analysis.

**Table 11:** Odds ratios of being a problem gambler who had gambled at NCGM venues in the last 12 months, by number of NCGMs within 800 m of neighbourhood centre

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | **Baseline model** | **Individual SES model** | **NZDep model** | **Urban/rural model** |
| Problem gambler who gambled on an NCGM in the last 12 months | **Number of NCGMs within 800 m** | *Model 14A* | *Model 14B* | *Model 14C* | *Model 14D* |
| | 37 or more machines | 1.52 (0.96–2.43) | 1.57 (0.99–2.51) | 1.49 (0.93–2.39) | 1.53 (0.93–2.51) |
| | 18–36 machines | 1.01 (0.64–1.62) | 1.02 (0.64–1.63) | 1.01 (0.63–1.61) | 1.03 (0.63–1.70) |
| | 1–17 machines | 1.77 (1.21–2.59)* | 1.79 (1.23–2.62)* | 1.78 (1.22–2.60)* | 1.83 (1.23–2.72)* |
| | No machines | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Model adjusts consecutively for individual- and neighbourhood-level covariates.

# 5 Number of Gambling Venues and Non-Casino Gaming Machines within Close Driving Distance

## Key results

Having at least some gambling venues within 5 km of the neighbourhood centre was significantly associated with having gambled at those types of venues in the last year.

The number of NCGMs within 5 km appeared to be associated with having gambled on an NCGM within the past year, although this association was not consistently significant, and did not show a clear exposure–response effect.

There were no significant associations between having gambled on **any** type of gambling activity in the last 12 months and the number of gambling venues or NCGMs within 5 km of the neighbourhood centre.

There were no consistently significant associations between problem gambling and the number of gambling venues or NCGMs within 5 km of the neighbourhood centre.

## 5.1 Introduction

This chapter examines the associations between gambling behaviour and the number of (a) all gambling venues and (b) non-casino gaming machines (NCGMs) within close driving distance. Totalisator Board Agency (TAB) venues and casinos have not been included separately in this analysis due to low numbers of these venues.

In this report, close driving distance is defined as being within a 5 km straight-line buffer around the neighbourhood centre (meshblock population-weighted centroid) for the neighbourhood in which the respondent lived.

For each section, key results are presented for two models. The first examines all gambling venues (TAB venues, NCGM venues and casinos) within close driving distance, and the second examines the number of NCGMs within close driving distance. For each model, the odds ratios for gambling accessibility are presented, controlling for baseline variables (A), then adding the following variables in a stepwise manner: individual selected socioeconomic (SES) status variable(s) (B), New Zealand Index of Deprivation (NZDep) 2001 quintiles (C) and urban/rural status (D).

Table 12 summarises the three analyses presented in this chapter. Section 5.2 explores whether gambling accessibility is associated with increased participation at gambling venues and on NCGMs. Section 5.3 investigates whether the number of gambling opportunities within 5 km is associated with an increase in gambling on any type of gambling activity in the last 12 months. Section 5.4 investigates problem gamblers who have gambled at specific types of gambling venues in the last 12 months.

**Table 12:** Outline of analyses included in Chapter 5

| Section | Dependent variables |
|---|---|
| 5.2 | • Gambled at a gambling venue in the last 12 months<br>• Gambled on an NCGM in the last 12 months |
| 5.3 | • Gambled on any type of gambling activity in the last 12 months |
| 5.4 | • Problem gamblers who gambled at a gambling venue in the last 12 months<br>• Problem gamblers who gambled on an NCGM in the last 12 months |

## 5.2 Gambling at gambling venues and on NCGMs in the last 12 months

Table 13 presents the results that show how the number of gambling venues and the number of NCGMs within 5 km of the neighbourhood centre were associated with having gambled at a gambling venue or on an NCGM in the last year.

These results show that having at least some gambling venues within 5 km of the neighbourhood centre (Quartiles 1–3) was significantly associated with having gambled at a gambling venue in the last year (Models 15A–15D).

For example, when controlling for rurality, people living in neighbourhoods with the most gambling venues within 5 km had significantly higher odds of having gambled at a gambling venue in the last year (odds ratio = 1.67; 95% confidence interval: 1.25–2.23), compared with people living in neighbourhoods with no gambling venues within 5 km. Model 15D also shows that, after full adjustment, there appeared to be a possible exposure–response effect in the association between the number of gambling venues within 5 km and the odds of having gambled at a venue in the past year (Model 15D).

There appeared to be a positive association between having an increased number of NCGMs within 5 km and having gambled on an NCGM within the past year (Models 16A–16C). However, this association was not consistently significant across the four models (Models 16A–16D), and did not show a clear exposure–response effect.

**Table 13:** Odds ratios of having gambled at gambling venues generally and on NCGMs in the last 12 months, by number of gambling venues and by number of NCGMs within 5 km of neighbourhood centre

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | Baseline model | Individual SES model | NZDep model | Urban/rural model |
| Gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months | **Number of gambling venues (NCGM venues, TAB venues and casinos) within 5 km** | *Model 15A* | *Model 15B* | *Model 15C* | *Model 15D* |
| | 44 or more venues | 1.38 (1.14–1.66)* | 1.48 (1.22–1.79)* | 1.44 (1.19–1.74)* | 1.67 (1.25–2.23)* |
| | 14–43 venues | 1.32 (1.10–1.58)* | 1.38 (1.15–1.66)* | 1.36 (1.13–1.63)* | 1.55 (1.17–2.05)* |
| | 1–13 venues | 1.39 (1.18–1.64)* | 1.44 (1.22–1.71)* | 1.43 (1.21–1.69)* | 1.39 (1.13–1.72)* |
| | No venues | 1 | 1 | 1 | 1 |
| Gambled on an NCGM in the last 12 months | **Number of NCGMs within 5 km** | *Model 16A* | *Model 16B* | *Model 16C* | *Model 16D* |
| | 448 or more machines | 1.13 (0.91–1.39) | 1.19 (0.96–1.47) | 1.16 (0.93–1.44) | 1.30 (0.91–1.85) |
| | 178–447 machines | 1.25 (1.02–1.52)* | 1.28 (1.04–1.56)* | 1.25 (1.02–1.53)* | 1.39 (0.98–1.96) |
| | 22–177 machines | 1.22 (1.02–1.47)* | 1.25 (1.04–1.50)* | 1.23 (1.02–1.48)* | 1.06 (0.80–1.42) |
| | 0–21 machines | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

## 5.3 Gambling on any type of gambling activity in the last 12 months

Table 14 presents the associations between general gambling behaviour (that is, having gambled on **any** gambling activity listed in the survey in the last 12 months) and the number of gambling venues within 5 km of the neighbourhood centre.

This analysis shows no apparent association between the number of gambling venues within 5 km of the neighbourhood centre and having gambled on any type of gambling activity in the last 12 months (Models 17A–17D).

Furthermore, having more NCGMs within 5 km of the neighbourhood centre was not associated with increased odds of having gambled on any type of activity in the last 12 months (Models 18A–18D).

In some of the models presented in Table 14, living in the quartile of neighbourhoods with the most venues and/or most NCGMs was associated with decreased odds of having participated in any type of gambling in the past year. However, these associations were not statistically significant when controlling for urban/rural status.

**Table 14:** Odds ratios of having gambled on any type of gambling activity in the last 12 months, by number of gambling venues and by number of NCGMs within 5 km of neighbourhood centre

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | Baseline model | Individual SES model | NZDep model | Urban/rural model |
| Gambled on any type of gambling activity in the last 12 months | **Number of gambling venues (NCGM venues, TAB venues and casinos) within 5 km** | *Model 17A* | *Model 17B* | *Model 17C* | *Model 17D* |
| | 44 or more venues | 0.81 (0.67–0.97)* | 0.87 (0.72–1.05) | 0.84 (0.70–1.02) | 0.86 (0.64–1.15) |
| | 14–43 venues | 0.97 (0.80–1.16) | 1.02 (0.85–1.23) | 1.01 (0.83–1.21) | 0.98 (0.74–1.31) |
| | 1–13 venues | 1.10 (0.93–1.31) | 1.15 (0.97–1.37) | 1.15 (0.97–1.37) | 1.05 (0.84–1.31) |
| | No venues | 1 | 1 | 1 | 1 |
| Gambled on any type of gambling activity in the last 12 months | **Number of NCGMs within 5 km** | *Model 18A* | *Model 18B* | *Model 18C* | *Model 18D* |
| | 448 or more machines | 0.77 (0.65–0.91)* | 0.81 (0.69–0.97)* | 0.79 (0.67–0.94)* | 0.80 (0.61–1.06) |
| | 178–447 machines | 0.94 (0.80–1.11) | 0.98 (0.83–1.16) | 0.96 (0.82–1.14) | 0.96 (0.73–1.26) |
| | 22–177 machines | 1.00 (0.86–1.17) | 1.05 (0.90–1.22) | 1.03 (0.89–1.21) | 0.87 (0.69–1.10) |
| | 0–21 machines | 1 | 1 | 1 | 1 |

Notes An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

## 5.4 Being a problem gambler who gambled at gambling venues in the last 12 months

Table 15 presents the results that show how the number of gambling venues and the number of NCGMs within 5 km of the neighbourhood centre were associated with being a problem gambler who had gambled at a gambling venue or on an NCGM in the last year.

These results show that having at least some gambling venues within 5 km of the neighbourhood centre was associated with increased odds of being a problem gambler who had gambled at a gambling venue in the last year (Models 19A–19D). These associations, however, were generally not statistically significant.

No clear significant associations were found between the number of NCGMs within 5 km of the neighbourhood centre and being a problem gambler who had used NCGMs in the last year (Models 20A–20D).

**Table 15:** Odds ratios of being a problem gambler who had gambled at specific types of gambling venues in the last 12 months, by number of gambling venues and by number of NCGMs within 5 km of neighbourhood centre

| Dependent variable | Neighbourhood gambling accessibility variables | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | Baseline model | Individual SES model | NZDep model | Urban/rural model |
| Problem gambler who gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months | **Number of gambling venues (NCGM venues, TAB venues and casinos) within 5 km** | *Model 19A* | *Model 19B* | *Model 19C* | *Model 19D* |
| | 44 or more venues | 1.30 (0.75–2.26) | 1.47 (0.84–2.55) | 1.43 (0.81–2.50) | 1.39 (0.61–3.19) |
| | 14–43 venues | 1.59 (0.96–2.62) | 1.69 (1.02–2.79)* | 1.63 (0.98–2.71) | 1.58 (0.72–3.46) |
| | 1–13 venues | 1.25 (0.80–1.96) | 1.31 (0.83–2.05) | 1.28 (0.82–2.02) | 1.41 (0.81–2.44) |
| | No venues | 1 | 1 | 1 | 1 |
| Problem gambler who gambled on an NCGM in the last 12 months | **Number of NCGMs within 5 km** | *Model 20A* | *Model 20B* | *Model 20C* | *Model 20D* |
| | 448 or more machines | 0.92 (0.53–1.59) | 1.00 (0.58–1.74) | 0.98 (0.56–1.71) | 1.21 (0.47–3.12) |
| | 178–447 machines | 1.57 (1.00–2.47) | 1.63 (1.03–2.56)* | 1.58 (1.00–2.50) | 1.94 (0.79–4.77) |
| | 22–177 machines | 1.05 (0.69–1.61) | 1.09 (0.71–1.66) | 1.05 (0.69–1.62) | 1.24 (0.59–2.62) |
| | 0–21 machines | 1 | 1 | 1 | 1 |

Notes: An asterisk (*) indicates that the 95% confidence interval does not include 1, and therefore the result is statistically significant. Models adjust consecutively for individual- and neighbourhood-level covariates.

# 6 Discussion and Conclusions

## 6.1 Key results

The purpose of this study was to investigate whether individual-level gambling behaviour was associated with neighbourhood access to gambling venues, after controlling for individual-level and area-level factors that had the potential to confound results.

This study found gambling behaviour was significantly associated with gambling accessibility, and in particular, with the distance to the nearest gambling venue, in several analyses.

### Main findings

This study found that living in neighbourhoods closer to gambling venues was significantly associated with having gambled at a gambling venue in the last year, compared with living in the quartile of neighbourhoods furthest from gambling venues. Similar results were found for specific types of gambling. For example, living in neighbourhoods closer to non-casino gaming machine (NCGM) venues was significantly associated with having gambled on an NCGM in the last year. Similarly, living in neighbourhoods closer to Totalisator Agency Board (TAB) venues was significantly associated with having gambled at a TAB venue in the last year.

On the other hand, this study found that having gambled on **any** type of gambling activity in the last 12 months (for example, playing only Lotto) was not associated with the accessibility of NCGMs, TAB venues and casinos. This result suggests that the accessibility of a gambling venue is associated with participation in that type of gambling specifically, rather than being associated with participation in gambling generally.

People living in neighbourhoods closer to gambling venues were significantly more likely to be problem gamblers and to have gambled at a gambling venue in the last year, compared with people living in the furthest quartile from gambling venues. This greater likelihood suggests that increased access to gambling venues is associated with problem gambling. The results were similar when limiting the respondents included in the analysis (the denominator sample), first, to only past-year gamblers and, second, to only past-year gamblers who had undertaken the specific types of gambling that were the focus of this study. However, the results for these analyses were not presented as the small numbers involved may have made them less robust.

The association of gambling behaviour with the number of gambling venues and NCGMs within walking or close driving distance was less clear. The number of gambling venues within walking distance (800 m) of a neighbourhood centre was not significantly associated with having gambled at gambling venues (NCGM venues, TAB venues and casinos combined) in the last year. However, analysis showed that having at least some NCGMs within 800 m of the neighbourhood centre was associated with gambling on NCGMs in the last year.

In regard to the density of gambling venues within close driving distance (5 km) of the neighbourhood centre, having at least some gambling venues within 5 km significantly increased the odds of having gambled at those types of venues in the past year. Although a similar association was shown for NCGMs, this relationship was not consistent and did not remain significant once controlling for rurality.

Being a problem gambler who had gambled at a gambling venue in the last year was not significantly associated with the density of either gambling venues or NCGMs within walking distance (800 m) or close driving distance (5 km). Results were not presented for the analysis of how problem gambling might be associated with the number of gambling venues within walking distance, due to small numbers.

There appeared to be an exposure–response relationship for some associations. For example, the closer a TAB venue was to the neighbourhood centre, the more likely it was for a person living in that neighbourhood to have gambled at a TAB venue in the last 12 months. For other associations, the results suggest a potential threshold effect, whereby living anywhere within a certain distance from a gambling venue increased the odds of gambling and problem gambling to a similar level. For example, in the association between problem gambling and the distance to the nearest gambling venue, there were similarly high odds ratios for the two closest quartiles (together representing a travel distance of anything up to 1.3 km), and reduced odds ratios for the furthest two quartiles. However, exposure–response relationships were not consistently found for all models.

In the analyses, it was important to control for other factors such as neighbourhood deprivation and urban/rural status, as differences in gambling behaviour between areas may have been due to social context and/or cultural differences. However, an interesting finding was that controlling for area-level socioeconomic deprivation did not appear to change the odds ratios of the gambling accessibility variables, for either the distance or density measures. This finding suggests that accessibility is still a risk factor for problem gambling, over and above neighbourhood socioeconomic deprivation.

By contrast, including the urban/rural variable in some analyses, such as the analysis of the association between problem gambling and the distance to the nearest gambling venue, substantially increased the odds ratios. If, when controlling for urban/rural status, this association was no longer apparent or statistically significant, this finding would have suggested the study was picking up an urban–rural effect rather than an accessibility effect. However, given that the odds ratios for problem gambling increased when controlling for urban/rural status, the results suggest that urban status may be an important possible confounding factor, and that the association between gambling accessibility and behaviour is not explained by urban/rural status.

### Summary

Overall, these results suggest that the accessibility of gambling venues is associated with gambling behaviour. Gambling behaviour appears to be more strongly associated with distance to the nearest gambling venue than with the number of gambling venues within walking distance. Furthermore, having more gambling venues within 5 km appears to increase the odds of having gambled at a gambling venue in the last year.

In regard to problem gambling specifically, it appears that problem gambling is significantly associated with the distance to the nearest gambling venue. However, there appear to be no consistent significant associations with the number of gambling venues or NCGMs within 800 m or 5 km.

The results from this study suggest that establishing gambling venues in a neighbourhood could possibly have a negative impact on the people living in that neighbourhood, due to the relationship between distance to the nearest gambling venue and gambling behaviour. Having more gambling venues within 5 km of the neighbourhood centre also increased the odds of having gambled at a gambling venue in the last year. These findings suggest that policies aimed at preventing and minimising gambling-related harm could focus on environmental modifications, such as reducing the geographic dispersal of gambling venues and minimising the number of gambling venues in neighbourhoods, particularly in vulnerable communities.

The results on the association between gambling behaviour and the distance to the nearest gambling venue in New Zealand are generally consistent with some previous studies in other countries (for example, Welte et al 2004b). This New Zealand study adds further evidence about the complex relationship between gambling accessibility and gambling behaviour.

The key results from this study will also be published in an upcoming article in the Journal of Epidemiology and Community Health (Pearce et al 2008b).

## 6.2 Study strengths and limitations

A key strength of this study was that it combined both Geographic Information Systems (GIS) spatial analysis and survey data, to provide valuable insight into gambling accessibility and gambling behaviour. This study is among the first problem gambling studies to use multilevel modelling techniques to assess area-level influences on gambling behaviour, while adjusting for individual-level factors.

The study used data from the nationally representative 2002/03 New Zealand Health Survey. This survey had a large sample size, and oversampled for ethnic groups in order to get accurate estimates for these population groups. The survey was carried out with face-to-face interviews, and the response rate was reasonable (72%).

The change-in-estimate methodology was used to control for individual socioeconomic status (SES) factors that may have confounded the results. This approach was chosen because of the move away from relying on significance tests in epidemiology and because previous research has suggested that associations between two variables could be substantially changed by variables that were themselves non-significant predictors of the behaviour at the 5% significance level (Greenland 1989; Mickey and Greenland 1989). This methodology meant that rather than the best fitting model of the outcomes being calculated, the SES variables were chosen as confounding variables for accessibility. Thus even if one of the SES variables was an important predictor of gambling behaviour, if it had no effect on the access–gambling relationship, it was not included in the model. Given the use of this method, it may not be appropriate to comment on the odds ratio estimate for the other variables included in the models, such as social class, ethnic group or New Zealand Index of Deprivation (NZDep) 2001.

A number of assumptions were made when defining measures of accessibility, and the limitations that these impose are acknowledged. A traditional approach to defining spatial accessibility was used and, although non-spatial accessibility factors were incorporated (for example, SES), other important accessibility factors such as transportation and mobility were not included in analyses. The use of population-weighted centroids of meshblocks in which respondents lived meant that the calculated distances did not represent the precise distance from the respondents' house to a gambling venue. Furthermore, the accessibility measures did not take into account where the respondent travelled in the course of a day, the actual gambling venues where respondents gambled, or the actual route that respondents may have taken to access a gambling venue. The density measures of the number of gambling venues and NCGMs within 800 m and 5 km buffers around each neighbourhood assumed equal access to these facilities within each buffer boundary and did not take account of travel to gambling venues beyond these boundaries.

It is possible that the significant associations between gambling accessibility and gambling behaviour were due to some important factors that were not controlled for in these analyses. These factors may have included neighbourhood-level variables, such as urban zoning, or individual-level variables, such as lifetime gambling experience, frequency of gambling, the age that the respondent started gambling, and family gambling history. However, as there were no data for these variables, it was not possible to control for them in analysis. Future studies could examine these factors.

A general limitation of cross-sectional surveys is that they cannot be used to measure causality. One interpretation of the results of this survey is that living closer to gambling venues increases your chances of becoming a problem gambler; however, an alternative interpretation is that problem gamblers are more likely to choose to live closer to gambling venues. A further limitation of this study is that the analyses conformed to Census boundaries of meshblocks, rather than the actual neighbourhoods where people lived.

The problem gambling screen included in the 2002/03 New Zealand Health Survey also had the general limitation that it was developed for the survey, and has not been used in other studies, which limits the comparability of the results. However, despite this limitation, the screen still measures a construct of problem gambling and is useful for analysing risk factors and correlates with problematic gambling behaviour (Ministry of Health 2006b).

There were small sample sizes for some analyses, as the prevalence of problem gambling in the New Zealand population is quite low (approximately 1.2% according to the 2002/03 New Zealand Health Survey). The small numbers involved may explain the wide confidence intervals found in some results. Furthermore, the small numbers in many analyses meant that it was impractical to explore interactions during analysis. Future work could investigate how the effects of gambling accessibility vary for certain population groups, for example by age, gender and ethnic group.

Some limitations related to the measures of gambling and problem gambling. The gambling screen was also only asked of a limited group of respondents who exceeded certain limits on time and money spent on gambling, which may have excluded some gamblers from answering the problem gambling screen. Additionally, gambling and problem gambling may be under-reported in general, due to recall error or social desirability bias. Furthermore, past-year gambling participation is a fairly simple measure of gambling involvement. It does not reflect other aspects of gambling such as frequency of involvement, which may be indicative of harmful gambling.

## 6.3 Conclusions

With the above limitations acknowledged, the results of this study are consistent with previous research suggesting a link between the locational accessibility of gambling and individual gambling behaviour. This study showed that individual gambling behaviour is significantly associated with the neighbourhood gambling environment and, in particular, the distance to the nearest gambling venue.

Building on the evidence presented in this report, further research may be warranted to fill potential information gaps. For example, future studies could examine further the complexities of the relationships between gambling behaviour and accessibility, definitively establish a clear causal link between accessibility and behaviour, and update these findings for the New Zealand gambling environment that has developed since the implementation of the Gambling Act 2003. Further research could also focus on other neighbourhood- or individual-level factors, such as urban zoning, gambling frequency and investigating the accessibility of the particular gambling venues where people gamble at.

Like previous studies (Rush et al 2007), this study lends support to policies that attempt to control the expansion of gambling. This research also supports the Ministry of Health's problem gambling strategy, which includes the objective of encouraging supportive environments to minimise gambling harm (Ministry of Health 2005).

These findings suggest that policies aimed at preventing and minimising gambling-related harm could focus on environmental modifications, which increase people's distance to gambling venues. Examples of such modifications include limiting the number of gambling venues in areas, in particular in vulnerable communities, and reducing the geographical dispersal of gambling venues in the community. These results will be of interest to local authorities, who are responsible for policies on Class 4 gambling venues (non-casino gaming machine venues) in their area and for urban planning and zoning issues.

# Appendix A: Detailed Methodology

This appendix provides detailed information about the methodology used in this study, including definitions of the analysis variables, and the model selection procedures.

## Dependent variables

### Gambling behaviour

In the 2002/03 New Zealand Health Survey, respondents were asked which gambling activities they had participated in during the last 12 months, from the following: Lotto, Instant Kiwi, Daily Keno, casinos, gaming machines (pokies not in casinos), TAB horses/dogs, overseas horse and dog races, track horse and dog races, TAB sports, overseas sports betting, Housie, 0900 (telephone) gambling games, and Internet gambling. Table A1 presents the dependent variables for past-year gambling behaviour used in analysis.

**Table A1**: Definitions of dependent variables about past-year gambling behaviour from 2002/03 New Zealand Health Survey

| Dependent variable | Definition | Number of respondents |
|---|---|---|
| Gambled on any type of gambling activity in the last 12 months | People who reported gambling on any of the listed gambling activities in the last 12 months (includes all activities on the list of gambling activities) | 8586 |
| Gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months | People who reported gambling on any of the following activities in the last 12 months: casinos, gaming machines, TAB horses/dogs, TAB sports | 2777 |
| Gambled on an NCGM in the last 12 months | People who reported gambling on gaming machines (pokies not in casinos) in the last 12 months | 1570 |
| Gambled at a TAB venue in the last 12 months | People who reported gambling on TAB horses/dogs or TAB sports in the last 12 months | 1191 |

### Problem gambling

Problem gambling status was measured with a 10-question gambling screen in the 2002/03 New Zealand Health Survey (Ministry of Health 2006b). The questions and scoring for this gambling screen were developed by the Ministry of Health and a contracted technical specialist. When the questionnaire was being developed, it was considered that no existing screens would fulfil the survey requirements for a screen that was short and measured a range of gambling-related harms.

The 10 items in the questionnaire were as follows.

1. In the last 12 months, have you felt worried or depressed after playing any of those games?
2. In the last 12 months, has anyone been worried or concerned enough to ask you about your gambling?
3. In the last 12 months, have you ever gone into debt or borrowed money or had your credit card owing, from money spent on gambling?
4. Do you feel that you have ever had a problem with gambling?
5. *(If yes to previous question)* And in the last 12 months?
6. In the last 12 months, have you said you were winning from gambling when in fact you lost?
7. In the last 12 months, have you felt you would like to stop gambling but didn't think that you could?
8. In the last 12 months, have you felt guilty or bad for doing wrong because of your gambling?
9. In the last 12 months, have you felt at any time, the need to bet more and more money?
10. In the last 12 months, have you had to lie to people important to you about how much you gambled?

The gambling screen was only asked of those respondents who reported spending $30 or more on gambling, during five or more weeks in the last year. People were classified as current (past-year) problem gamblers if they answered yes to: (a) at least one of questions 5, 9, 10; or (b) at least five of questions 2, 3, 5, 6, 7, 8; or (c) at least three of questions 1, 2, 3, 6, 7, 8. Overall, 227 respondents were classified as problem gamblers, according to these criteria.

Table A2 presents the dependent variables about problem gambling that were used in analysis. For analysis, problem gamblers were limited to those who had used each particular type of gambling venue.

**Table A2:** Definitions of dependent variable about past-year problem gambling behaviour from 2002/03 New Zealand Health Survey

| Dependent variable | Definition | Number of respondents |
|---|---|---|
| Problem gamblers who gambled at a gambling venue (NCGM venue, TAB venue or casino) in the last 12 months | People who were classified as a current (past-year) problem gambler on the gambling screen, and who reported gambling on any of the following activities in the last 12 months: casinos, gaming machines, TAB horses/dogs, TAB sports | 213 |
| Problem gamblers who gambled on an NCGM in the last 12 months | People who were classified as a problem gambler on the gambling screen and who reported gambling on gaming machines (pokies not in casinos) in the last 12 months | 184 |
| Problem gamblers who gambled at a TAB venue in the last 12 months | People who were classified as a problem gambler on the gambling screen and who reported gambling on TAB horses/dogs or TAB sports in the last 12 months | 91 |

## Gambling accessibility variables

Once gambling accessibility had been measured for every meshblock in New Zealand for each accessibility measure, meshblocks were categorised into four groups for each measure according to the methods described below. Generally, the variables for the distance to the nearest gambling venue were quartiles, while the variables for the number of gambling venues or non-casino gaming machines (NCGMs) within set distances were grouped; quartiles were not used for these variables due to the skewed distributions.

### Distance to nearest gambling venue

Calculated for each meshblock was the travel distance from the population-weighted meshblock centroid to the nearest gambling venue (which included non-casino gaming machine venues, TAB venues and casinos), via the road network. The meshblocks were then sorted according to the travel distance and assigned to quartiles, with approximately 9575 meshblocks in each distance quartile. The groups of distance to the nearest gambling venue were defined as follows: (a) less than 698 m, (b) 698–1260 m, (c) 1261–2965 m, (d) 2966 m and above.

### Distance to nearest NCGM venue

The distance was measured from each population-weighted meshblock centroid via the road network to the nearest non-casino gaming machine venue. From this analysis, meshblocks were then sorted according to travel distance and grouped into quartiles, with approximately 9575 meshblocks in each group. The distance groupings were: (a) less than 734 m, (b) 734–1316 m, (c) 1317–3076 m, (d) 3077 m and above.

### Distance to nearest TAB venue

After the travel distance had been measured from each meshblock centroid to the nearest Totalisator Agency Board (TAB) venue via the road network, meshblocks were sorted according to travel distance and divided into quartiles, with approximately 9575 meshblocks in each group. The four distance groupings were as follows: (a) less than 1052 m, (b) 1052–1854 m, (c) 1855–5490 m, (d) 5491 m and above.

### Number of gambling venues within 800 m buffer

The number of gambling venues within an 800 m straight-line buffer of each population-weighted meshblock centroid was calculated. An 800 m distance was selected to approximate comfortable walking distance. From this analysis, meshblocks were divided into four different groups for analysis. Due to the skewed distributions of number of gambling venues within 800 m, meshblocks were categorised into the following four groups: (a) no venues (19,568 meshblocks), (b) 1–5 venues (14,984 meshblocks), (c) 6–10 venues (2325 meshblocks) and (d) 11 or more venues (1422 meshblocks).

### Number of NCGMs within 800 m buffer

This analysis calculated the number of non-casino gaming machines within an 800 m straight-line buffer of the population-weighted centroid of each meshblock. Due to a very skewed distribution, these densities were categorised into the following four groups: (a) no machines (20,543 meshblocks), (b) 1–17 machines (5572 meshblocks), (c) 18–36 machines (6482 meshblocks), and (d) 37 or more machines (5702 meshblocks). These groupings also closely follow the number of gaming machines allowed at venues (generally 9 or 18).

### Number of gambling venues within 5 km buffer

For each meshblock, the number of gambling venues within a 5 km straight-line buffer of the population-weighted centroid was calculated. A 5 km distance was selected as an approximate measure for close driving distance. This analysis also resulted in a skewed distribution, so ‘no venues’ was given its own category, then the remaining meshblocks were divided into tertiles, producing the following four categories: (a) no venues (5807 meshblocks), (b) 1–13 venues (10,991 meshblocks), (c) 14–43 venues (10,714 meshblocks), and (d) 44 or more venues (10,787 meshblocks).

### Number of NCGMs within 5 km buffer

The number of non-casino gaming machines within a 5 km straight-line buffer from the population-weighted centroid of each meshblock was calculated. From this analysis, meshblocks were grouped into these quartiles: (a) 0–21 machines (9552 meshblocks), (b) 22–177 machines (9532 meshblocks), (c) 178–447 machines (9450 meshblocks), and (d) 448 or more machines (9765 meshblocks).

## Other independent variables

### Summary of independent variables

Table A3 summarises the independent variables that were included in analysis. These variables are described in more detail below.

**Table A3: Summary of independent variables included in analysis**

| Independent variable | Number of categories | Level |
|---|---|---|
| Gambling accessibility variable | 4 | Area-level |
| Stratum | 7 | Area-level |
| Number of respondents in PSU | 8 | Area-level |
| Number of adults in household | 5 | Individual-level |
| Sex | 2 | Individual-level |
| Age group | 3 | Individual-level |
| Prioritised ethnic group | 4 | Individual-level |
| Education | 3 | Individual-level |
| Household income | 3 | Individual-level |
| Social class | 5 | Individual-level |
| Benefits | 2 | Individual-level |
| Work status | 2 | Individual-level |
| NZDep 2001 quintiles | 5 | Area-level |
| Urban/rural status | 4 | Area-level |

### Stratum

The stratum for each respondent was categorised into seven groupings, from both the initial sample design:

1. 60% or more Māori
2. 40% or more Asian
3. 55% or more Pacific
4. Other (initial sample design)

and from the latter sample design:

5. 70% or more Māori with a sample fraction of two-thirds
6. 70% or more Māori with a sample fraction of one in seven
7. Other (latter sample design).

In some cases when the models would not converge, the two categories ‘40% or more Asian’ and ‘Other (initial sample design)’ were collapsed into one category.

### Number of respondents in PSU

The number of respondents in each primary sampling unit (PSU) in the survey was divided into the following categories: 1–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, and 70–90 respondents. In some cases where the model was not converging, the final three categories were collapsed into the category of 50–90 respondents.

### Number of adults in household

The number of adults living in the household was categorised into 1, 2, 3, 4, and 5 or more adults living in the household.

### Sex

The variable of sex (male, female) was included in analysis.

### Age

Respondents were categorised into three age groups: (a) 15–24 years; (b) 25–44 years; and (c) 45 years and over.

### Prioritised ethnic group

Ethnic group was classified based on which ethnicities that respondents indicated they identified with. Prioritised ethnicity was used, grouped into these categories: (a) Māori; (b) Pacific; (c) Asian; and (d) Other (in that order of priority). This technique meant that if a respondent identified with more than one ethnicity, they were assigned to the first ethnic group in the above list that they identified with.

### Education

Education was classified into three categories: (a) no qualifications; (b) no post-secondary school qualifications; and (c) post-secondary school qualifications.

### Household income

Annual pre-tax household income was classified into three categories: (a) up to $25,000; (b) $25,001–$50,000; and (c) $50,001 or more.

### Social class

Social class was measured using the occupation of the respondent, grouped into the following five categories: (a) managerial or professional; (b) other non-manual jobs; (c) skilled manual job; (d) semi-skilled or unskilled manual job; and (e) unavailable.

### Benefits

For the purposes of this analysis, the benefits variable included the poverty-related benefits of family support, unemployment benefit and domestic purposes benefit. The variable of benefits was classified as either: (a) receives benefits; or (b) does not receive benefits.

### Work status

Work status was categorised as either: (a) works (for pay, profit or income, or in a family business or family farm without pay); or (b) does not work.

### NZDep2001 quintiles

Area-level socioeconomic deprivation for the meshblock in which respondents lived was measured with the New Zealand Index of Deprivation (NZDep) 2001 (Salmond and Crampton 2002), with deciles grouped into quintiles.

The NZDep2001 was derived for each meshblock using the weighted sum from the following nine 2001 Census variables for each meshblock: receiving a benefit; unemployment; low income; no access to a car; no access to a telephone; single-parent family; no qualifications; overcrowding (bedroom occupancy); and not living in their own home. Each meshblock was given a score based on the people living within that meshblock, which was used to determine the NZDep2001 decile for the meshblock.

### Urban/rural status

The Statistics New Zealand five-level 2001 Urban–Rural Area Classification was used for meshblocks (Department of Statistics 1992). Using 2001 Census counts, this classification system grouped meshblocks into: main urban areas (cities and towns with a population of 30,000 or more); secondary urban areas (towns with a population of 10,000 to 29,999); minor urban areas (towns with a population between 1000 and 9999); rural centres (population between 300 and 999); and true rural areas (population less than 300).

For this study, the two rural categories were combined into one rural category ('rural'), due to small numbers and problems with multi-collinearity. This approach gave four categories: (a) main urban areas; (b) secondary urban areas; (c) minor urban areas; and (d) rural areas. Even after collapsing the two rural categories, the standard error of the access quartiles increased. However, the increase was never by more than a third, so it should not have strongly affected results.

## Statistical methods

Multilevel logistic regression models with a random intercept were fitted. The data had a two-level structure, with respondents as level 1 and meshblocks as level 2. With this approach, the clustered nature of the data could be taken into account.

The dependent variables for the models included gambling status and problem gambling status. The independent variables of interest were the gambling accessibility variables. The models investigated the associations between a particular dependent variable and an independent variable about gambling accessibility. For all independent variables included in the model, categorical variables were fitted rather than continuous variables, to satisfy confidentiality requirements.

### Estimation technique

In multilevel modelling using MLwiN, ideally iterative generalised least squares (IGLS) and second order penalised or predictive quasi-likelihood (PQL) estimation would be used for all analyses. These methods were used where possible in this study. However, there were convergence problems in some models due to the small number of respondents who could be classified as problem gamblers and the large number of independent variables. In these cases, using first order PQL and truncated versions of two of the design variables was necessary.

Furthermore, some of the models estimated the neighbourhood-level variance as being zero when the IGLS estimation method was used; as a result, the restricted form of estimation (RIGLS) was used for these analyses. Given the persistence of the results for the various outcome variables, it is unlikely that the different procedures (IGLS versus RIGLS) had a substantial impact on the results.

Full details of the estimation techniques for all models are given in Appendix B.

### Procedure for selecting individual SES variables

The modelling procedure for the study involved producing models for four different stages, to control for various levels of confounding. The second stage of analysis controlled for individual socioeconomic status (SES), by selecting at least one of the following variables into the model: education, household income, social class, working status and receiving benefits.

A backwards elimination of individual socioeconomic status variables was carried out, as recommended by Budtz-Jorgensen et al (2007). For this study, a modified change-in-estimate criterion procedure was used to select individual socioeconomic status variable(s), as this technique controls for possible confounding variables (Greenland and Rothman 1998; Mickey and Greenland 1989). In some cases where no SES variable would have been included using this method, an SES variable was retained in the study model in order to control for individual socioeconomic status, with the following method.

The method involved comparing the odds ratios of the gambling accessibility variable from the full model that contained all SES variables, with the odds ratios in a reduced model that contained only selected SES variables. As suggested in the literature (Mickey and Greenland 1989), a particular SES variable was retained if the change-in-estimate of the odds ratio of any gambling accessibility category was 10% or more when the SES variable was removed from the model. If no SES variable changed the gambling accessibility estimate by 10% or more after the backwards selection procedure, then the model included the SES variable with the greatest change-in-estimate. If the difference between the change-in-estimates of remaining SES variables was less than 1%, and the change-in-estimates were greater than 1%, all these SES variables were retained. Change-in-estimate procedures have been criticised in the past for increasing error, so SES variables were also to be retained if eliminating them increased the size of the confidence interval for any access category by more than 5%; however, this condition did not arise during any analysis.

# Appendix B: Model Information

**Table B1:** Information about models

| Model (A–D) | Dependent variable | Denominator group | Gambling access variable | Individual SES variable(s) for models B–D | Estimation method |
|---|---|---|---|---|---|
| 1 | Gambled at gambling venue (NCGM venue, TAB venue or casino) in last 12 months (N = 2777) | Whole sample (N = 12,467) | Quartiles of distance to nearest gambling venue | Social class | 2nd order PQL, IGLS |
| 2 | Gambled on NCGM in last 12 months (N = 1570) | Whole sample (N = 12,467) | Quartiles of distance to nearest NCGM venue | Social class | 1st order PQL, RIGLS, truncated strata and PSU variables |
| 3 | Gamblers at TAB venue in last 12 months (N = 1191) | Whole sample (N = 12,467) | Quartiles of distance to nearest TAB venue | Social class | 1st order PQL, IGLS, truncated strata and PSU variables |
| 4 | Gambled in last 12 months (N = 8586) | Whole sample (N = 12,467) | Quartiles of distance to nearest gambling venue | Social class | 2nd order PQL, IGLS |
| 5 | Gambled in last 12 months (N = 8586) | Whole sample (N = 12,467) | Quartiles of distance to nearest NCGM venue | Social class, work status | 2nd order PQL, IGLS |
| 6 | Gambled in last 12 months (N = 8586) | Whole sample (N = 12,467) | Quartiles of distance to nearest TAB venue | Social class | 2nd order PQL, IGLS |
| 7 | Problem gambler who gambled at gambling venue (NCGM venue, TAB venue or casino) in last 12 months (N = 213) | Whole sample (N = 12,467) | Quartiles of distance to nearest gambling venue | Social class | 1st order PQL, truncated strata and PSU decile variables |
| 8 | Problem gambler who gambled on NCGM in last 12 months (N = 184) | Whole sample (N = 12,467) | Quartiles of distance to nearest NCGM venue | Social class | 1st order PQL, RIGLS, truncated strata and PSU decile variables |
| 9 | Problem gambler who gambled at TAB venue in last 12 months (N = 91) | Whole sample (N = 12,467) | Quartiles of distance to nearest TAB venue | Social class | 1st order PQL, RIGLS, truncated strata and PSU decile variables |
| 10 | Gambled at gambling venue (NCGM venue, TAB venue or casino) in last 12 months (N = 2777) | Whole sample (N = 12,467) | Number of gambling venues within 800 m of meshblock centroid | Social class, household income, benefits | 2nd order PQL, IGLS |
| 11 | Gambled on NCGM in last 12 months (N = 1570) | Whole sample (N = 12,467) | Number of NCGMs within 800 m of meshblock centroid | Social class | 2nd order PQL, truncated strata and PSU decile variables, IGLS |
| 12 | Gambled in last 12 months (N = 8586) | Whole sample (N = 12,467) | Number of gambling venues within 800 m of meshblock centroid | Social class | 2nd order PQL, IGLS |

| Model (A–D) | Dependent variable | Denominator group | Gambling access variable | Individual SES variable(s) for models B–D | Estimation method |
|---|---|---|---|---|---|
| 13 | Gambled in last 12 months (N = 8586) | Whole sample (N = 12,467) | Number of NCGMs within 800 m of meshblock centroid | Social class, household income | 2nd order PQL, IGLS |
| 14 | Problem gambler who gambled on NCGM in last 12 months (N = 184) | Whole sample (N = 12,467) | Number of NCGMs within 800 m of meshblock centroid | Social class | 1st order PQL, RIGLS, truncated strata and PSU decile variables |
| 15 | Gambled at gambling venue (NCGM venue, TAB venue or casino) in last 12 months (N = 2777) | Whole sample (N = 12,467) | Number of gambling venues within 5 km of meshblock centroid | Social class | 2nd order PQL, IGLS |
| 16 | Gambled on NCGM in last 12 months (N = 1570) | Whole sample (N = 12,467) | Number of NCGMs within 5 km of meshblock centroid | Social class | 2nd order PQL, truncated strata and PSU decile variables, IGLS |
| 17 | Gambled in last 12 months (N = 8586) | Whole sample (N = 12,467) | Number of gambling venues within 5 km of meshblock centroid | Social class | 2nd order PQL, IGLS |
| 18 | Gambled in last 12 months (N = 8586) | Whole sample (N = 12,467) | Number of NCGMs within 5 km of meshblock centroid | Social class | 2nd order PQL, IGLS |
| 19 | Problem gambler who gambled at gambling venue (NCGM venue, TAB venue or casino) in last 12 months (N = 213) | Whole sample (N = 12,467) | Number of gambling venues within 5 km of meshblock centroid | Social class | 1st order PQL, truncated strata and PSU decile variables, IGLS |
| 20 | Problem gambler who gambled on NCGM in last 12 months (N = 184) | Whole sample (N = 12,467) | Number of NCGMs within 5 km of meshblock centroid | Social class | 1st order PQL, RIGLS, truncated strata and PSU decile variables |

# Appendix C: Example of Full Model

Table C1 presents the full models of Models 1A–1D, which examined the association between having gambled at a gambling venue in the last 12 months and the neighbourhood distance to the nearest gambling venue.

These full models are given as an example of the results of the full models. However, given that the change-in-estimate method was used to select individual socioeconomic variables into the models, it may not be appropriate to comment on the odds ratio estimate for the other variables included in the models, such as ethnic group or New Zealand Index of Deprivation (NZDep) 2001.

All full models are available on request from Public Health Intelligence.

**Table C1:** Models 1A–1D – association between gambling at specific types of venues (NCGM venues, TAB venues or casinos) in the last year, and quartiles of distance to nearest gambling venue

| | | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | **Baseline** ***Model 1A*** | **Individual SES** ***Model 1B*** | **NZDep** ***Model 1C*** | **Urban/rural** ***Model 1D*** |
| Constant | Constant | 0.31 (0.26–0.38) | 0.28 (0.23–0.35) | 0.27 (0.21–0.34) | 0.25 (0.19–0.33) |
| Distance to nearest gambling venue (quartiles) | <698 m | 1.41 (1.21–1.66) | 1.50 (1.27–1.75) | 1.45 (1.23–1.71) | 1.51 (1.22–1.87) |
| | 698–1260 m | 1.29 (1.10–1.50) | 1.35 (1.16–1.58) | 1.33 (1.13–1.56) | 1.38 (1.12–1.71) |
| | 1261–2965 m | 1.36 (1.16–1.58) | 1.43 (1.22–1.67) | 1.41 (1.21–1.65) | 1.47 (1.19–1.80) |
| | 2966 m + | 1 | 1 | 1 | 1 |
| Strata | Other – latter | 1 | 1 | 1 | 1 |
| | 70% 2/3 Māori | 0.93 (0.81–1.08) | 0.95 (0.81–1.10) | 0.88 (0.74–1.04) | 0.84 (0.70–1.00) |
| | 70% 1/7 Māori | 0.40 (0.19–0.84) | 0.41 (0.19–0.86) | 0.37 (0.17–0.79) | 0.35 (0.16–0.76) |
| | Other – initial | 1.24 (1.02–1.51) | 1.24 (1.02–1.51) | 1.24 (1.02–1.51) | 1.25 (1.03–1.52) |
| | 60% Māori | 0.87 (0.63–1.19) | 0.86 (0.62–1.19) | 0.80 (0.58–1.11) | 0.78 (0.56–1.08) |
| | 55% Pacific | 0.54 (0.19–1.58) | 0.51 (0.18–1.49) | 0.47 (0.16–1.39) | 0.49 (0.17–1.42) |
| | 40% Asian | 0.70 (0.25–1.91) | 0.65 (0.24–1.77) | 0.64 (0.23–1.76) | 0.65 (0.24–1.78) |
| Number of respondents per PSU | 1–9 people per PSU | 1 | 1 | 1 | 1 |
| | 10–19 | 0.81 (0.73–0.91) | 0.81 (0.73–0.91) | 0.80 (0.72–0.90) | 0.80 (0.72–0.90) |
| | 20–29 | 0.71 (0.59–0.84) | 0.70 (0.59–0.84) | 0.68 (0.56–0.81) | 0.68 (0.57–0.82) |
| | 30–39 | 0.64 (0.49–0.84) | 0.65 (0.50–0.85) | 0.62 (0.47–0.81) | 0.62 (0.47–0.81) |
| | 40–49 | 0.89 (0.61–1.29) | 0.94 (0.65–1.37) | 0.91 (0.63–1.33) | 0.92 (0.63–1.34) |
| | 50–59 | 0.29 (0.09–0.93) | 0.27 (0.08–0.85) | 0.26 (0.08–0.82) | 0.28 (0.09–0.90) |
| | 60–69 | 2.63 (1.08–6.42) | 2.75 (1.12–6.75) | 2.54 (1.03–6.24) | 2.61 (1.06–6.40) |
| | 70–90 | 1.09 (0.41–2.87) | 1.14 (0.43–3.02) | 1.03 (0.39–2.76) | 1.05 (0.40–2.80) |
| Household adults | 1 adult | 1 | 1 | 1 | 1 |
| | 2 adults | 1.16 (1.04–1.30) | 1.09 (0.97–1.22) | 1.10 (0.98–1.23) | 1.10 (0.98–1.23) |
| | 3 adults | 1.32 (1.14–1.52) | 1.22 (1.05–1.42) | 1.23 (1.07–1.43) | 1.24 (1.07–1.43) |
| | 4 adults | 1.20 (0.98–1.45) | 1.12 (0.92–1.36) | 1.12 (0.92–1.37) | 1.13 (0.93–1.37) |

| | | Odds ratio (95% confidence interval) | | | |
|---|---|---|---|---|---|
| | | **Baseline** ***Model 1A*** | **Individual SES** ***Model 1B*** | **NZDep** ***Model 1C*** | **Urban/rural** ***Model 1D*** |
| | 5 adults | 1.16 (0.88–1.53) | 1.09 (0.83–1.44) | 1.10 (0.84–1.46) | 1.11 (0.84–1.47) |
| Prioritised ethnic group | NZ European/Other | 1 | 1 | 1 | 1 |
| | Māori | 1.53 (1.35–1.73) | 1.52 (1.34–1.71) | 1.47 (1.30–1.67) | 1.47 (1.29–1.66) |
| | Pacific | 0.84 (0.69–1.03) | 0.84 (0.68–1.04) | 0.81 (0.65–1.00) | 0.82 (0.66–1.01) |
| | Asian | 0.40 (0.32–0.50) | 0.43 (0.35–0.54) | 0.43 (0.34–0.53) | 0.44 (0.35–0.54) |
| Gender | Male | 1 | 1 | 1 | 1 |
| | Female | 0.70 (0.64–0.76) | 0.74 (0.68–0.82) | 0.74 (0.68–0.82) | 0.74 (0.67–0.81) |
| Age group | 15–24 years | 0.86 (0.75–1.00) | 0.89 (0.77–1.03) | 0.89 (0.77–1.03) | 0.89 (0.77–1.03) |
| | 25–44 years | 1 | 1 | 1 | 1 |
| | 45 years or older | 0.68 (0.61–0.74) | 0.77 (0.70–0.86) | 0.77 (0.70–0.86) | 0.77 (0.70–0.86) |
| Social class | Professional/ managerial | | 1 | 1 | 1 |
| | Other non-manual | | 1.12 (0.98–1.28) | 1.11 (0.97–1.27) | 1.11 (0.97–1.27) |
| | Skilled manual | | 1.26 (1.08–1.47) | 1.24 (1.07–1.45) | 1.23 (1.05–1.43) |
| | Semi/unskilled manual | | 1.19 (1.03–1.39) | 1.17 (1.01–1.36) | 1.17 (1.00–1.35) |
| | Unavailable | | 0.69 (0.59–0.80) | 0.68 (0.58–0.79) | 0.67 (0.58–0.78) |
| NZDep2001 quintile | Least deprived | | | 1 | 1 |
| | Less deprived | | | 1.05 (0.87–1.28) | 1.04 (0.86–1.27) |
| | Middle | | | 1.10 (0.91–1.33) | 1.10 (0.92–1.33) |
| | More deprived | | | 1.13 (0.94–1.36) | 1.12 (0.93–1.35) |
| | Most deprived | | | 1.22 (1.00–1.49) | 1.21 (0.99–1.48) |
| Urban/rural | Main urban | | | | 1 |
| | Secondary urban | | | | 1.10 (0.90–1.36) |
| | Minor urban | | | | 1.15 (0.98–1.36) |
| | Rural | | | | 1.12 (0.92–1.36) |
| *Level 2 variance* | *U(SE)* | *0.13 (0.03)* | *0.14 (0.03)* | *0.13 (0.03)* | *0.13 (0.03)* |

# Glossary of Terms and Abbreviations

| | |
|---|---|
| **Buffer** | Common GIS functionality that creates an area of a defined distance around a point, line or area |
| **Dependent variable** | The outcome (or response) variable in a regression model; the regression model examines the associations between this dependent variable and each of the independent (or explanatory) variables in the model |
| **EGM** | Electronic gaming machine, also known as a 'pokie' machine |
| **Exposure–response relationship** | When the risk of having the outcome increases with increasing exposure (similar to a dose–response relationship) |
| **GIS** | Geographic Information System |
| **IGLS** | Iterative Generalised Least Squares; an estimation technique used by the computer software MLwiN |
| **Independent variable** | Also known as an explanatory variable; several independent variables may be included in a regression model to 'explain' or 'predict' the dependent variable |
| **Instant Kiwi** | Also known as 'scratch tickets' |
| **Lotto** | The national lottery in New Zealand |
| **Meshblock** | The smallest census unit in New Zealand, with an average of 100 people |
| **Multilevel modelling** | A statistical method used to estimate effects at both the individual and area level |
| **NCGM** | Non-casino gaming machine; also known as electronic gaming machine, 'pokie', and video lottery machine |
| **Neighbourhood centre** | In this report, the population-weighted centroid of the meshblock in which a respondent lives |
| **NZDep** | New Zealand Index of Deprivation 2001; a measure which provides a multi-dimensional view of socioeconomic deprivation, including income poverty, access to cars and phones, unemployment, and overcrowding |
| **NZHS** | New Zealand Health Survey |
| **Pathological gambling** | The severe form of problem gambling, included as a disorder of impulse control in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) |
| **PQL** | Penalised or predictive quasi-likelihood; an estimation technique used by the computer software MLwiN |
| **Prioritised ethnic group** | A method of classifying ethnicity data, where if an individual reports more than one ethnicity, they are classified as only one ethnic group, in the following prioritised order: Māori, Pacific, Asian, European/Other |
| **Problem gambling** | Gambling behaviour that causes problems or harm to the individual and/or the people around them |

| | |
|---|---|
| **PSU** | Primary sampling unit; the PSUs in the 2002/03 New Zealand Health Survey were meshblocks |
| **Quartiles** | The groups formed when a distribution is divided into four ordered groups, with equal numbers of observations in each group (for example, in this study, the variable of quartiles of distance to the nearest gambling venue had approximately 25% of meshblocks in New Zealand in each group) |
| **Quintiles** | The groups formed when a distribution is divided into five ordered groups, with equal numbers of observations in each group (for example, NZDep01 quintiles have approximately 20% of meshblocks in New Zealand in each group) |
| **RIGLS** | Restricted Iterative Generalised Least Squares; an estimation technique used by the computer software MLwiN |
| **SES** | Socioeconomic status; includes work status, income, education, receiving benefit, and social class (occupation) |
| **SOGS** | South Oaks Gambling Screen; a set of questions used in many problem gambling studies over the last two decades, to estimate the prevalence of problem gambling |
| **TAB** | Totalisator Agency Board; the organisation responsible for venues where people can bet on horse races, dog races and sporting events |
| **Threshold effect** | When having exposure at or above a certain level leads to a similar risk of having the outcome |
| **Track-betting** | Betting on horse or dog races |

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