



THE VICTORIAN GAMBLING STUDY

A LONGITUDINAL STUDY OF GAMBLING AND HEALTH IN VICTORIA 2008–2012

TECHNICAL REPORT TWO

SOCIAL DETERMINANTS AND CO-MORBIDITIES: UNIVARIATE ANALYSIS OF GAMBLERS

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Our vision: A Victoria free from gambling-related harm

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Summary

A series of secondary analyses were undertaken from *The Victorian Gambling Study- A longitudinal study of gambling and health 2008-2012 (The Victorian Gambling Study)* (Billi, Stone, Abbott and Yeung 2014; Billi, Stone, Marden and Yeung 2014). This paper is the second of a series of technical reports. The focus of this paper is to explore the relationship between the PGSI score and the social determinants and comorbidities in gamblers. The purpose was to investigate a range of possible determinants (for example socio-demographics, physical and mental health, smoking and alcohol use, trauma, life events and social capital) to indicate which showed the strongest association with increased gambling problems as defined by an increase in PGSI score. The analysis is underpinned by a public health approach which views problem gambling as part of a gambling continuum and explores the broader personal, social, economic and environmental as well as biological determinants of gambling problems.

The public health approach is also reflected in the choice of analytical technique which treats the Problem Gambling Severity Index (PGSI) score as count data on a continuum. A higher PGSI score is achieved when gamblers experience more problems or a problem more frequently. This is in contrast to the case finding approach that classifies people as distinct groups of non, non-problem, low, moderate or problem gamblers.

The determinants of gambling problems investigated in this secondary analysis have been identified in literature reviews, and in *The Victorian Gambling Study*, as associated with gambling or problem gambling. These include co morbidities (such as substance use, physical and mental health), trauma, life events, socio-demographics and indicators of social capital. There were 60 variables investigated.

Findings

The PGSI score was analysed to determine the importance of various social determinants and comorbidities in predicting the level of gambling problems indicated by the PGSI score. Univariate analyses (PGSI score and one variable) were conducted on data from gamblers only from the first year of the longitudinal study. Determinants are labelled as strongest, strong, moderate and mild to give an indication of their importance based on model fit statistics.

Socio-demographics

More gambling problems were moderately associated with male gender and speaking a language other than English at home, and mildly associated with younger age and some occupations.

Trauma, life events and social capital

The strongest relationships with increased gambling problems were found with the number of life events and an increase in number of arguments with someone close. Strong relationships were seen with experience of trauma, hardship and problems in life and upbringing; any life event; major change in financial situation; and lack of social capital as measured by 'like living in their community' and being 'able to get help from family, friends or neighbours'. Moderate relationships were seen with life events; major injury or illness to either yourself or someone close; legal difficulties; and troubles with work, boss or superiors and lack of social capital as measured by rating of overall quality of services; and facilities and things to do in your community. Of mild importance in association with increased PGSI were life events such as marriage or finding a relationship partner; taking on a mortgage, loan or making a big purchase; major change in living or work conditions (e.g. renovations, new job); divorce; and death of someone close.

Comorbidities

The strongest association out of all tested was found between the PGSI score and the Kessler 10, a measure of psychological distress. The more psychological distress the higher the PGSI score. Among the strongest group were also anxiety, depression, self-rated health status and past year smoking. Strong associations were found with current smoker, CAGE score and category, number of cigarettes smoked, and alcohol use and abuse. Moderate associations were found with obesity, disability affecting daily life, the number of physical health conditions, and lung conditions including asthma. Mild associations were found with any 'other' physical or mental health condition.

Findings – detailed

The relationship between PGSI score (gambling problems) and its determinants was explored using negative binomial regression. Unweighted data on gamblers only from the first wave of *The Victorian Gambling Study* were analysed. There are two components to the results:

- The first consists of the model fit statistics which give an indication of the relevant importance of a determinant in explaining or predicting¹ the variation in the PGSI scores. For example, this component indicates whether age and gender are strong determinants of the PGSI score and if they are stronger or weaker in importance compared with other determinants such as current depression.
- The second component explores the size of the effect of belonging to a subgroup of the determinants. For example, the effect on the PGSI score of being male compared to being female gender.

a) Relative importance of determinants (Model fit statistics)

The variables that were the strongest explanatory determinants with gambling problems were established using univariate analyses (PGSI score and one variable). The model fit statistics are an indication of how well a single determinant or group of determinants explains the final PGSI score. The 60 variables analysed were then formed into 5 groups; Groups 1-4, below, list the strongest or best explanatory variables to the weakest. Group 5 have little or no explanatory value for gambling problems based on the Bayesian Information Criteria (BIC'). The BIC' was used to determine which variables were best suited in modelling the distribution of the PGSI score. The groups include

1. Kessler 10 score, Kessler 10 categories, anxiety and/or depression, depression, number of life events, anxiety, increase in number of arguments with someone close, self-reported health status, Smoked in past 12 months, (strongest 10 explanatory variables)
2. Current smoking, trauma or hardship, CAGE score, like living in their community, any life event, major change in financial situation, able to get help, number of cigarettes smoked, alcohol use and abuse, CAGE category, (next strongest 10 explanatory variables)
3. Obesity, major injury or illness to either yourself or someone close, disability that affects daily life, number of physical health conditions, LOTE, rating of overall quality of services, facilities and things to do in your community, gender, legal difficulties, troubles with work, boss or superiors, lung conditions including asthma
4. Age/gender 4 categories, marriage or finding a relationship partner, taking on a mortgage, loan or making a big purchase, major change in living or work conditions (e.g. renovations, new job), any other physical or mental health conditions, age, divorce, death of someone close, occupation

¹ Predicting in statistical sense means association and is not used to suggest causality. This is a cross sectional study design. There is no indication of the temporal relationship between the PGSI score and the determinant.

5. Any physical health condition, urban/rural residence, pregnancy or new family additions, member of a community group, heart conditions, high blood pressure or high cholesterol, diabetes, retirement, cancer, migration in past 5 years, education, Consumed alcohol in past 12 months, number of dependent children, household type, age group, type of internet, personal income, employment status, SEIFA IRSD, household income, SEIFA IEO, SEIFA IER, EGM spend band (little to no explanatory value).

b) Size of the effect of subgroup of determinants (IRR)

In the univariate analyses (PGSI score and one factor) subgroups were analysed for their association with or effect on gambling problems (PGSI score). Some subgroups were associated with an increase in the PGSI score and therefore are risk factors for problem gambling. Some subgroups were associated with a decrease in PGSI score and therefore are protective factors. The findings from this analysis are described for gambling problems and socio-demographics, trauma and life events, social capital and finally comorbidities.

Socio-demographics

- Age and gender: All things being equal the PGSI score for males tended to be 1.5 times the score for females. For each year increase in age the PGSI score decreased by 1% and this value compounds, so that an increase in age of ten years results in a decrease of 10%.
- Households: Those who speak only English at home tended to have a lower (by 0.56 times) PGSI score than those who speak a language other than English at home. The other variables had little explanatory value. Therefore there was no evidence to support an association between household type, internet access type or migration in last 5 years and gambling problems.
- Education and work: Working as a community and personal service worker, a sales worker, machinery operator and driver or as labourer was associated with an increase in PGSI score of 1.88, 1.70, 2.56 or 2.36 times those working as managers. The other variables had little explanatory value. Therefore there was no evidence to support an association between educational achievement, employment status or household and personal income and gambling problems.
- Area of residence: These variables had little explanatory value. Therefore there was no evidence to support an association between where people live and gambling problems.

Trauma and life events

- The PGSI score was associated with trauma, reporting any life event, number of life events and most individual life event except for retirement and pregnancy or new family additions.
- The strongest associations were with an Increase in the number of arguments with someone you are close to (by 3.46 times), trauma, hardship and problems in life (2.16), any life events (1.99), major change in financial situation (2.04) and major injury or illness to either yourself or someone close (1.77) compared with those who did not report these events or trauma. For each unit increase in the number of life events the PGSI score increased by 1.29 times.

Social capital

- The PGSI score was associated with social capital. Compared with those who definitely like living in their community, those who do not (by 3.66 times) or have no feeling about it (3.82) have an increased PGSI score. Compared with those who are able to get help from family friends and neighbours, those who sometimes can (by 1.72 times) or cannot (3.67) have an increased PGSI score. Compared with those who rate their local services as poor, ratings of good (by 0.45 times) and very good (0.40) have decreased PGSI score. There was no evidence to support an association between being a member of a community group and gambling problems.

Comorbidities – Smoking and alcohol misuse

- Past year smokers and current smokers tended to have a PGSI score 2.33 and 2.37 times that of past year non-smokers and non-current smokers respectively. For each unit increase in number of cigarettes smoked the PGSI increased by 1.22 times.
- For each unit increase in CAGE score the PGSI score increased by 1.45 times.
- Those with signs of alcohol abuse or dependence tended to have a PGSI score increased by 1.79 times compared with those who were alcohol non-drinkers, whereas those without signs of alcohol abuse showed no difference.

Comorbidities – Physical and mental health

- As self-reported health status decreased the PGSI score increased. Compared with excellent health, good, fair and poor health was associated with increases in the PGSI score by 1.66, 2.53 and 3.75 times.
- As self-reported health status decreased the PGSI score increased. Compared with excellent health, the PGSI score increased by 1.66, 2.53 and 3.75 times in those who report good, fair and poor health respectively.
- Presence of lung conditions including asthma (by 1.70) and obesity (by 2.11) were associated with an increase in PGSI score; an unit increase in number of physical health conditions was associated with an increase of PGSI score by 1.31 times. There was no evidence to support an association between cardiac conditions (heart conditions, high blood pressure or high cholesterol), diabetes and cancer, with gambling problems.
- The Kessler 10 score had the strongest explanatory value of all variables explored. Each unit increase in the Kessler 10 score was associated with an increase in PGSI score by 1.12 times. The Kessler10 analysed as a categorical variable also had a strong association with gambling problems. Compared with those with low levels of distress, the PGSI score increased by 2.92, 4.80 and 7.61 times in those who report moderate, high and very high levels of distress respectively.
- Depression (by 3.53 times) and anxiety (by 3.35) were all strongly associated with an increase in PGSI score compared with those who did not report these conditions. For each increase in mental health conditions reported, the PGSI score increased by 2.18 times.
- Reporting any other physical or mental health conditions the PGSI score increased by 1.47 times compared with those who did not. Having a disability that affected your day-to-day life increased the PGSI score by 1.91 times compared with those who do not.

1. Introduction

A series of secondary analyses were undertaken from *The Victorian Gambling Study- A longitudinal study of gambling and health 2008-2012 (The Victorian Gambling Study)* (Billi, Stone, Abbott and Yeung 2014; Billi, Stone, Marden and Yeung 2014). This paper is the second of that series of technical reports. The focus of this paper is to explore the relationship between the PGSI score and the social determinants and comorbidities in gamblers. The purpose was to investigate a range of possible determinants (for example socio-demographics, physical and mental health, smoking and alcohol use, trauma, life events and social capital) to indicate which showed the strongest association with increased gambling problems as defined by an increase in PGSI score.

Technical report series

This report is part of a series of technical reports commissioned by the Victorian Responsible Gambling Foundation.

The Victorian Gambling Study: a longitudinal study of gambling and health in Victoria 2008–2012, Technical report one – Social determinants and co-morbidities: social determinants and co-morbidities of gamblers and non-gamblers. The first technical report describes a secondary analysis of *The Victorian Gambling Study- A longitudinal study of gambling and health 2008-2012 (The Victorian Gambling Study)* (Billi, Stone, Abbott and Yeung 2014; Billi, Stone, Marden and Yeung 2014) which compares the social determinants, trauma and life events, social capital, and comorbidities between gamblers and non-gamblers over the four years of *The Victorian Gambling Study*.

The Victorian Gambling Study: a longitudinal study of gambling and health in Victoria 2008–2012, Technical report two – Social determinants and co-morbidities: univariate analysis of gamblers. The second technical report describes a secondary analysis of gamblers from the first year of *The Victorian Gambling Study*. Each of the variables describing the social determinants, trauma and life events, social capital, and comorbidities were explored to determine which have the best or strongest individual association with the PGSI score. It investigated which characteristics of the determinants were associated with an increase (more gambling problems) or a decrease (less gambling problems) in the PGSI score.

The Victorian Gambling Study: a longitudinal study of gambling and health in Victoria 2008–2012, Technical report three – Social determinants and co-morbidities: multivariate models of trauma and social capital. The third technical report describes a secondary analysis of *The Victorian Gambling Study* which examined in detail the complex interplay between social determinants, trauma and life events, and social capital, and their association with the PGSI score in gamblers. This multivariate analysis indicated which determinants best explain the PGSI score after having taken into account other important determinants.

The Victorian Gambling Study: a longitudinal study of gambling and health in Victoria 2008–2012, Technical report four – Social determinants and co-morbidities: multivariate models of co-morbidities. The fourth technical report describes a secondary analysis of *The Victorian Gambling Study* which examined in detail the complex interplay between social determinants and comorbidities, and their association with the PGSI score in gamblers. This multivariate analysis indicated which determinants best explain the PGSI score after having taken into account other important determinants.

Structure of Technical Report Two

The Technical Report Two reports on an exploration of individual determinants associated with variations in the PGSI score in gamblers. A brief literature review on the determinants is included. The

analysis showed which determinants best explain the variations in the PGSI score and which characteristics of those determinants were associated with an increase (more gambling problems) or a decrease (less gambling problems) in the PGSI score. The report is divided into eight sections.

1. Introduction

The introduction describes the approach to this secondary analysis of the data from *The Victorian Gambling Study* and how it differs from the traditional approach. The aim of the study is to add to the understanding of the relationship between gambling problems and social determinants and comorbidities.

2. Relevant literature

The relevant literature outlines the types of studies that provide evidence about the relationship between gambling and gambling problems and their determinants. The key findings on gambling and gambling problems, and the social determinants and comorbidities are detailed.

3. Materials and methods

Materials and methods section details the analytical approach and how to interpret the results.

4. Overview of determinants of gambling problems

This section describes the social determinants and comorbidities that best explained the level of gambling problems.

5. Socio-demographics and gambling problems

The results of the exploration of gambling problems and socio-demographics are reported. Socio-demographics explored include age and gender, recent migration and speaking a language other than English at home, household characteristics, education and work, income, and local area of residence.

6. Trauma and life events and gambling problems

The results of the exploration of the effects of trauma and life events on gambling problems are reported in this section.

7. Social capital and gambling problems

The results of the exploration of the effects of social capital on gambling problems are reported in this section.

8. Comorbidities and gambling problems

Many comorbid conditions were studied for their effects on gambling problems. The conditions included mental health measures such as response to the Kessler 10, self-report depression or anxiety, physical health measures such as self-reported health, obesity and a number of other medical conditions, and a disability that affected daily life.

9. Conclusion and next steps

This final section provides an overview of the findings contained throughout the report and discusses future directions.

Appendix One: Wording of relevant CATI questions

This section outlines some of the relevant questions from the CATI survey.

Appendix Two: Order of importance of determinants based on model fit statistics

This section consists of a table of the determinants highlighting the different values for the model fit statistics from the univariate negative binomial regression.

Appendix Three: Glossary

This section provides a glossary of the key terms in the document.

Appendix Four: References

This section consists of the references used.

Public Health Approach

The analysis is underpinned by a public health approach which views problem gambling as part of a gambling continuum and explores the broader personal, social, economic and environmental as well as biological determinants of gambling problems. (Abbott, Volberg, Bellringer and Reith 2004; Shaffer, LaBrie, LaPlante, Nelson et al. 2004; Williams, Volberg and Stevens 2012). In such a model it is assumed that there is a broad overlap between the social determinants of health and the social determinants of gambling.

The chosen outcome of interest is the **severity of gambling problems in gamblers** as defined by the score from the Problem Gambling Severity Index (PGSI). The PGSI consists of the nine items which are scored from the Canadian Problem Gambling Index (CPGI) (Ferris and Wynne 2001). Using appropriate cut-points, this population screen is used to classify people as non, non-problem, low-risk, moderate-risk or problem gamblers. A higher PGSI score is achieved when gamblers experience more problems or a problem more frequently. Therefore the analytical section refers to changes in the PGSI score as an increase or decrease in gambling problems. The assumption is that gambling problems are part of a continuum and a higher score indicates more problems. The question being asked is 'what factors are linked with an increase or decrease in gambling problems?'. The analytical technique of choice for this over-dispersed count data is the negative binomial regression.

The approach differs from much of the literature which asks 'how do problem gamblers differ from the 'others'. The 'others' are a group consisting of varying combinations of moderate-risk and low-risk gamblers, non-problem gamblers and non-gamblers' who have varying risk profiles for gambling problems. The usual approach concentrates on 'case finding' rather than progression of problems.

The determinants of interest are social determinants of health, as well as comorbidities. The WHO defines the **social determinants of health** as

'the conditions in which people are born, grow, live, work and age, including the health system. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels, which are themselves influenced by policy choices. The social determinants of health are mostly responsible for health inequities – the unfair and avoidable differences in health status seen within and between countries' (CSDH 2008).

Comorbidity is a term used to describe the co-occurrence of two or more disorders in the same person (Petry and Weinstock 2007), often medical conditions. The comorbidities examined include a variety of physical health conditions, mental health conditions and combinations of the two. Addictive behaviours of smoking and alcohol use and abuse are also explored for their relationship with gambling problems.

2. Relevant Literature

This section outlines the evidence in the literature on some of the determinants of gambling problems. The determinants being considered are socio-demographics, trauma, life events and comorbidities. The literature review provides some context for the findings of this study.

There is a large volume of literature on the determinants of gambling problems. The studies are many and varied depending on the purpose of the research. The findings of these studies can be affected by the factors relating to the study as well as changes over time and location. These factors include study objectives, study design, the study subjects, measures of problem gambling and the determinants of gambling/gambling problems, the analytical tools and reporting. It is important to consider these variations when comparing findings of a new study with current evidence in a particular field.

Studies of studies

A large body of evidence is readily available in reviews of gambling studies. There are other advantages of these reviews. By combining findings from multiple small studies or low prevalence studies, it may be possible to demonstrate an effect where previously there were insufficient numbers to do so. Furthermore replication of findings across studies adds credence to the original findings rather than the results being a chance occurrence. A good example is the systematic review (1998–2010) and meta-analysis of population surveys that were conducted to determine the prevalence of comorbid disorders in problem and pathological gambling (Lorains, Cowlishaw and Thomas 2011). A 2009 review of general risk factors for problem gambling used very strict inclusion criteria to identify papers for analysis such as published papers in international scientific literature with detailed analytical information (Johansson, Grant, Kim, Odlaug et al. 2009). On a larger scale, a major review of 202 jurisdiction wide adult prevalence surveys of problem gambling between 1975 and 2012 summarises the demographic, characterological, environmental and gambling format correlates of problem gambling (Williams, Volberg and Stevens 2012). The large number of studies reviewed has enabled multiple comparisons of problem gambling and determinants across time and place.

Particularly relevant is a broader literature review of problem gambling and comorbidities which gives preference to Australian studies and recent studies (since 2000) however considers international literature and older studies where relevant (Haw, Holdsworth and Nisbet 2013). Also from the same group, there is a review of the literature on the links between gambling, problem gambling, significant life events, psychological comorbidities and related social factors including a discussion concerning ways of coping (Holdsworth, Nuske and Hing 2013).

Study populations

Valuable information on problem gambling and its determinants come from studies of different populations. These studies are often conducted in the general population or sub-segments of the general population, often called community studies; convenience samples from various sources such as gaming machine venues or internet sources; and gamblers seeking treatment.

Jurisdiction wide prevalence surveys of problem gambling are a useful source of information on the demographic correlates of problem gambling in the general or community population. These studies are expensive, particularly if those that have a longitudinal component, and vary on how much additional information is collected beyond gambling severity and type and demographics. *The Victorian Gambling Study 2008–2012* (Billi, Stone, Abbott and Yeung 2014) was designed to collect a broad array of factors to enable a more detailed analysis of gambling and health. Other similar studies

include the Swelogs Study (Romild, Volberg and Abbott 2014), the New Zealand 2012 National Gambling Study (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a; Abbott, Bellringer, Garrett and Mundy-McPherson 2014b), the Canadian Quinte Longitudinal Study of Gambling and Problem Gambling (Williams, Hann, Schopflocher, West et al. 2015) and the Canadian Leisure, Lifestyle, & Lifecycle Project (LLLLP) (el-Guebaly, Casey, Currie, Hodgins et al. 2015).

Some population studies collect more detailed information on particular risk factors. National surveys such as the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) (Petry, Stinson and Grant 2005) and The National Comorbidity Survey Replication (NCS-R) (Kessler, Hwang, LaBrie, Petukhova et al. 2008) provide useful information on comorbidities and in the case of the NCS-R provide some indication of the temporal relationship between comorbidities and gambling problems. Others collect information on particular segments of the general community or of the gambling community such as adolescents (Felsher, Derevensky and Gupta 2010; Lee, Storr, Ialongo and Martins 2012; Storr, Lee, Derevensky, Ialongo et al. 2012).

Additional information comes from treatment studies where subjects are recruited from gambling treatment settings. These studies are thought to represent the more severe end of the gambling problems or comorbidity spectrum (Crockford and el-Guebaly 1998; Slutske, Eisen, Xian, True et al. 2001). Problem gambling is a rare event with PGSI prevalence rates of between 0.5% to 1% (Devlin and Walton 2012). While comorbidities in problem gamblers are common, some forms may be too infrequent to be studied in population settings (Westphal and Johnson 2007). Some conditions are more difficult to be diagnosed using the types of tools used in population studies. In addition, the findings of these studies have relevance for clinical settings as they represent treatment seeking gambling (Lorains, Cowlishaw and Thomas 2011). On the other hand they only represent treatments seeking gamblers and/or clients of specialised service who may differ from the general population of problem gamblers.

Finally qualitative studies are useful for a more detailed exploration of the lives of gamblers and problem gamblers, their families and communities, and service providers. These studies are conducted via methods such as individual interviews, focus groups or direct observation of subjects. Interpretation is often theory driven but in some cases its purpose may be to develop a theoretical perspective. A qualitative study was conducted as part of *The Victorian Gambling Study* between waves three and four (Market Access Consulting and Research Pty Ltd 2012). Valuable information about the complex relationship between gambling problems and trauma or stress, and social supports comes from qualitative studies (McMillen, Marshall, Murphy, Lorenzen et al. 2004; Holdsworth, Nuske and Hing 2013; Holdsworth, Nuske and Hing 2014).

Disordered gambling, pathological gambling or problem gambling

The increase in knowledge and understanding of the pathology of gambling problems has led to changes in how it is perceived as a psychiatric disorder. In the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) the condition of pathological gambling was considered under the category of impulse control disorders. In the revised DSM V it has been moved to the substance-related and addictive disorders category as the only behavioural addiction, and renamed gambling disorder (American Psychiatric Association 2013).

In the literature the label for the most severe category of gambling problems is derived from the screening tool used in the study. Therefore it may be referred to as problem gambling, or pathological gambling with the next most severe category being problem gambling. This terminology can be confusing. There are over 20 problem gambling screens (Abbott and Volberg 2006). If the PGSI screening tool is used the most severe category of gambling is called problem gambling. *The*

Victorian Gambling Study 2008-2012 (Billi, Stone, Abbott and Yeung 2014) used the PGSI to identify the level of problems with gambling in people who gambled over the past year. Those with scores of eight and over are defined as ‘problem gamblers’. For the South Oaks Gambling Screen (SOGS) the most severe category is probable pathological gambling, with the next severe category being called problem gambling.

Determinants of gambling problems

This section describes which determinants of gambling problems are identified more consistently or in better controlled studies. An understanding of these enables comparisons to be made between the current study and previously reported findings. The more consistent results are over time and place, the more confident we can be about the findings although it is important to recognise that changes can occur over time or be due to cultural differences.

Socio-demographics

This section describes the association between socio-demographics and problem and pathological gambling as reported in the literature. The aim is to identify which socio-demographics identify people at risk of gambling problems. A large number of socio-demographics have been investigated in prevalence studies, empirical studies of population samples and in treatment settings. A smaller number of socio-demographics variables are considered the basic variables to report in any study such as age and gender, and are consistently measured and therefore comparable across studies. Other determinants have more varied definitions. An example of this is ethnicity or race which can be measured by country of birth, recent migration, language spoken or self-identified ethnic/racial identity, to name a few.

Socio-demographics in this paper refer to characteristics that describe the individual as well as where they live. The determinants investigated are age and gender; recent migration and speaking a language other than English at home; household characteristics including number of dependent children, internet type and household composition. They include measures of education and work, educational achievement, employment, occupation, household income and personal income. There are also measures that relate to where people live; urban or rural/regional, electronic gaming machine spend areas and the four Australian Bureau of Statistics (ABS) SocioEconomic Index For Areas (SEIFA) which are measures of area level socio-economic status.

Age and gender

Male gender and, to a lesser extent, younger age are identified as risk factors around the world and over a reasonable length of time. Out of 202 studies, males gender (145 studies) was the most frequently reported correlate, as was being under age 35 years (119 studies) although other age groups were reported in 32 studies (Williams, Volberg and Stevens 2012). Johansson, Grant, Kim, Odlaug et al. (2009) identified male and young age as well-established risk factors in their review. The 2003 Victorian prevalence study found that problem gamblers were more often males and aged 39 to 64 years (The Centre for Gambling Research: Australian National University 2004). Recent Australian studies have all found that male gender is linked with problem gambling (Davidson and Rodgers 2009; Department of Justice and Attorney-General 2012; Sproston, Hing and Palankay 2012; Office for Problem Gambling 2013). Younger age group was identified as a determinant in NSW (Sproston, Hing and Palankay 2012), in Queensland (Department of Justice and Attorney-General 2012) and the ACT (Davidson and Rodgers 2009) but not in South Australia (Office for Problem Gambling 2013). Male gender and younger age group were identified as risk factors for problem gambling in both the Swelogs study (Romild, Volberg and Abbott 2014) and the Canadian Leisure, Lifestyle, & Lifecycle Project (LLLLP).

However there is some evidence that the gender differences may be reducing in some areas. In New Zealand these gender differences which were substantial in 1991 have decreased markedly. In the most recent survey in 2012 males have only marginally higher current problem gambling prevalence rate than females but there are no gender differences in the prevalence of moderate-risk and combined problem and moderate-risk gambling (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). There was also no gender or age difference found as correlates in the Quinte Longitudinal Study of Gambling and Gambling Problems (QLS) (el-Guebaly, Casey, Currie, Hodgins et al. 2015).

Ethnicity or racial identification

In *The Victorian Gambling Study* ethnicity or racial identification was measured by questions on recent migration and speaking a language other than English at home. As mentioned above how ethnicity or racial identification is measured varies greatly across the studies. Being in a minority or belonging to an immigrant group has been shown to be linked to problem gambling although this is not consistent across all studies and varies by cultural group.

Some studies reported correlates with minority or immigrants groups (25), non-immigrant (2) and indigenous (16) (Williams, Volberg and Stevens 2012). Being an immigrant/foreign was identified as a probable risk factor by Johansson, Grant, Kim, Odlaug et al. (2009). The 2003 Victorian prevalence study found that problem gambling was more prominent among Victorian adults who were born outside Australia, whose mother was born outside Australia, whose father was born outside Australia and whose main language at home is not English (The Centre for Gambling Research: Australian National University 2004). Whereas being Australian born was identified as a risk factor in the ACT (Davidson and Rodgers 2009) but not in NSW (Sproston, Hing and Palankay 2012), Queensland (Department of Justice and Attorney-General 2012) or South Australia (Office for Problem Gambling 2013).

Being an immigrant was not a correlate or predictor of problem gambling in both Canadian studies whereas being non-Caucasian was a correlate in both studies and a predictor in the QLS but not the LLP (el-Guebaly, Casey, Currie, Hodgins et al. 2015; Williams, Hann, Schopflocher, West et al. 2015). People not born in Sweden were high risk for problem gambling in Swelogs (Romild, Volberg and Abbott 2014). Susceptibility to problem gambling shows ethnic differences. Maori and Pacific Islanders continue to be at high risk of problem gambling in New Zealand whereas Asians do not (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). Problem gambling prevalence was higher in those of Asian/Asian British origin (2.8%) and Black/Black British origin (1.5%) compared with those whose ethnic group was White/White British (0.8%) as it was in 1999 and 2007 British surveys (Wardle, Moody, Spence, Orford et al. 2010).

Household characteristics

Household characteristics or structure are defined in many different ways. A potential common theme is small nuclear households of one person or single parent. People living in households of two or more are at higher risk of problem gambling (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). Problem gamblers were over-represented in one parent families (9.5%) compared with non-problem gamblers (5.5%) (The Centre for Gambling Research: Australian National University 2004). Problem gambling was higher in one person households in the 2012 South Australian prevalence survey (Office for Problem Gambling 2013), and amongst those who were single, or divorced/separated/widowed in NSW (Sproston, Hing and Palankay 2012) or never married in the ACT (Davidson and Rodgers 2009). In the Canadian QLS being separated or not married was identified as a correlate of problem gambling (Williams, Hann, Schopflocher, West et al. 2015).

Education and work

Low educational achievement, unemployment, some occupations, low household income or personal income have been reported to be associated with problem gambling. These determinants are often interrelated so it can be hard to identify the most important determinants. Lower education than

average was reported in 65 studies and higher education in 4; low income in 56 studies, middle income in 9 and high income in 5 studies; being unemployed in 30, part or full-time in 14 and student in 7 studies (Williams, Volberg and Stevens 2012). Johansson, Grant, Kim, Odlaug et al. (2009) identified being unemployed, on social welfare and having low academic achievement as probable risk factors, and low education as a possible risk factor.

The 2003 Victorian prevalence study found that problem gamblers were more often of low educational attainment, unemployed, and main income source from social security payments (The Centre for Gambling Research: Australian National University 2004). Lower educational attainment was linked with problem gambling in a number of Australian studies (Davidson and Rodgers 2009; Department of Justice and Attorney-General 2012; Sproston, Hing and Palankay 2012; Office for Problem Gambling 2013). Problem gambling was associated with being unemployed in NSW (Sproston, Hing and Palankay 2012), low household income and being in financial stress in South Australia (Office for Problem Gambling 2013) and have their main income derived from pensions, benefits or superannuation, or to be employed full time rather than part time in the ACT (Davidson and Rodgers 2009).

Low education attainment was identified as a risk factor for problem gambling in the New Zealand Study, the Swelogs and the QLS but not the LLP (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a; Romild, Volberg and Abbott 2014; el-Guebaly, Casey, Currie, Hodgins et al. 2015; Williams, Hann, Schopflocher, West et al. 2015). In Britain, problem gambling was most prevalent within the small employers and own account workers category and least prevalent within managerial and professional households (Wardle, Moody, Spence, Orford et al. 2010).

Local area

Where people live influences their risk of becoming a problem gambler. The parameters considered include the accessibility to venues or gambling opportunities, or the area level measure of socioeconomic status. These two dimensions may be interrelated. Area level associations were reported for urban in 9 studies and rural in one; specific geographic areas (7), proximity to (2) or density of venues (1) (Williams, Volberg and Stevens 2012). Living in a large city was identified as probable risk factors by Johansson, Grant, Kim, Odlaug et al. (2009). The 2003 Victorian prevalence study found that problem gamblers were more often living in the metropolitan areas of Victoria (The Centre for Gambling Research: Australian National University 2004). Swelogs found big city residence compared to elsewhere to be a determinant of problem gambling (Romild, Volberg and Abbott 2014) whereas location was not important in the Canadian studies (el-Guebaly, Casey, Currie, Hodgins et al. 2015; Williams, Hann, Schopflocher, West et al. 2015). Proximity and perceived proximity were correlates of problem gambling, and perceived proximity was a predictor of problem gambling in the QLS but not the LLP (el-Guebaly, Casey, Currie, Hodgins et al. 2015; Williams, Hann, Schopflocher, West et al. 2015).

Using Electronic Gaming Machines (EGM) losses as a surrogate for problem gambling, Rintoul, Livingstone, Mellor and Jolley (2012) showed that higher losses were associated with more socioeconomic disadvantaged areas using the Index of Relative Socioeconomic Disadvantage (IRSD), one of the ABS SEIFA measures, and this is partly mediated by the density of EGMs. Storr, Lee, Derevensky, Ialongo et al. (2012) in their study of urban youth showed that experience of any life event was related to disadvantaged neighbourhoods and this was linked to gambling. Welte, Wieczorek, Barnes and Tidwell (2006) have shown there are environmental influences in disadvantaged neighbourhoods that encourage gambling. In New Zealand, the New Zealand deprivation index, an area level measure of deprivation, was linked to problem gambling (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a).

A history of trauma, hardship or problems and life events

This section describes the association between trauma and traumatic life events with problem or pathological gambling as described in the literature. The aim is to identify the evidence relating to how the experience of trauma, hardship and problems in life has affected the development of gambling problems. Investigations of life events include those that may contribute to the development of gambling problems and those that may be a result of gambling problems. Review of the literature on these determinants had an additional degree of difficulty as definitions and measuring instruments of trauma and the specified life events varied. In addition it is important to consider when the trauma, hardship or problems and life events occurred across the person's lifespan. Did it occur in childhood, adolescence or concurrent with the gambling problems?

For example, **trauma** is defined by the American Psychological Association as

‘an emotional response to a terrible event like an accident, rape or natural disaster. Immediately after the event, shock and denial are typical. Longer term reactions include unpredictable emotions, flashbacks, strained relationships and even physical symptoms like headaches or nausea. While these feelings are normal, some people have difficulty moving on with their lives. Psychologists can help these individuals find constructive ways of managing their emotions.’
(<http://apa.org/topics/trauma/index.aspx> accessed 6th April 2015).

However, in *The Victorian Gambling Study*, trauma was not linked to a specific event and related to a person's perception of life in general. It was defined by the response to the question: ‘thinking of your personal background, would you say you are someone who has had 1) no really major problems, hardships and traumas in your life or upbringing or 2) a lot of trauma, hardship and problems in their life or upbringing?’

The social stress of life events has been linked to illness onset (Rahe, Meyer, Smith, Kjaer et al. 1964). These stressful life events have been described as occurrences that usually evoke or are associated with some adaptive or coping behaviour on the part of the involved individual. They are either indicative of or require a significant change in the ongoing pattern of the individual (Holmes and Rahe 1967). The events can be negative or socially undesirable as well as positive or socially desirable. They do however require a change in the existing steady state of the individual.

Stressful life events

In *The Victorian Gambling Study*, the stressful life events were specified and related to the previous twelve months which is concurrent with the questions on problem gambling. Stressful life events were explored for their potential relationship with problem gambling. While these positive and negative life events are considered as potential stressors or triggers for gambling problems many are also an indicator of the harms associated with gambling problems. In the survey respondents were asked to consider ‘things that happened in your life during the past 12mths. Which of the following life events did you experience in the past 12mths?’

1. Death of someone close to you
2. Divorce
3. Legal difficulties
4. Major injury or illness to either yourself or someone close to you
5. Marriage or finding a relationship partner
6. Troubles with your work, boss, or superiors
7. Retirement
8. Pregnancy or new family additions
9. Major change to your financial situation
10. Taking on a mortgage, loan or making a big purchase
11. Increase in the number of arguments with someone you are close to
12. Major change in living or work conditions (e.g. renovations, new job)

Gambling problems are linked with a higher frequency of trauma particularly childhood trauma. Pathological gamblers in treatment programs more often report a history of trauma and those with a history of trauma or more severe trauma tend to have comorbidities or more severe comorbidities particularly depression, anxiety, and alcohol or drug abuse (Taber, McCormick and Ramirez 1987; Kausch, Rugle and Rowland 2006). For many the trauma or maltreatment occurred in childhood (Kausch, Rugle and Rowland 2006; Felsher, Derevensky and Gupta 2010). These findings are further supported by findings from a community sample. In the multivariate analysis, childhood maltreatment was associated with severity of gambling problems and frequency of gambling independent of other individual and social factors such as alcohol and other drug use disorders, family environment, psychological distress, and symptoms of antisocial disorder (Hodgins, Schopflocher, el-Guebaly, Casey et al. 2010). Childhood trauma was linked with the development of gambling problems in both Canadian longitudinal studies (el-Guebaly, Casey, Currie, Hodgins et al. 2015; Williams, Hann, Schopflocher, West et al. 2015).

The stress and the number of stressors or life events have been shown to be associated with gambling and gambling problems. In the 2003 Victorian prevalence study (The Centre for Gambling Research: Australian National University 2004) a greater proportion of problem gamblers (27%) reported being under doctor's care for stress related health issues, compared to non-problem regular gamblers (8.6 per cent). Using similar questions to those used in *The Victorian Gambling Study*, the number of life events was associated with problem gambling in New Zealand (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). The Canadian longitudinal studies using the Life Events Questionnaire (Vuchinich, Tucker and Harlee 1986) found the number of stressful events to be linked with concurrent and future problem gambling (el-Guebaly, Casey, Currie, Hodgins et al. 2015; Williams, Hann, Schopflocher, West et al. 2015). The number and impact of routine daily stressors over the last 24 hours were found to be higher in pathological gamblers than normal subjects. The effects of stressors representing interpersonal problems were stronger than personal competency, environmental hassles and varied stressors. Gambling urges were also studied as an outcome. The

daily stress index was the only predictor of gambling urges when all factors were taken into consideration (Elman, Tschibelu and Borsook 2010).

Adolescents with gambling problems report more stress, daily hassles and major traumatic life events and generally have poor coping styles (Shead, Derevensky and Gupta 2010). In a community sample of adolescents, those with gambling problems had experienced a greater number of stressors or negative life events. The more severe gamblers tended to use more maladaptive forms of coping than the others (Bergevin, Gupta, Derevensky and Kaufman 2006). In a community sample of adolescents, those who gambled more frequently than others reported experiencing more threatening or violent life events. The number of life events was linked with gambling but not with severity. These life events are also linked with addictive behaviour (Lee, Storr, Ialongo and Martins 2012; Storr, Lee, Derevensky, Ialongo et al. 2012).

The association between specific life events and gambling problems is well recognised and some are even part of the definition. In Australia problem gambling is described as being 'characterised by difficulties in limiting money and/or time spent on gambling which leads to adverse consequences for the gambler, others or for the community' (Neal, Delfabbro and O'Neil 2005). It is no surprise that the financial consequences, crime and legal difficulties, relationship problems, work-related issues and housing concerns are some of the major harms that occur as a result of problem gambling. Holdsworth, Nuske and Hing (2013) have reviewed in detail the relationship between gambling and significant life events including legal difficulties, work-related problems, financial difficulties, relationship problems, the death of a loved one, enduring a major injury and illness, and changes in living conditions, such as moving and homelessness.

Financial difficulties including debt and bankruptcy are linked with problem gambling (Holdsworth, Nuske and Hing 2013) and tend to be the most common type of harm (The Centre for Gambling Research: Australian National University 2004; Productivity Commission: Australia 2010; Department of Justice and Attorney-General 2012; Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). Prevalence rates of financial difficulties (major change in financial situation) in problem gamblers are in the order of 46% (Hare 2009), 57% (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a) and 46% (Department of Justice and Attorney-General 2012). The 2003 Victorian prevalence study demonstrated a link between problem gambling and filed for bankruptcy as well as committed crime to obtain money (The Centre for Gambling Research: Australian National University 2004).

Crime and legal difficulties are linked with problem gambling (Holdsworth, Nuske and Hing 2013) and are a major form of harm from problem gambling (The Centre for Gambling Research: Australian National University 2004; Productivity Commission: Australia 2010; Department of Justice and Attorney-General 2012; Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). Prevalence rates for legal difficulties in problem gamblers are in the order of 11% (Hare 2009), 22% (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a) and, combined moderate and problem gamblers 12% (Department of Justice and Attorney-General 2012).

Work-related issues such as unemployment, retrenchment, poor work performance, conflicts in the work place and retirement can be a trigger for problem gambling (Holdsworth, Nuske and Hing 2013) and problem gambling can be a cause of work-related problems and psychological ill-health (Productivity Commission: Australia 2010). Prevalence rates of troubles with work, boss or superiors in problem gamblers are in the order of 20% (Hare 2009), 20²% (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a) and combined moderate and problem gamblers 22% (Department of Justice and Attorney-General 2012).

Relationship concerns including increased conflict within relationships, including separation and divorce, are connected with problem gambling (Holdsworth, Nuske and Hing 2013). Prevalence of an

² Not significantly different to non-problem gamblers

increase in arguments with someone close was particularly high in Victoria 42% (Hare 2009), New Zealand 38³% (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a) and Queensland 37% (Department of Justice and Attorney-General 2012). The prevalence of marriage or finding a relationship partner was higher in problem gamblers in Victoria (17%) (Hare 2009) and in New Zealand (17%) (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a) but not in Queensland (Department of Justice and Attorney-General 2012). The prevalence of divorce or separation was higher in Victoria (9% divorce only) (Hare 2009) and in Queensland (18%) (Department of Justice and Attorney-General 2012) but not in New Zealand (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a).

Major injury or illness is linked with problem gambling (Holdsworth, Nuske and Hing 2013). Prevalence rates in Victoria were 45% (Hare 2009) and New Zealand 28% (Abbott, Bellringer, Garrett and Mundy-McPherson 2014a) for problem gamblers, and Queensland 33% for combined moderate and problem gamblers (Department of Justice and Attorney-General 2012). There was no evidence to suggest that retirement, or pregnancy or new family additions was linked with problem gambling in Victoria or New Zealand (Hare 2009; Abbott, Bellringer, Garrett and Mundy-McPherson 2014a).

Housing concerns and changes in living conditions are related to problem gambling (Holdsworth, Nuske and Hing 2013). However this may be as a result of the form of the question which can encompass both positive and negative life events and therefore contribute little to clarify housing-linked difficulties and gambling problems (Holdsworth, Nuske and Hing 2013). The authors highlight that links to housing are not as well studied and the issues more complex to tease out the independent effects of housing on gambling problems and vice versa. There was no evidence that a major change in living or work conditions was associated with problem gambling in the recent Victorian, New Zealand or Queensland surveys (Hare 2009; Department of Justice and Attorney-General 2012; Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). Furthermore taking on a mortgage, loan or making a big purchase was not linked to problem gambling (Hare 2009; Abbott, Bellringer, Garrett and Mundy-McPherson 2014a).

Death of a loved one has been associated with gambling levels (Holdsworth, Nuske and Hing 2013). Similar to housing concerns, the evidence is more circumstantial than those mentioned above. Much of the evidence is from studies of significant life events of which death of someone close is one of or an example of the type of event that is reported to trigger an increase in gambling behaviour. There was no evidence that the death of someone close was associated with problem gambling in the recent Victorian, New Zealand or Queensland surveys (Hare 2009; Department of Justice and Attorney-General 2012; Abbott, Bellringer, Garrett and Mundy-McPherson 2014a). On the other hand Swelogs, the Swedish longitudinal study of gambling problems, found that the death of significant other as well as divorce or separation led to an increased risk of problem gambling (Folkhälsomyndigheten 2014).

Social capital

This section describes the association between social capital and problem or pathological gambling as described in the literature. The aim is to identify whether measures of social capital (or lack of social capital) can identify people at reduced (or increased) risk of problem gambling.

Social capital is a complex concept whose definitions vary by the disciplinary field of investigation (Falzer 2007). Coleman (1990), using a sociological perspective, proposes that social capital is a property of the individual. He suggests that it is 'defined by its function, it is not a single entity, but a variety of different entities having characteristics in common: they all consist of some aspect of a social structure, and they facilitate certain actions of individuals who are within the structure'. Whereas Putnam, Leonardi and Nanetti (1994) describe it as a property of the community with 'the

³ Not significantly different to non-problem gamblers

features of social organization, such as trust, norms and networks, that can improve the efficacy of society by facilitating coordinated actions’.

The **WHO HPR/HEP (1998)** in its health promotion glossary define **social capital** as representing ‘the degree of social cohesion which exists in communities. It refers to the processes between people that establish networks, norms and social trust, and which facilitate coordination and cooperation for mutual benefits (WHO HPR/HEP 1998). Social capital is created from the myriad of everyday interactions between people, and is embodied in such structures as civic and religious groups, family membership, informal community networks, and in norms of voluntarism, altruism and trust. The stronger these networks and bonds, the more likely it is that members of a community will co-operate for mutual benefit. In this way social capital creates health, and may enhance the benefits of investments for health.’

The variety of definitions and perspectives of social capital leads to a myriad of conceptual frameworks and terms to describe the different dimensions of the social capital. As an example the Office of National Statistics in the UK identified a range of terms that equated to social capital including social energy, community spirit, social bonds, civic virtue, community networks, social ozone, extended friendships, community life, social resources, informal and formal networks, good neighbourliness and social glue (Office of National Statistics 2001). The OECD argues that not all social capital is beneficial and lack of social capital may result in exclusion and development of an underclass that does not conform to the mainstream social norms (Côté and Healy 2001). The results of such marginalisation from social supports include the poorer outcomes we associate with social isolation, social disconnectedness and social exclusion.

In the Victorian Gambling Study, four questions were used to capture social capital and its converse social isolation. They are indicative of an individual's social networks and trust in family, friends and neighbours; organised groups, the local community and formal institutions. The measures were chosen for their comparability to major Victorian population surveys: The Victorian Department of Health's Victorian Population Health Survey and the Department of Victorian Communities Indicators of Community Strength. To our knowledge these indicators have not been used in other gambling surveys. They include:

- 1) Can the individual get help from friends, family or neighbours when needed? This indicator is designed to measure an individual's perceived ability to get help. It gauges whether an individual is part of an informal social network, and that there are benefits in the form of reciprocity (giving and taking) from that network. It is also an important indicator of social exclusion. (Community Indicators Victoria ; Victorian Government Department of Human Services 2003; Australian Bureau of Statistics 2004)
 - 2) Is the individual a member of an organised group such as a sports or church group, or another community group including those over the internet? This indicator is designed to measure an individual's level of informal social participation in a community. It gauges whether an individual is welcomed into a community, made to feel accepted and included, and has the potential to benefit from integration within that community. Benefits may include introductions to channels of information, which may include social norms and moral codes. (Victorian Government Department of Human Services 2003; Australian Bureau of Statistics 2004)
 - 3) Does the individual like living in their community? This indicator is designed to measure social attitudes and trust at the community level. It gauges the individual's attitude and trust towards strangers and casual acquaintances, and to institutions in their communities. It also measures their integration into the community and sense of friendliness and acceptance. (Community Indicators Victoria ; Victorian Government Department of Human Services 2003; Australian Bureau of Statistics 2004)
 - 4) How does the individual rate the overall quality of services, facilities and "things to do" in their community? This indicator is designed to measure social attitudes and trust of the formal community. It gauges the individual's attitude and trust towards the broader community, public services, facilities and institutions. It also measures their integration into the community, ability to access services and information. (Community Indicators Victoria ; Victorian Government Department of Human Services 2003; Australian Bureau of Statistics 2004)
- 'It is believed that when community members have access to the services they need, when they need them, they are more likely to have feelings of civic engagement and well-being. Not having access to such services can place vulnerable groups at greater disadvantage and signal pockets of social isolation' (Bastian, 2000 cited in (Community Indicators Victoria)).

There is a wealth of evidence that links social capital and health outcomes (Baum 2003; Kawachi, Subramanian and Kim 2008; Lin, Smith and Fawkes 2014). Some of these studies analysed the effects of social capital at the area level while others were of individual level social capital. To understand this complex multilevel phenomenon and associated cross level interactions, prospective multilevel studies have been conducted. An appraisal of 13 eligible studies found that both individual and area-level social capital generally but not always had positive effects on health outcomes (Murayama, Fujiwara and Kawachi 2012). Outcomes measured were mortality, hospitalisation, self-rated health, health related behaviour and depression. Using data from the household, income and labour dynamics in Australia (HILDA), social capital was found to be related to mental health particularly, as well as physical functioning and general health (Berry and Welsh 2010).

The relationship between social capital and mental illness has been explored. There is an indication that individual level social capital and social supports are associated with mental health, whereas the evidence for area level social capital is more equivocal. Fourteen studies of social capital at the

individual level were reviewed. They showed that cognitive social capital was inversely related to common mental disorders, and probably linked with child mental illness, and the combined measures of social capital were probably linked with common mental disorders. Seven were of social capital at the area level. The results of these were more mixed with some studies finding an inverse, some positive and other no evidence of a relationship between social capital and mental health outcomes (De Silva, McKenzie, Harpham and Huttly 2005). Poor social support has been shown to be a contributory factor in addictive disorders (Havassy, Hall and Wasserman 1991; Beattie and Longabaugh 1999; Fals-Stewart and O'Farrell 2003), resulting in higher symptoms of depression and psychological distress as well as more severe addiction problems. Relapse is also more common in those with poor social support (Galea, Nandi and Vlahov 2004).

The effects of social capital on gambling problems are not as well studied as they are for other areas, such as mental health. Studies conducted tend to be of an informal social supports or loneliness at the individual level rather than multidimensional or of area level social capital. Current evidence indicates that social supports or lack of social supports can trigger gambling problems, may play a part in the success of treatment and prevent relapse. Only one study was found which measured social capital at the area level. It showed the presence of a casino within 15 miles reduces that community's social capital (Griswold and Nichols 2006). This effect is independent of the existing social capital of the area.

Individuals in a gambling treatment program with lower scores on the Social Support Scale had higher gambling problems, significantly more psychiatric symptoms and family problems. The level of social support had a moderating effect on success of treatment outcomes and with longer term outcomes (Petry and Weiss 2009). Social support was associated with ability to abstain (reducing relapse) from gambling in a group of attendees of Gambling Anonymous (Oei and Gordon 2008). In a community sample of adults, problem gambling was associated with lower levels of social support in men but not in women (Afifi, Cox, Martens, Sareen et al. 2010a). The level of loneliness as measured by the UCLA Loneliness Scale was associated with gambling problems in a quantitative survey of adult gamblers (McQuade and Gill 2012). The Canadian longitudinal studies using Lubben Social Network Scale, found that lower social support was a correlate of problem gambling but not a predictor of future problem gambling (el-Guebaly, Casey, Currie, Hodgins et al. 2015; Williams, Hann, Schopflocher, West et al. 2015).

Qualitative studies have identified the importance of social supports as mediators of the effects of trauma and life events, and psychological comorbidities. A qualitative study of 20 recreational gamblers and 20 people with gambling problems found that both groups experienced life events and psychological comorbidity however their ways of coping were different. Gamblers with problems increased their gambling involvement whereas the recreational gamblers did not. Most recreational gamblers had strong social support networks and resilience (Holdsworth, Nuske and Hing 2014). Social isolation, disconnectedness, socio-cultural ambivalence and the need to participate in acceptable recreational activities were frequently identified as factors for triggering gambling related problems in a study conducted in the ACT (McMillen, Marshall, Murphy, Lorenzen et al. 2004).

Comorbidities

This section describes the association between comorbidities and problem and pathological gambling as described in the literature. The aim is to identify which comorbidities identify people at risk of problem gambling, or co-occur with problem gambling or result from problem gambling. Comorbidities to be considered are smoking, alcohol and drug use as well as physical and mental health conditions. The comorbidities are identified using a mixture of self-report, clinical and population measures.

Comorbidity is a term used to describe the co-occurrence of two or more disorders in the same person (Petry and Weinstock 2007) often medical conditions. This may occur in many ways: both disorders are independent of each other; one disorder protecting against the other; one disorder

causing the other; or both disorders sharing a common cause or being components of a more complex set of symptoms (Shaffer and Korn 2002). The comorbidities examined include a variety of physical health conditions, mental health conditions and combinations of the two. Addictive behaviours of smoking, alcohol and drug are also explored for their relationship with gambling problems.

Reviews of community studies show that in general people with gambling problems have an elevated prevalence of comorbid disorders including depression, anxiety disorders and other mental health disorders as well as substance abuse disorders including alcohol, tobacco and illicit drugs (Johansson, Grant, Kim, Odlaug et al. 2009; Lorains, Cowlishaw and Thomas 2011; Williams, Volberg and Stevens 2012). In the review of 202 prevalence studies (Williams, Volberg and Stevens 2012), only a small number of studies reported associations with substance abuse (13), tobacco use (12), illicit drug use (3), mental health problems (12), and poor physical health and/or disabled (9). A systematic review (1998-2010) and meta-analysis of population surveys was conducted to determine the prevalence of comorbid disorders in problem and pathological gambling (Lorains, Cowlishaw and Thomas 2011). The study found 11 eligible studies from peer reviewed and unpublished articles of general population samples. The meta-analysis showed that problem and pathological gamblers had high rates of nicotine dependence (60%), substance use disorder (57%), any mood disorder (38%) and any type of anxiety (38%). The range of results from the individual studies varied for alcohol use disorder (10-49%), major depression (9-47%), bipolar disorder/manic episodes (3-48%), substance use disorders (26-76%), illicit drug abuse/dependence (2-49%), nicotine dependence (15-76%), any anxiety disorder (14-60%), generalised anxiety disorder (8-30%), any mood disorder (12-56%) and associated personality disorder (23-45%). A 2009 review of risk factors for problem gambling used very strict inclusion criteria to identify papers for analysis such as published papers in international scientific literature with detailed analytical information (Johansson, Grant, Kim, Odlaug et al. 2009). The review identified comorbid disorders (Obsessive compulsive disorder (OCD), drug abuse) as well established risk factors (3 or more well performed studies) and depression, anxiety and alcoholism as probable risk factors (1 or 2 well performed studies).

The National Comorbidity Survey Replication (NCS-R) showed that pathological gamblers have higher risk of substance use disorder (5.5 times), mood disorder (3.7 times) and anxiety (3.1 times) (Kessler, Hwang, LaBrie, Petukhova et al. 2008). A large psychiatric epidemiological survey, the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) showed that, compared with non-gamblers, pathological gamblers have higher risk of lifetime alcohol misuse (6 times), substance use (4.4), major depression (3.3), dysthymia (3.3), Generalised Anxiety Disorder (3.1) and panic disorders (4.2). (Petry, Stinson and Grant 2005). A survey of St Louis-area residents showed that, compared with non-gamblers, pathological gamblers have higher risk of lifetime alcohol misuse (3.3 times), substance use (1.3), major depression (3.3), dysthymia (2.1), generalised anxiety disorder (GAD) (1.1) and panic disorders (3.2) (Cunningham-Williams, Cottler, Compton 3rd and Spitznagel 1998).

In the 2003 Victorian prevalence study problem gamblers reported higher rates of being severely depressed (59%) compared to 13.1 per cent of non-problem regular gamblers over the last 12 months and 10% reported being severely depressed because of their gambling. Problem gamblers (11.5%) more often report seriously thinking about or attempting suicide than non-problem gamblers (1.1%) (The Centre for Gambling Research: Australian National University 2004).

A recent systematic review and meta-analysis of 36 studies of psychiatric comorbidities in treatment seeking problem gamblers identified high rates (both 75%) of current and lifetime comorbid disorders. Highest mean prevalence was nicotine dependence (56%) and major depressive disorder (30%). Alcohol abuse (18%) and dependence (15%), social phobia (15%), GAD (14%), panic disorder (14%), post-traumatic stress disorder (12%), cannabis use disorder (11%), attention deficit hyperactivity disorder (8%), adjustment disorder (9%), bipolar disorder (9%) and OCD (8%). They caution that

although these are all from treatment settings there is a great degree of variability between the studies. The variability was not explained by problem gambling severity, treatment facility type or study jurisdiction (Dowling, Cowlshaw, Jackson, Merkouris et al. 2015).

Problem gambling has been associated with physical health conditions in addition to mental health conditions. Persons with and without pathological gambling were studied to assess their self-reported chronic medical conditions, medication usage, lifestyle choices, health care utilization, quality of life variables, and body mass index (BMI). The study showed that pathological gambling is associated with obesity, chronic medical conditions, poor lifestyle choices, worse quality of life, and the use of costly forms of medical care. (Black, Shaw, McCormick and Allen 2013). Problem gambling was shown to be associated with unhealthy behaviours and obesity (Algren, Ekholm, Davidsen, Larsen et al. 2014). Adults from the NESARC 2001-2002 were evaluated for the relationship between gambling disorders and health problems. Gambling severity was found to be related to behavioural risk factors such as BMI as well as alcohol abuse and dependence, nicotine dependence, and mood and anxiety disorders (Morasco, Pietrzak, Blanco, Grant et al. 2006).

The temporal nature of the comorbidity has been studied. These studies suggest that gambling problems can precede or follow the development of comorbid conditions. In addition the temporal sequence may be different in males and females and at different ages (Kessler, Hwang, LaBrie, Petukhova et al. 2008; Haw, Holdsworth and Nisbet 2013). The NCS-R study indicated that the onset of pathological gambling preceded the comorbid disorder in a quarter of case and followed the comorbid disorder in three quarter of cases (Kessler, Hwang, LaBrie, Petukhova et al. 2008). Haw, Holdsworth and Nisbet (2013) explored the temporality of the comorbidities with problem gamblers in treatment and regular gamblers, using recall and 12 month follow up. They showed different patterns between males and females, and age. Males were more likely to have first onset of problem gambling before onset of depression/anxiety whereas for females it was the reverse. At 12 month follow up anxiety was more likely to precede problem gambling in females. For participants who had problems with alcohol and other drugs, both genders experienced substance abuse before the onset of gambling.

3. Materials and method

The aim of this work was to explore the relationship between comorbidities, as well as social determinants, with gambling problems. The Problem Gambling Severity Index (PGSI) score was used to define the level of gambling problems. A public health approach was applied to the analysis. Rather than treat problem gambling as the only outcome of interest, the analytical technique in this study uses the full range of the PGSI score to explore the relationship between the parameters of interest and the level of gambling problems.

Study design

The study design is a cross sectional observational study using data on all gamblers (n=4,677) from the first year of *The Victorian Gambling Study 2008-2012* (Billi, Stone, Abbott and Yeung 2014). Briefly this Study collected information from a representative sample (n=15,000) of the Victorian adult population (18 years and older) using computer assisted telephone interviewing (CATI) in 2008. Areas with higher electronic gaming machine expenditure were oversampled in order to enrich for participants with higher risk gambling.

Gambling problems measure

The PGSI consists of the nine questions from the Canadian Problem Gambling Index (CPGI) which are scored. The Queensland modification of the PGSI (Queensland Treasury 2001; Billi, Stone, Abbott and Yeung 2014) was used to measure problem gambling. This modification of the item response scale uses five-points (never, rarely, sometimes, often and always) rather than the original four-point scale (never, sometimes, often, almost always). Responses of 'rarely' and 'sometimes' were combined and given a score of 1, so that the range of scores remained from 0 to 27 as in the original PGSI. Cut-points for the total PGSI score were: 0, non-problem gamblers; 1-2, low-risk gamblers; 3-7, moderate-risk gamblers; and ≥8, problem gamblers.

The PGSI score is an indicator of gambling problems. The questions are listed in Appendix One. Gamblers score 0 on the PGSI measure when they respond 'never' to each question in the series of 9 questions on gambling behaviour or consequences of gambling. A higher PGSI score can occur in two ways: a gambler responds to one or more of the questions (more problems) and/or responds more frequently (problems are experienced more often).

Determinants or correlates of gambling problems

The determinants of gambling problems that were studied were those that described the person's socio-demographics, experience of trauma, hardship and problems in life and upbringing, life events over the previous 12 months, individual social capital and comorbidities. Most are indicative of current status or over the previous 12 months so are concurrent with the measure of gambling problems, the PGSI. Measures of area level socio-economic status, the ABS SEIFA, were merged into the database using the postcode of residence which was collected in the first wave of the study.

Analytical technique

The relationship between socio-demographic variables, traumatic experience, life events, social capital items, comorbidities and PGSI score in gamblers was modelled using the negative binomial regression. These analyses were conducted using STATA SE 12 and were unweighted because the model fit statistics could not be applied to weighted data.

The negative binomial was chosen for a number of reasons. Firstly it treats the PGSI score as a count variable in contrast to the usual reduction to four or five PGSI categories using the currently recognised cut-points. It makes use of the information from the full range of the score from 0 to 27 rather than reduction to the usual four categories which provides for a more statistically robust analysis. It is not limited by the low numbers of problem gamblers in the sample. Frequently, because of the low prevalence of problem gamblers, studies combine the problem gamblers with the moderate-risk gamblers to achieve sufficient numbers for a statistically robust analysis of the determinants of problem gambling (Crockford, Quickfall, Currie, Furtado et al. 2008; Afifi, Cox, Martens, Sareen et al. 2010b). These groups are combined, in spite of evidence that indicates moderate-risk and problem gamblers are quite distinct groups and that original cut-points between moderate and low risk are in need of revision (Currie, Hodgins and Casey 2013).

In addition, this technique identified which factors were associated with a higher (or lower) PGSI score and therefore more (or less) gambling problems. The most frequent analytical technique of logistic regression depends on conversion of the PGSI score to categories and then to dichotomous variable of problem gambling (yes/no). This is a more clinical ‘case finding’ method rather than a public health approach which considers the full range of PGSI scores to be a continuum from absence of problems to a high number or frequency of problems. Finally the distribution of the PGSI scores is over-dispersed i.e. the variance is greater than the mean. Use of a Poisson regression, the usual model for count data, would result in standard errors that are biased downwards (Long and Freese 2006). The results are reported as the incidence rate ratios (IRR), the p-value and a form of the Bayesian information criteria (BIC’).

How to interpret the IRR, p-value and the BIC’

We report the incidence rate ratios (IRR) from the negative binomial regression to indicate the **size of the effect**. For example an IRR of 2.0 for gender indicates that the PGSI score increased by a rate of 2 times for males when compared to females. IRRs less than one indicate a decrease in score. For example an IRR of 0.5 indicates that the PGSI score decreased by a rate of 0.5 times (or a half) for females when compared to males

The 95% confidence interval (CI) of the IRR demonstrates the precision of the model estimation at a traditional p-value of 0.05, the narrower the CI the more precise the estimation. The p-value indicates the certainty of the IRR estimation, the likelihood that the estimation is not mere chance.

In these analyses model fit statistics are used to identify the most **important determinants** and the **best models** for each logical group of variables. Model fit was determined using the Bayesian information criteria (BIC) calculated by the *fitstat* (Long and Freese 2000) post-estimation command. Concern has been raised over the use of p-values particularly in large samples (Raftery 1995). Conventionally p-values are set at 0.05, however in large samples a p-value at this level results in many significant associations. Lowering the p-value is recommended but is not totally satisfactory. BIC allows the comparison between models with different samples or non-nested samples and considers uncertainty in measuring the overall fit of a regression model (Raftery, 1995).

There are two versions of Bayesian information criteria, BIC and BIC’. BIC is the value returned when the current model is compared with a baseline model that is fully saturated. Whereas BIC’ is the value returned when the current model is compared with a baseline model that is a null model i.e. it has no variables in it at all. If the BIC’ is positive then the null model is preferred. The more negative the BIC’ the better overall fit the model. The guidelines for the strength of evidence of overall model fit between two models based on a difference in BIC’ are: an absolute difference of 0-2 indicates weak evidence, a difference of 2-6 indicates positive evidence, 6-10 indicates strong and more than 10 indicates very strong evidence (Raftery 1995).

4. Overview of determinants of gambling problems

This section provides an overview of the findings of the analysis conducted on the determinants of gambling problems in gamblers. It uses the evidence from the univariate binomial regression analyses (PGSI score and one determinant) to identify which factors were the most important determinants of gambling problems. Basically the more negative the value of the model fit statistic (BIC') the better the model (and the variables within the model) predicted the PGSI score.

These model fit statistics were particularly useful to guide the complex model development in the next phase of the project. While these model fit statistics were not the only input into model building they did provide a guide to the important determinants. In this study they were remarkably consistent with the relevant literature. The strongest associations were with mental health comorbidities, life events, increasing arguments and general health. Strong associations were seen with substance use/misuse, trauma or hardship, finance and social capital and then obesity and physical health, disability, LOTE, gender, legal and work difficulties.

Over 60 variables were analysed and then formed into 5 groups based on model fit statistics. A table of the fit statistics is included in Appendix Two. Starting with the strongest or best explanatory variables to the weakest, the groups include

1. Kessler 10 score⁴, Kessler 10 categories, anxiety and/or depression, depression, number of life events, anxiety, increase in number of arguments with someone close, self-reported health status, Smoked in past 12 months, (strongest 10 explanatory variables)
2. Current smoking, trauma or hardship, CAGE score, like living in their community, any life event, major change in financial situation, able to get help, number of cigarettes smoked, alcohol use and abuse, CAGE category, (next strongest 10 explanatory variables)
3. Obesity, major injury or illness to either yourself or someone close, disability that affects daily life, number of physical health conditions, LOTE, rating of overall quality of services, facilities and things to do in your community, gender, legal difficulties, troubles with work, boss or superiors, lung conditions including asthma
4. Age/gender 4 categories, marriage or finding a relationship partner, taking on a mortgage, loan or making a big purchase, major change in living or work conditions (e.g. renovations, new job), any other physical or mental health conditions, age, divorce, death of someone close, occupation
5. Any physical health condition, urban/rural residence, pregnancy or new family additions, member of a community group, heart conditions, high blood pressure or high cholesterol, diabetes, retirement, cancer, migration in past 5 years, education, Consumed alcohol in past 12 months, number of dependent children, household type, age group, type of internet, personal income, employment status, SEIFA IRSD, household income, SEIFA IEO, SEIFA IER, EGM spend band (little to no explanatory value).

⁴ The Kessler 10 questions are outlined in Appendix 1.

5. Socio-demographics and PGSI score

This section describes the relationship between socio-demographics and level of gambling problems. Many of the reviews of prevalence studies have identified a variety of socio-demographics are associated with problem gambling.

Age and gender

Consistent with a large body of literature, this study analysis showed that male gender and younger age were associated with more gambling problems (higher PGSI score). Males on average had a 50% higher score than females. Older age groups tended to have from 40% to 83% of the PGSI score that the youngest age group of 18-24 has.

There was no evidence that the gap between male and female problem gambling was narrowing in Victoria. However there has been a major change in the age-group at risk from the 39 to 64 year olds in the 2003 Victorian prevalence study to 18 to 24 year olds in the present study.

Various age and gender variables were explored for their relationship with the PGSI score and the results are reported in Table 1. The statistics in the table show that

- Male gender was associated with an increase in the PGSI score of 1.51 times that of females. The model with gender only was the strongest explanatory variable of the PGSI score amongst the age/gender variable as it had the most negative BIC' value and therefore showed the best fit.
- For each year increase in age the PGSI score was reduced by 0.99 times. This variable was the third best explanatory variable of this group.
- Age group was a poor explanatory variable.
- Age and gender combined and reduced to four categories indicated that compared with younger females, younger males had the highest increase in the PGSI score with older males having a moderate increase in PGSI score and no evidence of a difference for older females. These groupings were chosen because of their different gambling activity habits. Model fit is the second best.

Table 1 Relationship between age and gender and PGSI score

Socio-demographic	Univariate model		
	IRR	p-value	Model BIC'
Male gender	1.51 (1.30,1.75)	0.000	-21.4
Age 2008 in years	0.99 (0.98,0.99)	0.000	-4.8
Age group 2008			18.7
18-24 years	ref		
25-34 years	0.80 (0.56,1.13)	0.208	
35-44 years	0.68 (0.49,0.94)	0.020	
45-54 years	0.74 (0.54,1.02)	0.073	
55-64 years	0.83 (0.60,1.14)	0.266	
65-74 years	0.56 (0.39,0.79)	0.001	
75+ years	0.39 (0.27,0.58)	0.000	
Age and gender reduced to 4 categories			-10.9
Women <45 yrs	ref		
Women 45 plus	1.07 (0.87,1.30)	0.502	
Men <45 years	1.85 (1.46,2.35)	0.000	
Men 45 plus	1.39 (1.13,1.73)	0.002	

Recent migration and speaking a language other than English at home

Being in a minority group or belonging to an immigrant group has been linked with problem gambling although there are cultural differences modify these effects. In the current study there appeared to be a strong protective effect of only speaking English at home. Those who speak only English at home tended to have a lower (by 0.56 times) PGSI score than those who speak a language other than English at home. There was no evidence that migration over the past 5 years was associated with a change in the PGSI score. This was consistent with the 2003 Victorian prevalence study which demonstrated that those whose main language at home was not English were more at risk of problem gambling.

Many studies have shown that being part of a minority or an immigrant group were more at risk of problem gambling, although this was not always so. Other studies have also shown that these associations may be vary due to cultural factors. Victoria has had many waves of migration since settlement from many different areas of the globe, however the links between migration and gambling have not changed over time.

Table 2 Relationship between migration and LOTE and PGSI score

Immigrant factors	Univariate model		
	IRR	p-value	Model BIC'
Migration in last 5 years	1.06 (0.67,1.68)	0.781	8.4
Not speaking LOTE at home	0.56 (0.46,0.68)	0.000	-26.7

Household factors

Single parent or one person households have been linked with problem gambling. There was no evidence to support an association between number of dependent children, household type or internet access type and gambling problems. The model fit statistics indicated that including any of these parameters in the analysis did not improve the statistical model. The earlier 2003 Victorian prevalence study found higher rates of problem gambling in one parent households.

Table 3 Relationship between various household factors and PGSI score

Household factors	Univariate model		
	IRR	p-value	Model BIC'
Number of dependent children			16.3
no children	ref		
One child	1.00 (0.80,1.26)	0.957	
Two children	0.65 (0.53,0.80)	0.000	
Three children	0.91 (0.69,1.20)	0.532	
Four or more	1.17 (0.72,1.89)	0.521	
internet2008			19.2
no internet	ref		
broadband	0.73 (0.61,0.86)	0.000	
dialup	0.77 (0.57,1.03)	0.088	
other connection	0.44 (0.12,1.53)	0.197	
DK/Refused	0.70 (0.46,1.07)	0.107	
housetype2008			18.5

Couple with children	ref		
One parent family	1.41 (1.08,1.85)	0.011	
Other family type	1.80 (1.21,2.70)	0.004	
Couple without children	1.06 (0.88,1.28)	0.487	
Group household	2.53 (1.60,4.00)	0.000	
Lone person household	1.29 (1.05,1.58)	0.014	
Other Household /DK/refused	1.66 (0.61,4.49)	0.311	

Education and work

Low educational achievement, unemployment, some occupations, low household income or personal income have been reported to be associated with problem gambling. In this study an educational achievement of year 10 or less (by 1.72 times) or completed year 12 (by 1.55 times) increased the PGSI score compared to being educated at post graduate level however model fit statistics suggest that education has poor explanatory power. These results are consistent with the 2003 Victorian prevalence study and a large number of other Australian studies (Davidson and Rodgers 2009; Department of Justice and Attorney-General 2012; Sproston, Hing and Palankay 2012; Office for Problem Gambling 2013).

There was no evidence of an association between PGSI score and employment. These findings are in contrast to the 2003 Victorian prevalence study and a number of other studies which demonstrated a link with unemployment.

When compared with the PGSI score of managers, the PGSI score is increased for community and personal service worker (by 1.88 times), sales worker (by 1.70 times), machinery operators and drivers (by 2.56 times) and labourers (by 2.36). These results are consistent with the 2010 British prevalence survey (Wardle, Moody, Spence, Orford et al. 2010).

Table 4 Relationship between education, employment and occupation, and PGSI score

	Univariate model		
Socio-demographic	IRR(CI)	P-value	Model BIC'
Education			12.7
Post-graduate degree	ref		
Bachelor's degree	1.04 (0.75,1.42)	0.828	
Advanced diploma/diploma/certificate/TAFE	1.26 (0.93,1.70)	0.144	
Completed year 12	1.55 (1.15,2.10)	0.004	
Schooling year 10 or less	1.72 (1.29,2.28)	0.000	
Don't know or refused	1.32 (0.67,2.57)	0.419	
Employment2008			26.5
Employed F/T	ref		
Employed P/T	0.95 (0.78,1.15)	0.621	
Unemployed looking for work	1.41 (0.90,2.20)	0.130	
Not in labour force	0.99 (0.84,1.17)	0.963	
DK/Refused	0.00 (0,,)	0.992	
Occupation2008			-0.4
Manager	ref		
Professional	1.05 (0.74,1.50)	0.753	
Technicians and trades workers	1.01 (0.69,1.48)	0.946	
Community and personal service worker	1.88 (1.29,2.73)	0.001	
Clerical and administrative worker	0.95 (0.57,1.58)	0.855	
Sales worker	1.70 (1.25,2.31)	0.001	

	Univariate model		
Socio-demographic	IRR(CI)	P-value	Model BIC'
Machinery operators and drivers	2.56 (1.69,3.88)	0.000	
Labourers	2.36 (1.62,3.43)	0.000	
DK/refused	4.70 (2.10,10.4)	0.000	

Income

Low household or personal income has been shown to be associated with problem gambling. In this study, personal and household incomes demonstrated poor explanatory power. The model fit statistics suggested that these parameters were poor explanatory variables of gambling problems. The findings from the income data should be treated with caution. As is often the case with economic data there was a high proportion of missing values.

Table 5 Relationship between income and PGSI score

	Univariate model		
SD - income	IRR (CI)	P-value	BIC'
Household income			44.1
Negative/nil income	ref		
\$1–\$499	1.32 (0.53,3.29)	0.546	
\$500–\$799	1.40 (0.56,3.52)	0.468	
\$800–\$1199	1.36 (0.55,3.39)	0.499	
\$1200–\$1699	1.18 (0.47,2.95)	0.709	
\$1700–\$2499	0.91 (0.36,2.28)	0.852	
\$2500 plus	0.92 (0.36,2.31)	0.862	
DK/Refused	1.22 (0.50,3.01)	0.654	
Personal income			21.4
Negative/nil income	ref		
\$1–\$249	1.24 (0.84,1.81)	0.269	
\$250–\$399	1.57 (1.09,2.24)	0.013	
\$400–\$599	1.24 (0.85,1.81)	0.247	
\$600–\$799	1.34 (0.91,1.98)	0.130	
\$800–\$999	1.81 (1.24,2.63)	0.002	
\$1,000–\$299	1.24 (0.84,1.83)	0.266	
\$1,300 plus	0.71 (0.49,1.03)	0.076	
DK/Refused	1.02 (0.74,1.42)	0.862	

Local area of residence

Problem gambling is often associated with where people live. A number of factors contribute to this association. Firstly accessibility to gambling venues is linked with problem gambling. The density of gambling venue is frequently higher in lower socioeconomic areas. Secondly many people living in disadvantaged areas are more vulnerable to developing gambling problems. Some of this is mediated via the more difficult experiences of people living in these areas such as history of trauma. In this study while the effects show a significant p-value, the model statistic suggests that these area level determinants are poor explanatory variables of gambling problems.

Metropolitan and rural and regional areas

Living in urban areas is often reported as linked to gambling problems. In this study, living in metropolitan areas of Victoria was associated with an increase (by 1.23 times) in PGSI score compared with the rural/regional areas of Victoria. These findings are consistent with the 2003 Victorian prevalence study. However model fit statistics indicate that this parameter was a poor explanatory variable of gambling problems.

Table 6 Relationship between metropolitan and rural/regional residence and PGSI score

	Univariate model		
Socio-demographic	IRR	p-value	Model BIC'
Metropolitan residence	1.23 (1.04,1.45)	0.014	2.6

Electronic gaming machine expenditure (EGM) areas

Gambling problems are associated with proximity to gambling venues. People living in areas that have high EGM expenditure tended to have 2 to 3 times higher PGSI scores than the Eastern region low-spend areas. Eastern region is Victoria's most affluent region. Compared with the Eastern low spend LGAs all regional high spend areas (except the Grampians, and three medium spend areas, Loddon Mallee, North & Western and Southern), were associated with an increase in the PGSI score. However model fit statistics indicate that this parameter was a poor explanatory variable of gambling problems.

Table 7 Relationship between high, medium and low EGM spend areas and PGSI score

		Univariate model		
		IRR (CI)	p-value	BIC'
Region EGM spend				132.8
Barwon south west	high	2.21 (1.14,4.29)	0.018	
Barwon south west	low	1.86 (0.57,5.99)	0.299	
Barwon south west	medium	0.95 (0.35,2.52)	0.924	
Eastern	high	1.98 (1.06,3.67)	0.030	
Eastern	low	ref		
Eastern	medium	1.39 (0.66,2.93)	0.374	
Gippsland	high	2.01 (1.00,4.03)	0.048	
Gippsland	medium	1.29 (0.51,3.27)	0.583	
Grampians	high	1.60 (0.77,3.35)	0.205	
Grampians	low	2.23 (0.70,7.06)	0.172	
Grampians	medium	2.26 (0.83,6.16)	0.110	
Hume	high	2.31 (1.15,4.60)	0.017	
Hume	low	1.83 (0.58,5.73)	0.295	
Hume	medium	1.93 (0.79,4.72)	0.146	
Loddon-Mallee	high	2.25 (1.13,4.45)	0.020	
Loddon-Mallee	low	1.69 (0.58,4.91)	0.335	
Loddon-Mallee	medium	2.43 (1.03,5.75)	0.042	
North-west	high	3.11 (1.70,5.69)	0.000	
North-west	low	1.79 (0.87,3.65)	0.108	
North-west	medium	2.93 (1.54,5.55)	0.001	

		Univariate model		
		IRR (CI)	p-value	BIC'
Southern	high	2.28 (1.24,4.19)	0.007	
Southern	low	1.31 (0.58,2.93)	0.506	
Southern	medium	3.39 (1.75,6.54)	0.000	

ABS Socio-Economic Index For Areas (SEIFA) categories

Problem gambling is linked with area level low socio-economic status. In Australia the ABS has developed 4 measures of area level socio-economic status. This study grouped the SEIFA values into 10 groups or deciles. The first decile consists of Victorian postcodes with the 10th lowest values for the SEIFA variable. The 10th decile consists of the 10th highest values for the SEIFA variables. There are four different indices: Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD); Index of Relative Socio-Economic Disadvantage (IRSD); Index of Economic Resources (IER); and Index of Education and Occupation (IEO).

Consistent with the literature those living in high socioeconomic areas of Victoria tended to have a decreased level of gambling problems compared with those in the lowest SEIFA decile. Living in LGAs that have SEIFA values in the highest three deciles tended to have a protective or a decreased PGSI score when compared to the lowest decile. This effect was different for the Index of Education and Occupation (IEO). The protective effect was evident in the highest 6 deciles of IEO compared to the lowest decile. However model fit statistics indicate that these parameters were poor explanatory variables of gambling problems.

Table 8 Relationship between ABS SEIFA decile for Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD) and PGSI score

	Univariate model		
	IRR (CI)	p-value	Model BIC'
IRSAD decile vic			61.3
1	ref		
2	0.79 (0.53,1.17)	0.244	
3	0.77 (0.52,1.15)	0.208	
4	0.79 (0.51,1.23)	0.309	
5	0.93 (0.64,1.34)	0.712	
6	0.76 (0.51,1.15)	0.207	
7	0.76 (0.54,1.07)	0.120	
8	0.59 (0.42,0.82)	0.002	
9	0.69 (0.49,0.97)	0.032	
10	0.54 (0.38,0.77)	0.001	
9999	0.19 (0.01,3.18)	0.249	

Table 9 Relationship between ABS SEIFA decile for Index of Relative Socio-Economic Disadvantage and PGSI score

	Univariate model		
Socio-demographic	IRR	p-value	Model BIC'
IRSD decile vic			42.4
1	ref		
2	0.79 (0.57,1.09)	0.161	
3	0.94 (0.67,1.33)	0.764	
4	0.81 (0.59,1.11)	0.192	
5	0.63 (0.45,0.87)	0.005	
6	0.82 (0.59,1.14)	0.251	
7	0.78 (0.57,1.06)	0.124	
8	0.53 (0.40,0.71)	0.000	
9	0.63 (0.48,0.84)	0.002	
10	0.44 (0.32,0.61)	0.000	
9999	0.18 (0.01,3.09)	0.243	

Table 10 Relationship between ABS SEIFA decile for IER and PGSI score

	Univariate model		
Socio-demographic	IRR	p-value	Model BIC'
IER decile vic			51.5
1	ref		
2	0.85 (0.63,1.15)	0.303	
3	0.61 (0.44,0.86)	0.005	
4	0.74 (0.55,1.01)	0.062	
5	0.87 (0.63,1.20)	0.427	
6	0.76 (0.56,1.04)	0.090	
7	0.82 (0.60,1.11)	0.202	
8	0.65 (0.49,0.86)	0.003	
9	0.53 (0.40,0.71)	0.000	
10	0.52 (0.39,0.71)	0.000	
9999	0.19 (0.01,3.19)	0.252	

Table 11 Relationship between ABS SEIFA decile for IEO and PGSI score

Socio-demographic	Univariate model		
	IRR	p-value	Model BIC'
IEO decile vic			50.5
1	ref		
2	0.89 (0.65,1.21)	0.469	
3	0.71 (0.51,0.99)	0.047	
4	0.79 (0.57,1.10)	0.177	
5	0.55 (0.40,0.74)	0.000	
6	0.62 (0.43,0.90)	0.013	
7	0.51 (0.36,0.72)	0.000	
8	0.70 (0.51,0.95)	0.026	
9	0.54 (0.40,0.73)	0.000	
10	0.70 (0.51,0.95)	0.023	
9999	0.18 (0.01,3.02)	0.236	

6. Trauma and life events

Respondents were asked ‘thinking of your personal background, would you say you are someone who has had 1) no really major problems, hardships and traumas in your life or upbringing or 2) a lot of trauma, hardship and problems in their life or upbringing?’

Respondents were also asked to consider ‘things that happened in your life during the past 12mths. Which of the following life events did you experience in the past 12mths?’ A list of the specified life events are provided in Appendix One.

Current and past traumatic experiences and life events have been shown to be linked with gambling problems. Problem gamblers in treatment have a higher prevalence of trauma. Trauma and stress are also linked with comorbid disorders. The effects of trauma and stress are thought to be moderated by coping skills and/or social supports. Gambling problems are associated with life events such as legal difficulties, financial problems, work-related issues and relationship problems.

In this study, exploration of trauma and life events to explain the PGSI score showed that trauma and all life events are associated with PGSI scores except for retirement and pregnancy or new family additions. In order of strength of the association, the PGSI score was increased by 1.29 (1.24, 1.35) times for each increase in number of life events; by 3.46 (2.73, 4.39) times for an ‘Increase in the number of arguments with someone you are close to’; by 2.16 (1.84, 2.54) times for ‘Trauma, hardship and problems in life’; by 2.02 (1.72, 2.37) times for any life event; by 2.04 (1.70, 2.45) times for ‘Major change to your financial situation’; by 1.77 (1.49, 2.09) times for ‘Major injury or illness to either yourself or someone close to you’; by 2.18 (1.58, 3.01) times for ‘Legal difficulties’; by 1.80 (1.41, 2.30) times for ‘Troubles with your work, boss, or superiors’; by 1.44 (1.19, 1.73) times for ‘Major change in living or work conditions (e.g. renovations, new job)’; by 1.32 (1.12, 1.55) times for ‘Death of someone close to you’; by 1.98 (1.32, 2.99) times for ‘Divorce’; by 1.75 (1.32, 2.33) times for ‘Marriage or finding a relationship partner’; by 1.50 (1.22, 1.86) times for ‘Taking on a mortgage, loan or making a big purchase’. Model fit statistics indicate that ‘Retirement’ or ‘Pregnancy or new family additions’ showed poor explanatory value in predicting gambling problems.

Table 12 Relationship between PGSI score and of trauma and life events

Trauma and life events	IRR (CI)	p-value	BIC'
Trauma, hardship and problems in life	2.16 (1.84,2.54)	0.000	-75.4
1. Death of someone close to you	1.32 (1.12,1.55)	0.001	-3.3
2. Divorce	1.98 (1.32,2.99)	0.001	-4.2
3. Legal difficulties	2.18 (1.58,3.01)	0.000	-17.9
4. Major injury or illness to either yourself or someone close to you	1.77 (1.49,2.09)	0.000	-38.4
5. Marriage or finding a relationship partner	1.75 (1.32,2.33)	0.000	-8.3
6. Troubles with your work, boss, or superiors	1.80 (1.41,2.30)	0.000	-16.4
7. Retirement	1.25 (0.91,1.73)	0.164	6.4
8. Pregnancy or new family additions	1.31 (1.04,1.65)	0.022	2.9
9. Major change to your financial situation	2.04 (1.70,2.45)	0.000	-55.9
10. Taking on a mortgage, loan or making a big purchase	1.50 (1.22,1.86)	0.000	-7.0
11. Increase in the number of arguments with someone you are close to	3.46 (2.73,4.39)	0.000	-121.2

Trauma and life events	IRR (CI)	p-value	BIC'
12. Major change in living or work conditions (e.g. renovations, new job)	1.44 (1.19,1.73)	0.000	-6.9
Any life event (1 to 12)	1.99 (1.70,2.34)	0.000	-58.3
Number of life events	1.29 (1.24,1.35)	0.000	-133.8

7. Social capital

Respondents were asked four social capital questions in the first wave. The questions and how they were scored are described in appendix One. Basically they were asked

1. Can you get help from friends, family or neighbours when you need it?
2. Are you a member of an organised group such as a sports or church group or another community group including those over the internet?
3. Do you like living in your community?
4. How would you rate the overall quality of services, facilities and “things to do” in your community?

Gambling problems are associated with low social capital, isolation and loneliness. Social capital and social supports can moderate the effects of trauma and stress, comorbidities and decrease the likelihood of relapse from addictive disorders and gambling problems in the treatment setting.

In this study, exploration of social capital showed that low social capital was associated with increased PGSI scores (gambling problems). Being a member of an organised group was a poor explanatory variable of PGSI score. In order of strength of the association, the PGSI score was

- increased by 2.09 (1.64, 2.65) times, 3.65 (2.14, 6.24) times and 3.82 (2.33, 6.27) times when response to ‘like living in the community’ varies from ‘sometimes’ to ‘no – not at all’ to ‘no feeling about it’ when compared to ‘definitely’;
- increased by 1.72 (1.33, 2.21) times and 3.67 (2.56, 5.26) times when response to ‘able to get help’ varies from ‘sometimes’ to ‘no’ when compared with ‘yes’;
- decreased by 0.45 (0.27, 0.73) times and 0.40 (0.24, 0.65) times when response to ‘overall rating of community services’ varies from ‘good’ and ‘very good’ when compared with ‘very poor’;

Table 13 Relationship between PGSI score and social capital

	Univariate model		
Social capital measure	IRR (CI)	p-value	BIC'
Able to get help from family, friends and neighbours			
			-54.3
yes	ref		
sometimes	1.72 (1.33, 2.21)	0.000	
No	3.67 (2.56, 5.26)	0.000	
DK/Refused	1.31 (0.37, 4.59)	0.671	
Member of an organised group			
			3.2
No	ref		
Yes	0.76 (0.66, 0.88)	0.000	
DK/Refused	2.11 (0.26, 17.20)	0.488	
Like living in their community			
			-63.1
definitely	ref		
sometimes	2.09 (1.64, 2.65)	0.000	
no - not at all	3.65 (2.14, 6.24)	0.000	
no feeling about it	3.82 (2.33, 6.27)	0.000	

	Univariate model		
Social capital measure	IRR (CI)	p-value	BIC'
DK/Refused	1.21 (0.24,6.17)	0.815	
Rating of community services			
			-22.4
Very poor	ref		
poor	0.99 (0.56,1.73)	0.960	
ok	0.70 (0.42,1.16)	0.163	
good	0.45 (0.27,0.73)	0.001	
very good	0.40 (0.24,0.65)	0.000	
DK/Refused	0.63 (0.32,1.25)	0.185	

8. Comorbidities

There is a large body of literature that shows the relationship between gambling problems and comorbidities or co-occurrence of other conditions. Shaffer and Korn (2002) suggest this occurs in many ways: both disorders are independent of each other; one disorder protecting against the other; one disorder causing the other; or both disorders sharing a common cause or being components of a more complex set of symptoms (Shaffer and Korn 2002). The literature supports these multiple pathways of the co-occurrence of conditions. Mental health conditions as well as substance use/abuse are frequently reported as co-occurring with gambling problems. Physical health problems have also been reported to co-occur in problem gamblers.

Smoking and alcohol use

Gambling problems are associated with smoking and alcohol use/misuse. Exploration of the **smoking and alcohol use** of gamblers to explain the PGSI score showed that past year smoking, current smoking, number of cigarettes smoked, CAGE score and alcohol use and abuse were associated with higher PGSI score. The results of the univariate regressions on the measure of smoking or alcohol use are shown in Table 14.

Past year smoking was associated with a 2.33 (1.99, 2.73) times higher PGSI score than non-smoking. Current smoking was associated with a 2.37 (2.00, 2.81) times higher PGSI score than non-current smoking. For each increase in the cigarettes smoked the associated increase in PGSI score was 1.22 (1.15, 1.28) times.

Each unit increase in the CAGE score was associated with a 1.45 (1.33, 1.60) times increase in PGSI score. Compared to alcohol non-drinkers, those with signs of alcohol abuse or dependence tended to have a PGSI increased by 1.79 (1.35, 2.37) times whereas those with no sign of alcohol abuse, tended to have a lower PGSI score by 0.71 (0.59, 0.86) than non-drinkers.

Table 14 Relationship between smoking, alcohol and drug use, and PGSI score

	Univariate models		
	IRR (CI)	p-value	BIC'
Past year smoking	2.33 (1.99,2.73)	0.000	-107.6
Current smokers	2.37 (2.00,2.81)	0.000	-91.4
Number of cigarettes	1.22 (1.15,1.28)	0.000	-53.5
CAGE score	1.45 (1.33,1.60)	0.000	-66.4
Alcohol use and abuse			-51.2
Non-drinker	ref		
No signs of alcohol abuse	0.71 (0.59,0.86)	0.001	
Alcohol abuse or dependence	1.79 (1.35,2.37)	0.000	

Physical and mental health conditions

Problem gambling has been shown to be associated with mainly mental health issues as well as physical health conditions. In this study, exploration of physical and/or mental health conditions to explain the PGSI score showed that many measures of physical and/or mental health are associated with PGSI scores.

Physical health conditions

The strongest association was seen with self-reported health status and the effect on PGSI score increased as the reported health worsened. Compared with those who reported their health as 'excellent', the PGSI score increased by 1.66 (1.35, 2.04) times for those reporting 'good' health; by 2.53 (1.98, 3.24) times for those reporting only 'fair' health and by 3.75 (2.72, 5.16) times who reported their health as poor. Each unit increase in number of physical health conditions was associated with an increase in the PGSI score of 1.31 (1.20, 1.42) times. Increases in PGSI score for other conditions includes by 2.11 (1.68, 2.64) times for obesity, by 1.70 (1.36, 2.12) times for lung conditions including asthma. According to the model fit statistics, presence of current cardiac conditions (heart conditions, high blood pressure or high cholesterol), diabetes or cancer had little to no explanatory power for the level of gambling problems.

Mental health conditions

Many of the mental health measures are the strongest of all the comorbidities and social determinants factors investigated in this study. The strongest associations were seen, in order of strength of association: The Kessler 10, reporting depression or anxiety, depression only or anxiety only. The increases in PGSI score associated with each unit increase in Kessler 10 score were by 1.12 (1.10, 1.13) times, and for each increase in mental health conditions, by 2.18 (1.93, 2.45). Increases in PGSI score for those reporting depression were 3.53 (2.91, 4.31) times and for anxiety were 3.35 (2.69, 4.17).

Physical and/or mental health conditions

Increases in PGSI score for those reporting other physical or mental health conditions were 1.47 (1.20, 1.80) and for Disability that affected your day-to-day life were 1.91 (1.56, 2.32).

Table 15 Relationship between PGSI score and physical and mental health conditions

	Univariate model		
	IRR (CI)	p-value	Model BIC'
Physical Health conditions			
Self-reported health status			
			-114.6
Excellent	ref		
Very good	0.96 (0.78,1.18)	0.718	
Good	1.66 (1.35,2.04)	0.000	
Fair	2.53 (1.98,3.24)	0.000	
Poor	3.75 (2.72,5.16)	0.000	
1. Heart conditions, high blood pressure or high cholesterol			
Yes	1.18 (1.01,1.39)	0.035	3.9
2. Diabetes			
Yes	1.33 (0.99,1.78)	0.056	4.6
3. Cancer			
Yes	1.18 (0.76,1.82)	0.455	7.9
4. Lung conditions including asthma			
Yes	1.70 (1.36,2.12)	0.000	-15.8
7. Obesity			
Yes	2.11 (1.68,2.64)	0.000	-38.9

	Univariate model		
	IRR (CI)	p-value	Model BIC'
Physical Health conditions			
Physical health condition (1,2,3,4 or 7) count			
Count	1.31 (1.20,1.42)	0.000	-33.3
Mental health			
Kessler 10 score	1.12 (1.10,1.13)	0.000	-360.8
Kessler 10 type			
Low distress	ref		-246.5
Moderate distress	2.92 (2.21,3.87)	0.000	
High distress	4.80 (3.30,6.99)	0.000	
Very high distress	7.61 (5.16,11.2)	0.000	
5. Depression	3.53 (2.91,4.31)	0.000	-174.6
6. Anxiety disorders	3.35 (2.69,4.17)	0.000	-131.8
Mental health condition (5 or 6) count	2.18 (1.93,2.45)	0.000	-194.3
Mixed physical and mental health			
8. Any other physical or mental health conditions	1.47 (1.20,1.80)	0.000	-6.5
Disability that affected your day-to-day life	1.91 (1.56,2.32)	0.000	-36.6

9. Conclusion and next steps

The focus of this paper was to explore the relationship between the PGSI score and the social determinants and comorbidities in gamblers. The purpose was to investigate a range of possible determinants (for example socio-demographics, physical and mental health, smoking and alcohol use, trauma, life events and social capital) to indicate which showed the strongest association with increased gambling problems as defined by an increase in PGSI score. The analysis is underpinned by a public health approach which views problem gambling as part of a gambling continuum and explores the broader personal, social, economic and environmental as well as biological determinants of gambling problems.

This report has very purposely provided a section on an overview of the determinants of gambling problems. This section goes beyond describing an association but indicates different levels of strength of association between social determinants, comorbidities and gambling problems. This is rarely done and is often lost in the detailed statistics of the appendix. The purpose is to tease out the determinants that best explain the variation in the PGSI score. This study is cross-sectional in nature and therefore there is no indication of the cause or effect, but rather a co-occurrence of these determinants with a higher PGSI score. Mental health measures showed the strongest association with gambling problems, along with substance use/abuse, trauma and life events. Obesity, some physical health conditions, speaking only English at home, gender and some measures of social capital demonstrated low to moderate associations.

In the existing literature many socio-demographic determinants have been linked with problem gambling. An important finding of this secondary analysis of *The Victorian Gambling Study*, is that many of the socio-demographics parameters were poorly associated with an increase or decrease in gambling problems. Speaking only the English language at home was the strongest explanatory variable in the socio-demographic category and it was protective. This is consistent with the 2003 Victorian prevalence study which also found that a response of main language at home not being English was a risk factor for problem gambling. The finding in our secondary analysis of young age, male gender and occupation being determinants are consistent with well recognised risk factors in the literature. The rest of the socio-demographic determinants while many show significant p-values, did not demonstrate good model fit.

Current and past trauma, stress and life events are linked with gambling problems in the literature. In this study some of the measures showed the strongest associations; in particular, 'increase in arguments with someone close', trauma and hardship over life or upbringing, any life event, major change in financial situation, legal difficulties and troubles with work, boss or superiors.

Social capital and social supports are associated with gambling problems in the literature. Low social capital is a risk factor and high social capital is protective. In this study they showed strong association with gambling problems. Those who liked living in their community, were able to get help and rated their services, facilities and things to do as good or very good tended to have reduced gambling problems than those who did not.

In the literature, the prevalence of mental health conditions, substance use/abuse and poor self-reported are high in problem gamblers. In this study they were amongst the strongest associations with increased gambling problems. Obesity and a disability affecting daily life were also associated with increase in gambling problems.

The findings from this report provide the basis for additional more detailed analysis. Many of the determinants were inter-related. It is important to understand which determinants are the key factors that are associated with gambling problems. The intention is to develop a series of multivariate models that better explore the relationship between gambling problems and each grouping of social

determinants and comorbid conditions. Driven by a combination of theory and statistical tests models will be developed to explore the relationship between gambling problems and:

1. Social determinants
2. Trauma/life events model
3. Social capital
4. Trauma/life events/social capital
5. Comorbidities

It is envisaged that the models will then be combined into a final summary model.

Appendix One: Wording of relevant CATI questions

This appendix contains the wording of relevant CATI questions

Problem Gambling Severity Index questions and scores

The questionnaire states - Using ratings of Never (score of 0), Rarely/Sometimes (score of 1), Often (score of 2) and Always (score of 3), defining items of the CPGSI ask an individual to think about the past year and rate

'How often you have':

1. *Needed to gamble with larger amounts of money to get the same feeling of excitement?*
2. *Bet more than you could really afford to lose?*
3. *Gone back another day to try to win back the money you lost?*
4. *Borrowed money or sold anything to get money to gamble?*
5. *Felt that you might have a problem with gambling?*
6. *Felt guilty about the way you gamble, or what happens when you gamble?*
7. *Has your gambling caused any financial problems for you or your household?*
8. *Had people criticize your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?*
9. *Has your gambling caused you any health problems, including stress or anxiety?*

The Kessler 10 questions and scores

The question asks for each of the items - 'During the past 4wks, about how often did you feel...?' None of the time (score of 1); A little of the time (2); Some of the time (3); Most of the time (4) and All of the time (5).

During the past four weeks, how often have you felt

1. *Tired out for no good reason*
2. *Nervous*
3. *So nervous that nothing could calm you down*
4. *Hopeless*
5. *Restless or fidgety*
6. *So restless that you could not sit still*
7. *Depressed*
8. *That everything was an effort*

9. *So sad that nothing could cheer you up*

10. *Worthless*

Trauma and life events questions

Respondents were asked ‘thinking of your personal background, would you say you are someone who has had 1) no really major problems, hardships and traumas in your life or upbringing or 2) a lot of trauma, hardship and problems in their life or upbringing?’

Respondents were also asked to consider ‘things that happened in your life during the past 12mths. Which of the following life events did you experience in the past 12mths?’

1. Death of someone close to you
2. Divorce
3. Legal difficulties
4. Major injury or illness to either yourself or someone close to you
5. Marriage or finding a relationship partner
6. Troubles with your work, boss, or superiors
7. Retirement
8. Pregnancy or new family additions
9. Major change to your financial situation
10. Taking on a mortgage, loan or making a big purchase
11. Increase in the number of arguments with someone you are close to
12. Major change in living or work conditions (e.g. renovations, new job)

Social capital questions and scores

Respondents were asked four social capital questions in the first wave. They were asked how they felt about the community they lived in:

1. Can you get help from friends, family or neighbours when you need it? (Score 1. Yes definitely; 2. Sometimes; 3. Not at all; 98. Don't know; 99. Refused)
2. Are you a member of an organised group such as a sports or church group or another community group including those over the internet? (Score 1. Yes; 2. No; Don't know; 99. Refused)
3. Do you like living in your community? (score 1. Definitely; 2. Sometimes; 3. No - Not at all; 4. No feeling about it; 98. Don't know; 99. Refused)
4. How would you rate the overall quality of services, facilities and “things to do” in your community? (Score 1. Very poor; 2. Poor; 3. OK; 4. Good; 5. Very good; 98. DK; 99. Refused)

Appendix Two: Order of importance of determinants based on model fit statistics

This table provides a summary of the univariate analysis of the PGSI score and social determinants and comorbidities using a negative binomial regression. Only the model fit statistic (BIC') and the order of importance based on the BIC' are reported in this table. For example the measure of psychological distress, Kessler 10 score, has the most negative value for the BIC' and therefore is the most significant variable. It is labelled number 1. The IRR and the p-value are reported in the tables throughout the document. These statistics show how a characteristic is associated with the PGSI score and if there are significant differences between different characteristics of a variable. For example, when the effects of gender are analysed, the characteristic of being male is associated with a higher PGSI score when compared with the characteristic of being female, and these differences are significant.

Table 16 Social determinants and comorbidities, BIC' and the order of importance

Variable	BIC'	Order of importance
Socio-demographics/SES		
Gender	- 21	27
Age	- 4.8	36
Age group	19	54
Age_gen4	- 11	31
Age_gen12	42	58
Migration in past 5 years	8.4	48
LOTE	- 27	25
No of dependent children	16	52
Internet	19	55
Household type	18	53
Education	13	50
Employment status	27	57
Occupation	- 0.4	39
Occu2008	11	49
Household income	44	60
Personal income	21	56
Spendband	133	64
SEIFA (socioeconomic advantage and disadvantage) ABS	61	63
SEIFA (socioeconomic disadvantage) ABS	42	59
SEIFA (economic resources) ABS	52	62
SEIFA (education and occupation) ABS	51	61
Metro	2.6	41
Comorbidities		
Smoking		

Variable	BIC'	Order of importance
Smoked - past 12 months	- 108	10
Currently smoke	- 91	11
No of cigarettes currently smoked/day	- 54	18
Alcohol		
Consumed alcohol in the past 12 months	13	51
CAGE score	- 66	13
CAGE category	- 42	20
Alcohol use and abuse	- 51	19
Health conditions		
Self-reported health status	- 115	9
1. Heart conditions, high blood pressure or high cholesterol	3.9	44
2. Diabetes	4.6	45
3. Cancer	7.9	47
4. Lung conditions including asthma	- 16	30
5. Depression	- 175	5
6. Anxiety disorders	- 132	7
7. Obesity	- 39	21
8. Any other physical or mental health conditions	- 6.4	35
Physical health condition (1,2,3,4 or 7) cat	0.2	40
Physical health condition (1,2,3,4 or 7) count	- 33	24
Mental health condition (% or 6) cat	- 185	4
Mental health condition (% or 6) count	- 194	3
Disability that affected your day-to-day life	- 37	23
Psychological distress (K10) score	- 361	1
Psychological distress (K10) cats	- 246	2
Life events and trauma		
Trauma, hardship and problems in life	- 75	12
Life events experienced		
1. Death of someone close to you	- 3.3	38
2. Divorce	- 4.2	37
3. Legal difficulties	- 18	28
4. Major injury or illness to either yourself or someone close to you	- 38	22
5. Marriage or finding a relationship partner	- 8.3	32
6. Troubles with your work, boss, or superiors	- 16	29
7. Retirement	6.4	46
8. Pregnancy or new family additions	2.9	42
9. Major change to your financial situation	- 56	16

Variable	BIC'	Order of importance
10. Taking on a mortgage, loan or making a big purchase	- 7.0	33
11. Increase in the number of arguments with someone you are close to	- 121	8
12. Major change in living or work conditions (e.g. renovations, new job)	- 6.9	34
Any life event (1 to 12)	- 58	15
No of life events	- 134	6
Social capital		
Ability to get help	- 54	17
Member of community group	3.2	43
Do you like living in your community?	- 63	14
Rate the overall quality of services, facilities and 'things to do' in your community	- 22	26

Colour coding

Palest green – top ten determinants

Pale green – next 11 -20

Moderate green – next 21-30

Dark green – next 31 to 39

Pale pink – determinants that show no improvement over the null model

Appendix Three: Glossary

This appendix provides a glossary of the key terms in the document.

ABS

Australian Bureau of Statistics

Alcohol use and abuse

An alcohol use and abuse variable was derived by combining the alcohol over previous twelve months and the CAGE questions. This produced a variable consisting of three categories: No alcohol use over previous twelve months; alcohol use and no signs of abuse; and alcohol use with signs of abuse or dependence. See *CAGE*.

Association

Association refers to the statistical dependence between two variables, that is, the degree to which the rate of disease in persons with a specific exposure is either higher or lower than the rate of disease among those without that exposure. (Hennekens, Buring and Mayrent 1987) In statistical analysis, association is measured by correlation coefficient. See *correlate*.

BIC (Bayesian Information Criterion)

A model fit statistics using saturated model as a point of comparison. See *saturated model* and *model fit statistics*.

BIC'

An alternative form of Bayesian Information Criterion using null model with no independent variables as a point of comparison. See *null model* and *model fit statistics*.

BMI (Body Mass Index)

It is defined as the body mass divided by the square of the body height and is expressed in units of kg/m². The BMI is usually use as an indicator of obesity or anorexia in population research.

CAGE

A brief screening tool for alcohol use and disorder. It measures patterns of drinking that results in harm to one's health, relationship problems or inability to perform work functions. See *Alcohol use and abuse*.

Case finding

Case finding in this document refers to the tendency to concentrate on the small number of 'cases' of problem gambling and ignore the impact of the large number of gamblers with lower levels of problems.

CATI (Computer Assisted Telephone Interviews)

CATI is a telephone surveying tool where telephone interviews are supported by a computer application. The interviewers follow a script promoted by an application and input the responses obtained into the application.

Cohort

A group of persons followed or traced over time.

Comorbidity

Condition(s) or disease(s) that exist in a study participant in addition to the index condition that is the subject of study (i.e. gambling). (Last 2001)

Confidence interval (CI)

A computed interval with a given probability (usually 95%) that the true value of the variable of interest (e.g. a mean, proportion or rate) is contained within that interval.

Confounders or confounding variables

A variable that can cause or prevent the outcome of interest, is not an intermediate variable and is associated with the factor under investigation (Last 2001).

Correlate

Two variables (for example, variable x and variable y) are correlated or associated when the two variables change according to each other. Negative correlation means x decreases when y increase and a positive correlation means x increase when y increase. A correlation coefficient (r) ranges from -1 to 1. While $r = 0$ indicates no correlation, $r = -1$ indicates perfect negative correlation and $r = 1$ indicates perfect positive correlation. Note that correlation detected in observed data can be a completely random observation and correlation does not imply causal relationship. See *association*.

Count data continuum

Count data is a form of numerical discrete data. All values consist of whole numbers. In the case of the PGSI score, the only possible values are whole numbers along the continuum between 0 and 27. Therefore only 28 values are possible.

Decile

One-tenth (e.g. of a population)

Determinants

A factor which decisively affects the nature or outcome of something (Oxford University Press 2015). Whether people are healthy or not, is determined by many factors relating to their circumstances and their environment. These factors have many names including determinants, indicators, risk factors, predictors and influencers.

Dichotomous

Dichotomous variables are nominal variables which have only two categories or levels. For example, if we were looking at gender, we would most probably categorize somebody as either "male" or "female".

DK/refused

Don't know/Refused

DSM-IV (Diagnostic and Statistical Manual of Mental disorders, fourth edition)

DSM-IV is a manual published by the American Psychiatric Association (APA) in 1994, describing all recognised mental health disorders at the time of publication. It is regarded as a handbook for mental health professionals to identify the features of a given mental disorder and distinguished the disorder from similar problems. The latest manual is DSM-V published in 2013.

EGM (Electronic gaming machine)

A slot machine that has three or more reels that spin when a button is pushed. Often referred to 'poker machines' or 'pokies' (Australia), 'the slots' (Canada) or 'fruit machines' (United Kingdom).

Epidemiology

The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.

Factor

A factor is an influence/effect that contributes to a health outcome.

GAD (Generalised Anxiety Disorder)

A psychological disorder that describe a disproportionate anxiety about several aspects of life, such as work, relationships, health and financial matters for a long period of time (Beyond Blue 2015a).

Gambling continuum

Gambling is considered a continuum disorder. The continuum varies from occasional non-problematic gambling to extreme over-involvement resulting in problems or harms for the gambler, and their family, friends and community.

HILDA

The Household, Income and Labour Dynamics in Australia (HILDA) Survey is a household-based panel study which began in 2001. It is a large longitudinal study.

IRR (Incidence Rate Ratio)

In regression analysis, IRR refers to the marginal change of the outcome variable in relation to a unit of change in a given exposure variable. For binary exposure variable, IRR refers the marginal change of the outcome variable in relation to the present of the exposure variable compared to the absence of the exposure variable.

Item response scale

Response options to questions or items can be designed so that the options describe variations in intensity or frequency of a characteristic along an increasing or decreasing scale.

Kessler Psychological Distress Scale (K10)

A measure of distress based on 10 questions about the anxiety and depression an individual has experienced in the previous four weeks (Kessler, Andrews, Colpe, Hiripi et al. 2002).

Life events

A list of significant events (e.g. death, marriage, divorce, new employment and others) used in *The Victorian Gambling Study*

LLLP (Leisure, Lifestyle, Life Cycle Project)

LLLP is a Canadian population longitudinal study conducted in Alberta, Canada between 2006 and 2011. The study aimed to 1) identify the normal patterns of continuity and discontinuity in gambling and problem gambling behaviours; 2) identify biopsychosocial variables and behaviour patterns that predict current and future problem gambling and 3) identify an etiological model of problem gambling that is best supported by the longitudinal findings. QLS was a very similar to a study conducted in the Quinte region of Ontario, Canada during the same time period. With overlapping of researchers involved in QLS and LLLP, a set of parallel analyses were conducted in both the studies for comparison. See *Quinte Study*.

LOTE (Language Other Than English)

In population surveys, the question “Do you speak a language other than English at home?” is usually used to identify people from a culturally and linguistically diverse (CALD) background.

Logistic regression

Statistical method for analysing data used when the outcome/dependent variable is dichotomous (e.g. yes/no, true/false).

- univariable: logistic regression using only one exposure/independent variable and a dichotomous outcome variable
- multiple: logistic regression using multiple exposure/independent variables and a dichotomous outcome variable

Longitudinal

A study that involves repeated observations of a population over a long period of time (usually years).

Meta-analysis

A meta-analysis is the use of statistical methods to summarise the results of systematic reviews by contrasting and combining results from different studies to identify patterns among study results

Model

In statistical analysis, a theoretical model is used to describe the observed data. A theoretical model usually features a specific distribution and a selection of criteria.

Model fit statistics

A collection of statistic indicators for models comparison. The indicators provide information on whether a model better describes the observed data when compared to another model. BIC' (Bayesian Information Criterion) was used as the model fit statistic in this report. See *BIC* and *BIC'*.

NCS-R (National Comorbidity Survey Replication)

A National Comorbidity Survey (NCS) was conducted in 1990-92 in order to assess the prevalence and correlates of DSM-III-R disorders in America. Ten years later, respondents of the NCS were reinterviewed in NCS-2. The NCS-2 conducted in 2001-02 aimed to study the patterns and predictors of the course of mental and substance use disorders and to evaluate the effects of primary mental disorders in predicting the onset and course of secondary substance disorders. (Harvard Medical School 2005)

Negative binomial regression

The negative binomial regression is a statistical method for analysing data when the outcome/dependent variable is count data (i.e. discrete and positive number). Negative binomial regression model assumes variances increases with means and therefore better describes over-dispersed data. (See *over-dispersed* and *Poisson regression*)

- univariate: negative binomial regression using only one exposure/independent variable and a count outcome variable
- multiple: negative binomial regression using multiple exposure/independent variables

NESARC (National Epidemiological Survey on Alcohol and Related Conditions)

The NESARC is a longitudinal study and the first wave of the study was conducted in 2001-02 by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) in America. The second wave of the study was conducted in 2004-05. The study included questions on past and current alcohol consumption, and the use of alcohol treatment services. It also asked the respondents questions on tobacco and illicit drug use as well as mental wellbeing. (National Institute on Alcohol Abuse and Alcoholism 2006).

Null model

A null model is a model without any independent/exposure variables apart from the intercept. It is usually used in model fit statistics to compare between models with and without fitted independent variables. This is to find out whether the fitted variables improve the model in describing the observed data compared to the intercept only model. See *BIC* and *model fit statistics*.

OCD (Obsessive Compulsive Disorder)

OCD is an anxiety disorder and people who suffer from the disorder feel the necessity to perform an obsession or compulsion to release their anxiety. (Beyond Blue 2015b)

OECD (Organisation for Economic Co-operation and Development)

The OECD was officially established on 30 September 1961 to facilitate the co-operation between countries, addressing the challenges facing global economy. There are 34 OECE member countries worldwide in 2015. (OECD 2015)

Outcome

In epidemiology the outcome variable is the main variable of interest in the study. It is also called the dependent variable whose presence or absence, or level of severity may be 'dependent' on a particular exposure or circumstance which are often referred to as independent variables. In this report the outcome of interest was the PGSI score and its level of severity was dependent on socio-demographics variables, comorbidities, and trauma and life events.

Over-dispersed

The observed data is over-dispersed when the variance observed is greater than the mean in the theoretical model that used to describe the data. See *Poisson regression* and *negative binomial regression*.

Parameter

Parameter is usually unknown and is estimated from observed data through statistical method.

Poisson regression

The Poisson regression is a statistical method for analysing data which is used when the outcome/dependent variable is count data (i.e. a discrete and positive number). Poisson regression model assumes that the mean equals the variance. See *over-dispersed* and *negative binomial regression*.

P-value

Probability value, represented by *P*. The probability that a test statistic would be as extreme as or more extreme than observed if the null hypothesis were true (Last, 2001). See *Statistical significance*.

Predicting

In regression analysis, a selection of exposure/independent variables are fitted in a model to describe the outcome/dependent variable. In statistical terms, the independent variable "predicts" the dependent variable. However, this does not imply any causal relationship.

Problem Gambling Severity Index (PGSI) score

A score based on nine questions, from the Canadian Problem Gambling Index, which can be used to estimate an individual's gambling risk status in the preceding 12 months.

Psychological distress

Negative emotional states that impact on a person's level of functioning. In this study general psychological distress was measured using the 10 questions that make up the Kessler 10. See also *Kessler Psychological Distress Scale*.

Public health approach

This approach views problem gambling as part of a gambling continuum. It recognises that vulnerability to gambling problems are due to complex interplay between personal, social, economic and environmental as well as biological factors. It is a practice which focuses on improving the health of populations, that is, the health of groups or sub groups, rather than the health of individuals.

QLS (Quinte Longitudinal Study)

The QLS is a longitudinal prospective study of gambling and problem gambling conducted in the Quinte region of Ontario, Canada from 2006 to 2011. The study aimed to investigate the patterns of continuity and discontinuity in gambling and problem gambling over time, identify individual, social, and structural variables mediating the development of responsible gambling and problem gambling and examine the etiological model of gambling and problem gambling based on the study. The study also explored the implications of the study findings in the prevention of problem gambling. LLLP was a very similar study conducted in Alberta during the same time period. With overlapping of researchers involved in QLS and LLLP, a set of parallel analyses were conducted in both the studies for comparison. See *LLLP*.

Saturated model

A saturated model is a model with all the selected independent/exposure variables fitted. It is usually used in model fit statistics to compare between models with and without fitted independent variables. This is to find out whether the fitted variables improve the model in describing the observed data. See *null model* and *BIC*.

SEIFA (Australian Bureau of Statistics four indices of SocioEconomic Indexes For Areas)

SEIFA was developed by the ABS in order to rank areas in Australia according to relative socio-economic advantage and disadvantage, based on the five-yearly Census. The latest version of SEIFA 2011 consisted of four indexes: 1) Index of Socioeconomic Advantage and Disadvantage (IAD); 2) Index of Education and Occupation (IEO); 3) Index of Economic Resources (IER) and 4) Index of Socioeconomic Disadvantage (IRSD). Each index summarise a different subset of Census variables and focuses on a different aspect of socio-economic advantage and disadvantage. It is used in public health research, usually to examine the relationship between socio-economic disadvantage and various health and educational outcomes at the area rather than at the individual level. (Australian Bureau of Statistics 2013)

SEIFA IAD

Index of Socioeconomic advantage and Disadvantage. See *SEIFA*.

SEIFA IEO

Index of Education and Occupation. See *SEIFA*.

SEIFA IER

Index of Economic Resources. See *SEIFA*.

SEIFA IRSD

Index of Socioeconomic Disadvantage. See *SEIFA*.

Size of the effect

The magnitude of the difference between points of comparison in relation to an exposure or intervention.

Secondary analysis

Analysis undertaken on data from an existing database

Social capital

Social capital has been defined in many ways. It frequently refers to the features of social structures that make resources, advantages and opportunities available to individuals, and that can facilitate collective action. Most definitions of social capital are common in that they focus on networks among people that lead to cooperation and beneficial outcomes for all. Social capital affects health risk behaviour and, inversely, a lack of social capital can impair health. The association between strong social networks as a buffer to morbidity and mortality has been widely reported (Baum 2003; Lin, Smith and Fawkes 2014).

Social determinants of health

The social determinants of health (SDH) are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies and political systems. (World Health Organisation 2015)

Socio demographics

Socio-demographics in this study individual characteristics such as education, occupation, income, household type and area level characteristics such as residence in urban or rural regional areas or areas with high or low socioeconomic status.

South Oaks Gambling Screen (SOGS)

A self-administered screen that contains 20 questions based on DSM-III criteria for pathological gambling (Lesieur and Blume 1987).

STATA/SE 12

A statistical software to compute statistical analysis developed and licensed by StataCorp. (StataCorp 2011)

Statistical significance

A mathematical technique to measure whether the results of a study are likely to be true. Statistical significance is calculated as probability that an effect observed in a research study is occurring because of chance. Statistical significance is usually expressed as a P-value. The smaller the P-value, the less likely that the results are due to chance (and more likely that the results are true). Researchers generally believe the results are probably true if the statistical significance is a P-value less than 0.05 ($P < .05$).

Statistical test

A procedure that is intended to determine whether a hypotheses about the distribution of one or more variables should be rejected or accepted.

Swelogs (Swedish Longitudinal Study)

Swelogs is a prospective study of Swedish citizens aged 16-84 years at baseline in 2008 and who were follow for a further three waves. The main objective of this study was to estimate prevalence and incidence of problem and at-risk gambling. (Romild, Volberg and Abbott 2014)

Systematic review

A systematic review answers a defined research question by collecting and summarising all empirical evidence that fits pre-specified eligibility criteria. It is a critical assessment and evaluation of all research studies that address a particular clinical issue.

TAFE (Technical and Further Education)

TAFE refers to tertiary education providing vocational education and training in Australia.

Temporal

Relating to, or denoting, time

Variable

In statistical analysis, a variable refers to some unknown quantity fitted in a model. A model is used to describe and/or estimate the unknown quantities based on observed data. See model.

Variance

In statistics, variance refers to the variation between individual observations within a sample.

Weighted/unweighted

Adjustments or weightings are applied to the data to make it more representative of a broader population (such as the Victorian adult population). They are based on the combined probabilities of a person being selected in the survey. In *The Victorian Gambling Study*, the household selection probability, the intraregional selection probability and the population benchmark selection probability.

WHO HPR/HEP

World Health Organisation Division of Health Promotion, Education and Communications (WHO HPR/HEP 1998)

Appendix Four: References

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