Review

Early risk and protective factors for problem gambling: A systematic review and meta-analysis of longitudinal studies

N.A. Dowling [a,b,c,*], S.S. Merkouris [a], C.J. Greenwood [a], E. Oldenhof [a], J.W. Toumbourou [a], G.J. Youssef [a]

[a] *Deakin University, School of Psychology and Centre for Social and Early Emotional Development, Australia*
[b] *Melbourne Graduate School of Education, University of Melbourne, Australia*
[c] *Centre for Gambling Research, Australian National University, Australia*

HIGHLIGHTS

- First systematic review of risk and protective factors for problem gambling
- Strongest risk factors were gambling severity, male gender, poor school performance
- Protective factors included parental supervision and high socio-economic status
- Results were generally robust to the quality of methodological approaches
- Need for future research to explore relationship, community, and societal factors

ARTICLE INFO

ABSTRACT

This systematic review aimed to identify early risk and protective factors (in childhood, adolescence or young adulthood) longitudinally associated with the subsequent development of gambling problems. A systematic search of peer-reviewed and grey literature from 1990 to 2015 identified 15 studies published in 23 articles. Meta-analyses quantified the effect size of 13 individual risk factors (alcohol use frequency, antisocial behaviours, depression, male gender, cannabis use, illicit drug use, impulsivity, number of gambling activities, problem gambling severity, sensation seeking, tobacco use, violence, undercontrolled temperament), one relationship risk factor (peer antisocial behaviours), one community risk factor (poor academic performance), one individual protective factor (socio-economic status) and two relationship protective factors (parent supervision, social problems). Effect sizes were on average small to medium and sensitivity analyses revealed that the results were generally robust to the quality of methodological approaches of the included articles. These findings highlight the need for global prevention efforts that reduce risk factors and screen young people with high-risk profiles. There is insufficient investigation of protective factors to adequately guide prevention initiatives. Future longitudinal research is required to identify additional risk and protective factors associated with problem gambling, particularly within the relationship, community, and societal levels of the socio-ecological model.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Contents

* Corresponding author at: Building BC, 221 Burwood Highway, Burwood, Victoria 3125, Australia.
E-mail address: nicki.dowling@deakin.edu.au (N.A. Dowling).

1. Background

Renamed gambling disorder, pathological gambling has been reclassified as an addiction and related disorder alongside alcohol and substance use disorders in the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition) (DSM-5) (American Psychiatric Association (APA), 2013). Consistent with public health frameworks that conceptualise gambling problems across a risk continuum (Shaffer & Korn, 2002), the term problem gambling is also employed to describe gambling that results in adverse consequences for individuals, families, and communities (Neal, Delfabbro, & O'Neil, 2005). These consequences can include impaired mental health, physical health, relationship and family dysfunction, financial problems, employment difficulties, and legal issues (Shaffer & Hall, 2002). The standardised past year prevalence of problem gambling in adults ranges from 0.5% to 7.6% across countries, with an average of 2.3% (Williams, Volberg, & Stevens, 2012).

Although ostensibly an activity legally restricted to adults in most jurisdictions (typically older than 18 years of age), adolescent gambling is not uncommon. Individuals under the age of 18 years typically report gambling on lottery, instant scratch tickets, and informal private games, such as wagering with friends (Dixon et al., 2016; Jackson, Dowling, Thomas, Bond, & Patton, 2008). Internationally, estimates of past year gambling problems in adolescents (in the years 2000–2009) were highly variable, with rates of 0.8% to 6.0% (Volberg, Gupta, Griffiths, Olason, & Delfabbro, 2010). Although these prevalence rates are substantially higher than those reported by adults, there has been some concern that problem gambling rates for youth are inflated due to multiple situational and measurement issues (see Derevensky, Gupta, & Winters, 2003; Shaffer & Korn, 2002). Regardless of the actual level of risk, there is consensus that problem gambling among adolescents remains a significant social and public health policy issue, and that problem gambling in adolescents and young adults has been associated with a range of negative consequences across interpersonal, familial, economic, psychological, and legal domains (Blinn-Pike, Worthy, & Jonkman, 2010; Delfabbro, Lahn, & Grabosky, 2006; Nower, Derevensky, & Gupta, 2004). Moreover, adult gambling problems can

emerge from patterns developed in childhood and adolescence (Derevensky et al., 2003). For these reasons, research attempting to elucidate potential childhood, adolescence and young adulthood factors that may increase or ameliorate the risk of developing subsequent gambling-related problems has emerged.

1.1. Early risk and protective factors for problem gambling

Most of the evidence base for the identification of early risk factors for the development of problem gambling is derived from cross-sectional studies of adolescents. In this context, risk factors are defined as conditions that are associated with an increase in the likelihood of problem gambling (Coie et al., 1993; Farrington & Ttofi, 2011; Kazdin, Kraemer, Kessler, Kupfer, & Offord, 1997; Kraemer et al., 1997), although this definition has been expanded to describe a predictor that is able to predict problem gambling after adjustment for other known influences (Loxley et al., 2004). Risk factors that have concurrently been associated with gambling problems in cross-sectional studies of young people include male gender, lower socio-economic status, early gambling onset, a history of a big win, extraversion, low conformity, impulsivity, sensation seeking, risk propensity, maladaptive coping styles, life stress, delinquency, substance use, attention deficit hyperactivity disorder (ADHD) symptoms, anxiety, depression, emotional problems, peer substance abuse, peer problem gambling, poor academic performance, school difficulties, parental substance abuse, parental problem gambling, inconsistent parental discipline, family problems, gambling availability, gambling marketing, cultural gambling norms, and worldwide trends in gambling (e.g., internet gambling) (Ariyabuddhiphongs, 2013; Blinn-Pike et al., 2010; Dickson, Derevensky, & Gupta, 2002, 2008; Hardoon & Derevensky, 2002; Lussier, Derevensky, Gupta, & Vitaro, 2014; Messerlian, Gillespie, & Derevensky, 2007; Shead, Derevensky, & Gupta, 2010).

Despite well-established associations between many of these factors and gambling problems, many children, adolescents and young adults exposed to these risk factors never develop gambling problems, suggesting that there are factors that play a protective role (Lussier et al., 2014). Protective factors are often conceptualised as conditions that are associated with a decrease in the likelihood of problem gambling, regardless of exposure to identified risk factors (Coie et al., 1993; Farrington & Ttofi, 2011; Kazdin et al., 1997; Kraemer et al., 1997; Lussier et al., 2014; Shead et al., 2010). These factors, which may counteract risk factors through a cancellation process (Lussier et al., 2014), statistically imply a negative main effect with problem gambling (Dickson et al., 2008; Lussier et al., 2014). Although it may be argued that this definition views these factors as the opposite end of risk factors (Farrington & Ttofi, 2011; Loxley et al., 2004; Shead et al., 2010), this is not necessarily true if they are non-linearly related to problem gambling (Farrington & Ttofi, 2011). For this reason, these protective factors are sometimes referred to as compensatory factors (Dickson et al., 2008; Lussier et al., 2014) or promotive factors (Farrington & Ttofi, 2011).

Relative to the evidence base examining early risk factors for problem gambling, only a small number of studies have examined the role of early protective factors for problem gambling. Several cross-sectional studies of adolescents have identified that female gender, adaptive coping strategies, emotional intelligence, well-being, self-monitoring, personal competence, resilience, interpersonal skills, social competence, social support, social bonding, social competence, school connectedness, understanding of randomness, parental monitoring, and family cohesion play a protective role (Chalmers & Willoughby, 2006; Dickson et al., 2008; Lussier, Derevensky, Gupta, Bergevin, & Ellenbogen, 2007; Magoon & Ingersoll, 2006; Nower et al., 2004; Parker, Taylor, Eastabrook, Schell, & Wood, 2008; Shead et al., 2010; Turner, Macdonald, Bartoshuk, & Zangeneh, 2008; Vachon, Vitaro, Wanner, & Termblay, 2004; Weinstock & Petry, 2008). Although these cross-sectional studies provide some insight into the early factors associated with the development of problem gambling,

longitudinal research is required to identify risk and protective factors as they are generally conceptualised as antecedent conditions that temporally precede the development of gambling problems (Kazdin et al., 1997; Kraemer et al., 1997; Loxley et al., 2004). This is highlighted by recent findings suggesting that some of the early factors associated with the development of problem gambling in cross-sectional studies of young people have not been identified in subsequent longitudinal studies (e.g., Scholes-Balog, Hemphill, Toumbourou, & Dowling, 2015; Shenassa, Paradis, Dolan, Wilhelm, & Buka, 2012). These findings suggest that these factors may be, in fact, consequences of problem gambling or co-exist because they share common causes. The insights provided from longitudinal analyses shift the policy focus from characteristics that co-occur with problem gambling in young people at a single cross-sectional point in time to the factors that are predictive of problem gambling at a future time-point, including adulthood.

1.2. The socio-ecological model

Risk and protective factors can be organised according to the socio-ecological model, a multi-level framework that considers the different contexts in which these factors exist (Dahlberg & Krug, 2002). The levels of the socio-ecological model include: (1) *Individual level*: Factors specific to the individual, such as health and psychosocial problems; (2) *Relationship level*: An individual's closest social circle – family members, peers, teachers, workmates, and other close relationships – that contribute to their range of experience; (3) *Community level*: The settings in which social relationships occur, such as schools, workplaces, and neighbourhoods; and (4) *Societal level*: Broad societal factors, such as social and cultural norms, as well as the health, economic, educational, and social policies that contribute to economic and/or social inequalities between populations.

1.3. Review aims

Gambling prevention and interventions aim to reduce risk factors and increase protective factors in order to prevent problem gambling. To date, however, there are no comprehensive narrative or systematic reviews identifying the risk and protective factors that are longitudinally associated with the development of gambling problems to guide the development of such efforts. The current systematic review and associated meta-analysis therefore aims to provide an up-to-date overview of existing research designed to identify early risk and protective factors longitudinally associated with the development of gambling problems. Given that risk and protective factors are defined in relationship to developmental age and the development stage of the behaviour being predicted (Loxley et al., 2004), the focus of this review is on the identification of risk and protective factors in childhood (0–12 years), adolescence (13–17 years), and young adulthood (18–25 years), rather than adults. For the purpose of this review, young adulthood refers to individuals up to 25 years of age, as evidence indicates that individuals at this age are in a sensitive developmental period in which there is continued bio-psycho-social maturation into adult-like roles and responsibilities, and that influences during this period have strong impacts on later lifestyle and behaviour patterns (Arnett, Žukauskiene, & Sugimura, 2014). Secondary aims of the review are to provide a narrative review of the included studies, examine whether findings are robust to the quality of the study methodologies using sensitivity analyses, and explore gender differences in early risk and protective factors using subgroup analyses.

2. Method

The methodology employed in this review was compliant with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) (Moher, Liberati, Tetzlaff, & Altman, 2009) and the guidelines

for the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) (Stroup et al., 2000).

2.1. Search strategy

The systematic search procedure included an electronic and grey literature search. Electronic databases, including Medline, PsycInfo, EMBASE and CINAHL, were searched for peer-reviewed articles. The search terms incorporated a combination of keywords and wildcards relating to problem gambling (e.g., gambl*, betting, wager*) AND study design (e.g., longitudinal, prospective, cohort) OR risk or protective factors (e.g., protect*, resilience*, promot*, buffer*, correlate, vulnerability, predictor, risk factor, precipitating factor, promotive factor). This search was restricted to articles published from 1990, consistent with the development of the first standardised and validated assessment instrument for the identification of problem gambling (Lesieur & Blume, 1987). The search was limited to English language and the search terms were limited to title, abstract and keywords. The Journal of Gambling Issues (2000−2003) was manually searched as it is not indexed in the electronic databases. The grey literature search involved the examination of the first 100 citations (10 pages) in a Google search. The search terms for this search were (gamble OR gambling) and (longitudinal). Finally, the reference lists of all included articles were searched manually. A detailed description of the search strategy is provided in Appendix A.

2.2. Inclusion and exclusion criteria

Articles were considered eligible for the review if they met the following inclusion criteria: (1) included one or more variables as a predictor of subsequent problem gambling; (2) employed a quantitative prospective study design; (3) the mean age of participants was 25 years of age or younger when the risk or protective factor was measured (Arnett, 2000); (4) included any measure of problem gambling, pathological gambling or gambling disorder as outcome variables; and (5) the article was reported in a complete manuscript outlining original work published from 1990 to present. Articles were not eligible if they: (1) were a qualitative report, a review, a case report, a comment, a letter, a thesis, or conference presentation slides; (2) were an evaluation of a gambling intervention or prevention program, or an identification of predictors of treatment outcome; (3) were published in a language other than English; (4) presented solely cross-sectional or retrospective analyses; (5) assessed gambling involvement (e.g., frequency, number of activities, expenditure) but not problem gambling; (6) provided insufficient detail on the assessment of problem gambling; (7) included variables that are composites of multiple factors or lack adequate specificity; (8) employed a treatment-seeking or clinical sample; or (9) provided insufficient methodological or statistical information to allow for classification into a thematic factor and/or synthesis of findings.

2.3. Data extraction

A standardised, pilot-tested extraction sheet was employed to extract and collate the data from the included articles. Data extracted included basic descriptive study information (e.g., year of publication, study jurisdiction, sample type, follow-up interval, retention rate at each evaluation, sample sizes at each evaluation, age of participants at each evaluation, gender of participants at each evaluation, and industry sponsorship), the measures employed (problem gambling and risk or protective factors), and statistical and methodological considerations (e.g., type of analysis, data weighting, adjusting for covariates, effects, standard errors, effect size estimates, 95% confidence intervals [CIs], and corresponding p-values). Given the limited data available from a relatively small number of studies and articles, this hybrid review provides a narrative review of the included articles in addition to meta-analyses. Similar variables or measures from the included articles

were grouped into thematic factors via group discussion. When a risk or protective factor was examined in multiple analyses within the one article, the effect size estimate and p-value corresponding to the analysis providing the least amount of adjustment for covariates and comparison between the most extreme groups were estimated. When multiple articles using a shared sample contributed to the same thematic factor, the finding from the article that reported (in order of preference); the longest follow-up period, unadjusted results, and the most robust measurement tool was synthesised. This ensured that each effect size estimate or p-value was statistically independent from other estimates or p-values within the one thematic factor. Where possible, gender-specific associations were extracted and analysed as separate independent samples. Data were extracted from the included articles by two investigators. Double data extraction was then conducted for all included articles by an independent reviewer to ensure the data extraction was accurate. Discrepancies were resolved through group discussion with a fourth investigator as arbiter.

2.4. Data analysis

2.4.1. Risk of bias assessment

The use of quality scoring methods in meta-analyses of observational studies is generally not recommended (Higgins, Thompson, Deeks, & Altman, 2003; Stroup et al., 2000) because scores constructed in an ad hoc fashion may lack demonstrated validity, and results may not be associated with quality (Juni, Witschi, Bloch, & Egger, 1999). A components approach was therefore adopted to assess risk of bias in this review, whereby the research in each article was rated on individual criteria that reflect the methodological risk of bias (Higgins et al., 2003). These criteria included the measure of problem gambling employed (standardised measure, unstandardised measure), the time frame of problem gambling measure (current, lifetime), follow-up interval (5+ years, <5 years), industry sponsorship (non-sponsored, sponsored), controlling for confounding factors (non-adjusted data, adjusted data), age when the predictor was assessed (12–25 years old, 0–12 years old), age at which the predictor and problem gambling outcome was measured (predictor measured at 12–17 years and follow-up after 18 years, predictor and follow-up at other time-points), the type of effect estimate reported (r, other than r), and the type of sample employed (representative, non-representative). These criteria were recorded during the data extraction process and served as the basis for the meta-analytic sensitivity analyses.

2.4.2. Stouffer's p

The findings relating to each thematic factor were first synthesised using Stouffer's method of testing the combined significance level of the associations (Stouffer, Suchman, DeVinney, Star, & Williams, 1949). Stouffer's z is calculated by dividing the sum of the $z(p_i)$ values by the square root of k, where k is the number of articles (Darlington & Hayes, 2000). Directional hypotheses specified a priori for each association were tested with p-values converted to one-tailed values. The null hypothesis was rejected when Stouffer's z corresponded to a probability level of <0.05. This approach has been adopted in previous reviews of risk and protective factors for common mental health problems examining similarly heterogeneous literatures (e.g., Cairns, Yap, Pilkington, & Jorm, 2014). Stouffer's p was calculated when there were at least two independent estimates reporting a p-value for the relationship between a thematic factor and problem gambling. When the same thematic factor was used in different analyses within the one article, p-values based on unadjusted results were preferred. When an exact p-value was not reported in an article, the p-value from the available data (e.g., using estimated effect + confidence interval) was derived. When an exact p-value could not be derived, the p-value was assigned the value of 0.5 when the result was reported as non-significant in the manuscript, or assigned the value of the boundary that was reported (e.g., if a p-value was reported to be <0.05, the value of 0.05

was assigned). The decision rules relating to the assignment of *p*-values for the purpose of calculating Stouffer's p are provided in Appendix B.

2.4.3. Meta-analysis

The findings relating to each thematic factor were then synthesised using meta-analysis conducted with the Metafor package v1.9.8 (Viechtbauer, 2010) in R software v3.2.2 (R Development Core Team, 2015). Like the Stouffer's p, a meta-analysis was conducted when a thematic factor had at least two independent effect size estimates. The primary effect size used for meta-analysis was the correlation coefficient (r). All other effects were converted to correlations for the purpose of meta-analysis using widely employed formulas (Borenstein, Hedges, Higgins, & Rothstein, 2009). The null hypothesis was rejected when the *p*-value for the meta-analytic result corresponded to a probability level of <0.05. Cohen (1992) guidelines were employed when interpreting mean correlational effect sizes (r), whereby 0.1 indicates a small effect size, 0.3 indicates a medium effect size, and 0.5 indicates a large effect size. Given the expected heterogeneity between articles, a random effects model was employed, which provides an estimate of the weighted mean effect and a 95% CI that indicates the precision of this estimate. The I^2 statistic indicates the amount of variation across articles due to true differences (heterogeneity) rather than chance (sampling error) and is expressed as a proportion of the total observed variance. This statistic ranges from 0% to 100%, whereby values of 25%, 50% and 75% are tentatively suggested to represent low, moderate and high levels of heterogeneity, respectively (Higgins et al., 2003). The presence of publication bias, when there were 3 or more independent estimates available, was assessed by visual inspection of the funnel plot of the meta-analyses and by using Egger's test ($p < 0.05$) (Egger, Smith, & Phillips, 1997).

2.4.4. Sensitivity analyses

Sensitivity analyses were conducted to examine whether findings were robust to the quality of the methodological approaches of the included articles (Stroup et al., 2000). These involved conducting the meta-analysis for each thematic factor a second time, in which only articles that were definitely known to be eligible were included (Higgins & Green, 2011). Specifically, the eligibility for sensitivity analyses were sequentially limited to articles with standardised measures of problem gambling, current problem gambling measures, long follow-up periods (5+ years), non-industry sponsorship, use of non-adjusted data, first assessment during adolescence or young adulthood (12–25 years of age), first assessment between the ages of 12 to 17 years and follow-up assessment after the age of 18 years, estimate of r provided, and representativeness of the sample. In this review, a sensitivity analysis for a thematic factor was conducted when there were two or more estimates definitely known to be eligible.

2.4.5. Subgroup analyses

Only a small number of the included articles (Fröberg, Modin, Rosendahl, Tengström, & Hallqvist, 2015; Slutske, Moffitt, Poulton, & Caspi, 2012; Yücel et al., 2015) included gender-specific associations. The planned subgroup analyses to examine gender differences in thematic risk and protective factors were therefore not conducted.

3. Results

3.1. Search results

A PRISMA flow diagram of the literature search results is displayed in Fig. 1. After duplicate records were removed, the search identified 2425 articles. The title and abstracts of these records were independently reviewed for inclusion by two separate authors. The full-texts of the 187 articles that were deemed potentially eligible were retrieved. Overall, 15 studies published in 23 articles were included in this review.

3.2. Characteristics of included articles

The characteristics of the included articles are presented in Appendix C. Most articles were published from 2000 onwards (87.0%, k = 20) and most samples were recruited from the USA (47.8%, k = 11), Canada (21.7%, k = 5) and Australia (17.4%, k = 4). Most articles recruited participants from schools (69.6%, k = 16). Intervals from first to final evaluations ranged from 5 weeks to 32.2 years (M = 8.0 years, SD = 7.9, median = 6.0). The retention rate from the first to the final evaluation ranged from 16.3% to 100% (M = 66.1%, SD = 23.4, median = 71.1). The sizes of the samples ranged from 165 to 20,745 (M = 1992, SD = 4185, median = 1034) at the first evaluation and from 90 to 15,197 (M = 1363, SD = 3019, median = 575) at the final evaluation. Where reported, the average age of participants ranged from 3 to 21 years (M = 13.9 years, SD = 4.8, median = 14.9) at the first evaluation and from 17 to 39 years (M = 22.7 years, SD = 5.4, median = 21.8) at the final evaluation. At the final evaluation, the majority of the articles had participants with an average age of 25 years or less (82.7%, k = 19). Where reported, the proportion of males in the samples ranged from 35.8% to 100% (M = 69.2%, SD = 39.9, median = 52.0) at the first evaluation and from 35.8% to 100% (M = 69.4%, SD = 39.4, median = 52.9) at the final evaluation. The most commonly used measures of problem gambling employed across the time-points were the South Oaks Gambling Screen-Revised Adolescent (30.4%, k = 7) and the South Oaks Gambling Screen (21.7%, k = 5).

3.3. Narrative review of included articles

Of the 23 included articles, five described analyses from an ongoing longitudinal study of Caucasian kindergarten boys in Canada (Dussault, Brendgen, Vitaro, Wanner, & Tremblay, 2011; Vitaro, Arseneault, & Tremblay, 1997; Vitaro, Arseneault, & Tremblay, 1999; Vitaro, Brendgen, Ladouceur, & Tremblay, 2001; Wanner, Vitaro, Carbonneau, & Tremblay, 2009), three employed data from the Johns Hopkins University Prevention Intervention Research Center's Second Generation Intervention Trial (Lee, Storr, Ialongo, & Martins, 2011; Lee, Stuart, Ialongo, & Martins, 2014; Liu et al., 2013), two were published from the International Youth Development Study in Australia (Scholes-Balog, Hemphill, Dowling, & Toumbourou, 2014; Scholes-Balog et al., 2015), two employed data from the Dunedin Multidisciplinary Health and Development Study (Slutske, Caspi, Moffitt, & Poulton, 2005; Slutske et al., 2012), and two were published from a prospective study of Minnesota households (Winters, Stinchfield, Botzet, & Anderson, 2002; Winters, Stinchfield, & Kim, 1995). There were also nine articles that employed individual longitudinal datasets (Breyer et al., 2009; Delfabbro, King, & Griffiths, 2014; Edgerton, Melnyk, & Roberts, 2014; Faigin, Pargament, & Abu-Raiya, 2014; Fröberg et al., 2015; Shenassa et al., 2012; Slutske, Jackson, & Sher, 2003; Uecker & Stokes, 2015; Yücel et al., 2015).

3.3.1. Longitudinal kindergarten sample, Montreal

Five articles described analyses from an ongoing longitudinal study that started in 1984 with 1034 Caucasian kindergarten boys (mean age of 6 years) from 53 schools in economically disadvantaged areas in Montreal, Canada. Vitaro et al. (1997) investigated the possible relationship between impulsivity in early adolescence (age 13) and problem gambling in late adolescence (age 17). There was a linear trend for scores on both self-report and teacher ratings of impulsivity to increase across the groups defined by scores on the South Oaks Gambling Screen for Adolescents (non-gamblers [scores of 0 on both the problem severity and frequency/diversity scales], recreational gamblers [scores of 0 on the problem severity scale but scores of 1 or more on the frequency/diversity scale], low problem gamblers [scores of 1 or 2 on the problem severity scale], and high problem gamblers [scores of 3 or more on the problem severity scale]). Vitaro et al. (1999) explored whether impulsivity in early adolescence (12–14 years) could predict problem gambling in late adolescence (age 17), above and beyond other personality factors in a
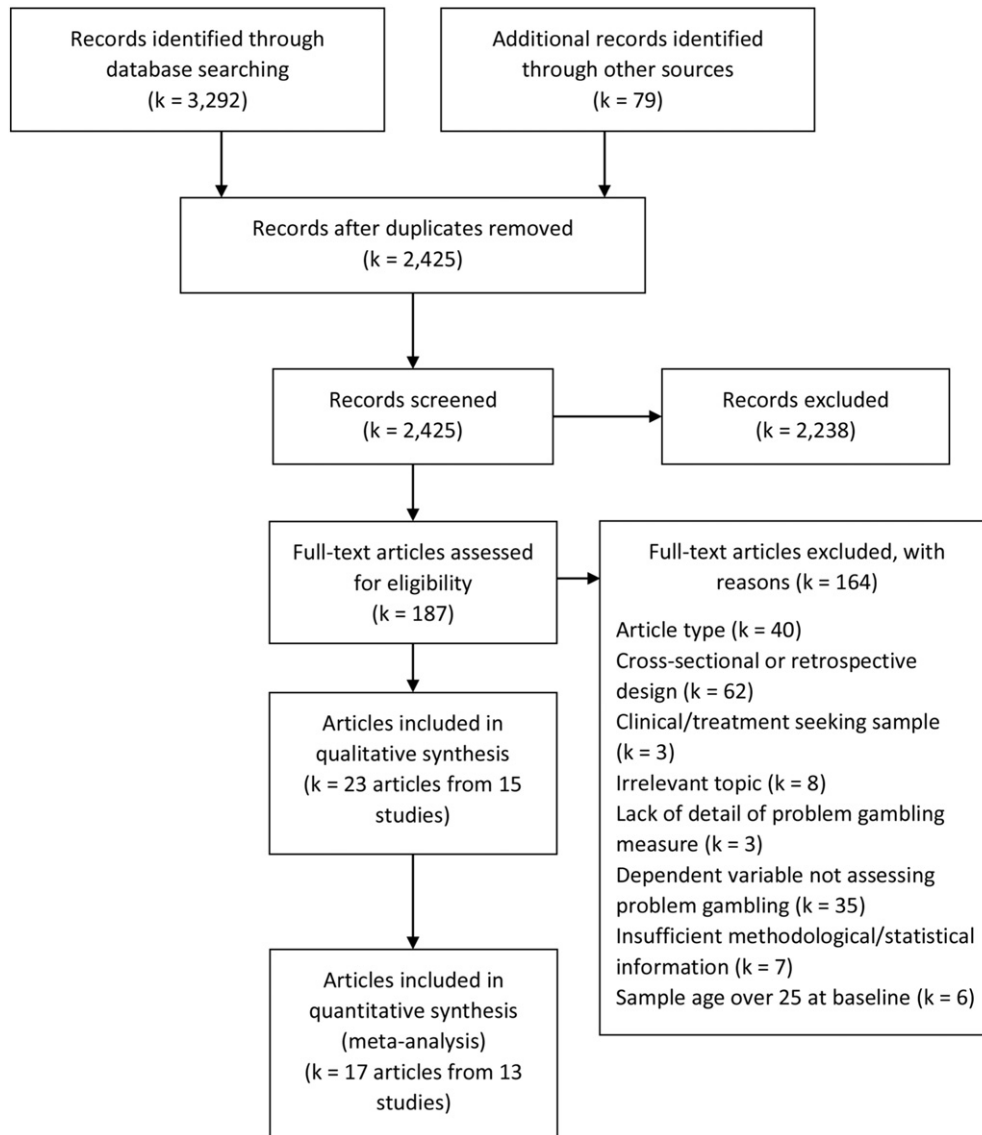
Fig. 1. PRISMA flow diagram.

sub-sample of boys displaying stable aggressiveness and anxiety. Impulsivity, measured using a self-report instrument and a card-sorting task, significantly predicted problem gambling after controlling for socio-demographic characteristics, early gambling behaviour, aggressiveness, and anxiety. High scores on both impulsivity measures increased the risk of problem gambling at age 17 by a factor of more than 18 and this predictive relationship held across all levels of aggressiveness and anxiety. Vitaro et al. (2001) explored the longitudinal relationships between several common antecedent factors (impulsivity, parental supervision, and deviant friends) and three problem behaviours (problem gambling, drug and alcohol use, and delinquency) over a 2-year period during mid-adolescence. Drug and alcohol use, but not delinquency, at age 16 significantly positively predicted problem gambling at age 17. Although impulsivity and friends' deviancy at age 13 to 14 years was predictive of problem gambling at age 17, parental supervision did not predict gambling problems at age 17. Despite the significance of these predictors, only 5% of the variance of gambling problems was explained by the set of predictors. Dussault et al. (2011) explored the degree to which common antecedent factors (socio-family risk and impulsivity) explain the concurrent links between depressive symptoms and gambling problems from late adolescence to early adulthood. Impulsivity at age 14 positively predicted gambling problems at ages 17 and 23, and depressive symptoms

at age 17 predicted an increase in gambling problems from age 17 to age 23.

Wanner et al. (2009) employed this sample, as well as a second sample from a longitudinal study initiated in 1986–1987 with a representative sample of 1001 Caucasian kindergarten boys from Quebec, Canada, to explore the cross-lagged links (the prospective links of one problem behaviour to another problem behaviour) among multiple problem behaviours (problem gambling, substance use, theft, and violence) from mid-adolescence (age 16) to young adulthood (age 23). This article also investigated the degree to which several risk factors (behavioural disinhibition, deviant peers, and parental supervision) explained or moderated these links. Across both samples, none of the variables at age 16 were significantly predictive of gambling problems at age 23. Behavioural disinhibition moderated the stability of problem gambling across the developmental period, whereby the stability of gambling problems was significant in the high disinhibition group and non-significant in the low disinhibition group.

3.3.2. Johns Hopkins university prevention intervention research Center's second generation intervention trial

Three articles employed data from the Johns Hopkins University Prevention Intervention Research Center's Second Generation Intervention

Trial, a study initiated in 1993 as a randomised prevention trial of interventions targeting academic achievement and aggression in 678 first grade students (mean age of 6.2 years) from nine urban primary schools in Baltimore, Maryland, USA. Lee et al. (2011) evaluated the possible synergistic effect of depressive symptoms and impulsivity in early adolescence (age 11) on late adolescent gambling behaviours (ages 17–20) in males using adjusted logistic regression models. The results revealed that although not statistically significant, depressive symptoms increased the odds of problem gambling by four-fold compared to non-gamblers and social gamblers. There was also a significant interaction between depressive symptoms and impulsivity in predicting problem gambling compared to social gambling, whereby increases in impulsivity decreased the odds of problem gambling among those with high depressive symptoms, and increases in depressive symptoms decreased the odds of problem gambling among those with high impulsivity. In a subsequent article, Liu et al. (2013) explored the association between developmental trajectories of teacher-rated impulsivity in early adolescence (ages 11–15 years) and gambling problems in late adolescence (age 19) in males. Conventional growth modelling revealed that males were more likely to develop gambling problems when starting at a higher level on impulsivity development. This article also identified two distinct trajectories using growth mixture modelling: a high impulsivity trajectory (41% of the sample) and a low impulsivity trajectory (59% of the sample). Heterogeneity in impulsivity development was significantly associated with gambling problems, whereby being in the high impulsivity trajectory compared to the low impulsivity trajectory doubled the odds of at-risk or problem gambling and tripled the odds of problem gambling. Finally, Lee et al. (2014) examined the association between parental monitoring trajectories throughout early adolescence (ages 11–14) and problem gambling in young adulthood (ages 16–22 years). Using general growth mixture modelling, this article identified two parental monitoring trajectories: a stable class in which high parental monitoring was maintained between the ages of 11 and 14 years (85% of the sample) and a declining class in which a lower level of parental monitoring at age 11 years significantly declined through to age 14. The declining class had significantly increased odds of problem gambling compared with non-gambling, even after controlling for demographic characteristics, intervention, parental monitoring (age 6), impulsivity (age 6), aggression (age 6), and deviant peer affiliation (age 16).

3.3.3. International Youth Development Study

Two articles were published from the Australian arm of the International Youth Development Study (IYDS), which is an ongoing bi-national longitudinal study investigating the development of healthy and problem behaviours among 2884 young people in Victoria, Australia, and Washington State, USA. A two stage cluster sampling approach was employed in which public and private schools across the state were randomly selected first, followed by one target grade level within each school. Scholes-Balog et al. (2014) analysed the data across two time points (mean age of 15 and 21 years) to examine 31 adolescent risk and protective factors for problem gambling in young adulthood across community, family, school and individual/peer group domains. Family conflict, family history of antisocial behaviour, academic failure, low school commitment, rebelliousness, interaction with antisocial peers, friends' use of drugs, rewards for antisocial involvement, antisocial behaviour, cigarette use, and alcohol use were associated with an increased risk of problem gambling after controlling for gender and age. In contrast, family rewards for prosocial involvement (example item: My parents notice when I'm doing a good job and let me know about it) and belief in the moral order (example item: It is important to be honest with your parents, even if they become upset or you get punished) were significantly associated with a reduced risk of problem gambling. Family rewards for prosocial involvement moderated the risk relationship between adolescent alcohol use and young adult problem gambling. This result revealed that there was no difference in the probability of

problem gambling between alcohol drinkers and non-drinkers for those with high levels of family rewards for prosocial involvement but that alcohol drinkers had an increased probability of problem gambling relative to non-drinkers for those with low levels of family rewards for prosocial involvement. In a fully adjusted multivariate model, however, only female gender was associated with a reduced risk of young adult problem gambling, while only the interaction between family rewards for prosocial involvement and alcohol use was associated with an increased risk of young adult problem gambling. In a subsequent article, Scholes-Balog et al. (2015) examined 15 protective factors for internalising (anxiety and depression) symptoms and problem gambling across 2 different time points (mean age of 21 and 23 years). Problem gambling was not significantly predicted by internalising symptoms, protective factors, or interactions between internalising symptoms and protective factors.

3.3.4. Dunedin Multidisciplinary Health and Development Study

Two articles employed data from the Dunedin Multidisciplinary Health and Development Study, a longitudinal study of the health and behaviour of a complete birth cohort initially comprising 1037 children born in Dunedin, New Zealand, between 1972 and 1973. Slutske et al. (2005) attempted to identify the association between dimensions of personality at age 18 years and problem gambling and alcohol and drug use at age 21 years. The personality dimensions measured included the higher order personality dimensions of positive emotionality (comprising dimensions of well-being, social potency, achievement, and social closeness), negative emotionality (comprising dimensions of stress reaction, alienation, and aggression), and constraint (comprising dimensions of self-control, harm avoidance, and traditionalism). Problem gambling was associated with higher scores on negative emotionality (including all of its primary scales) and with lower scores on the higher-order personality dimension of constraint (including all of its primary scales) compared with control participants who did not have a past-year addictive disorder. In a subsequent article, Slutske et al. (2012) examined whether child temperament at age 3 predicted problem gambling in adulthood. A set of behavioural descriptors were submitted to a series of multivariate analyses to derive five temperament groups: undercontrolled (10.4%), inhibited (7.8%), confident (27.5%), reserved (14.8%), and well-adjusted (39.6%). The children in the group characterised by behavioural and emotional undercontrol were more than twice as likely to experience gambling problems at ages 21 and 32 than well-adjusted children. These relationships remained significant after controlling for childhood IQ or family socioeconomic status.

3.3.5. Pre-Minnesota state lottery telephone survey

Two articles were published from a prospective study with a baseline sample of 702 adolescents (age 15–18 years) randomly recruited from a targeted statewide telephone list of 4000 Minnesota, USA, households that were expected to have adolescents in residence. Winters et al. (1995) identified no change in problem gambling scores across an 18 month period following the onset of the Minnesota State Lottery (instant scratch tabs and lottery games) for both underage and legal age samples. Winters et al. (2002) investigated the degree to which several risk factors (gender, early gambling onset, parental gambling history, delinquency, substance abuse, psychological distress, poor school performance, early at-risk gambling, and early problem gambling) at time 1 (age 15–18 years) and time 2 (age 17–20 years) predicted young adult problem gambling at time 3 (age 22–25 years) in a sub-sample of high- and low-risk gambling participants in the original cohort. Parental history of gambling problems, problem gambling during adolescence, male gender, at-risk gambling during adolescence, substance abuse, and poorer school performance were significantly associated with increased odds of problem gambling in young adulthood. In a multivariate model, however, only parental history of gambling problems

and male gender were significantly associated with increased odds of problem gambling.

3.3.6. Individual datasets

Nine articles described analyses from individual longitudinal datasets. Five articles employed samples recruited from school or university samples. Breyer et al. (2009) employed data from the Minnesota Competence Enhancement Program (USA), which initially identified elementary school students between the ages of 7 and 11 in 1991 who were screened for disruptive behaviour. In a sub-sample of 235 participants reassessed between the ages of 18 and 24 years, individuals who reported childhood ADHD symptoms which persisted into young adulthood had a higher likelihood of developing gambling problems than individuals with no ADHD or non-persistent ADHD. Slutske et al. (2003) employed a sample of 468 college students aged 18 to 19 years old in the USA who were participating in a longitudinal study exploring the development of alcohol use patterns and who were followed up in four waves across 10 years. Problem gambling predicted subsequent problem gambling, with the prediction of future problem gambling being stronger from more proximal years (3–4 years) than more distal years (6–10 years). Faigin et al. (2014) examined spiritual struggles as a predictor in the development of 14 domains of addictive behaviour, including problem gambling, among a sample of 90 freshman college students in the USA across a 5 week period. Higher scores on spiritual struggles at time 1 were not significantly associated with higher levels of problem gambling at time 2. Uecker and Stokes (2015) employed data from 13,980 participants from the National Longitudinal Study of Adolescent to Adult Health in the USA to investigate the relationship between adolescent religious beliefs and practices (12–18 years) and young adult problem gambling (18–25 years). Young adults who attended religious services up to three times per month during adolescence were more likely to develop gambling problems than those who never attended after adjusting for demographic characteristics, religious affiliation, religious salience, and thrill-seeking. Yücel et al. (2015) used data from the Orygen Adolescent Development Study in Australia to explore the role of sex, risk-taking behaviour and changes in temperament and psychiatric symptoms in the development of gambling problems in a sample of 156 early adolescents (mean age 13 years) with no history of gambling problems who were followed up in late adolescence (mean age 19 years). Problem gambling in late adolescence was associated with higher temperamental frustration (i.e., negative affectivity), lower temperamental attention (i.e., effortful control), and higher risk-taking behaviours, such as alcohol use. Moreover, there were several sex-dependent effects, whereby higher aggression in females and lower aggression in males were predictive of gambling problems.

The remaining four articles employed population or cohort longitudinal samples. Shenassa et al. (2012) employed data from 958 offspring of mothers enrolled in the Collaborative Perinatal Project (USA) to investigate the association between impulsive behaviour and shy/depressed behaviour at age 7 and the development of lifetime problem gambling in adulthood (mean age of 39 years) after controlling for demographic characteristics and childhood IQ. Although children who exhibited impulsive behaviours were more than 3 times more likely to report problem gambling than their non-impulsive counterparts, there was no significant association between shy/depressed behaviour and problem gambling. Delfabbro et al. (2014) used data from a four-wave longitudinal investigation of gambling behaviour in a sample of 256 young people in Australia who were interviewed in 2005 (age 16–19 years) then followed up by telephone two, three, and four years later. At-risk gamblers (including problem gamblers) at the final assessment were significantly more likely than non-problem gamblers to play keno, play private card games, gamble on horse/dog racing, recall a big win when they started gambling, and report an earlier gambling onset at the first assessment. Edgerton et al. (2014) used data from the Manitoba Longitudinal Study of Young Adults (USA), which began in 2007 with a sample of 679 young adults aged 18 to 20 years and involved

four cycles, concluding in 2011. Of 11 time-invariant predictors measured at 18–20 years (gender, age of gambling onset, a big early win, a big early loss, alcohol dependence, drug dependence, anxiety, depression, perceived social support, illusion of control, and impulsiveness), only impulsiveness affected the trajectory of change in gambling severity over time. Unexpectedly, however, higher impulsiveness predicted a slight acceleration in the rate of decline in problem gambling severity over time. Finally, using data from the population-based Swedish Longitudinal Gambling Study, Fröberg et al. (2015) followed 2241 16 to 24 year old participants for two years. Low and average school grades were associated with increased incidence of mild and moderate/severe problem gambling compared to high grades after adjusting for socio-demographic characteristics, psychological distress, and alcohol use. The probability of moderate/severe problem gambling was eight times higher for females and twice as high for males with low grades.

3.4. Risk of bias assessment

The risk of bias assessment (Appendix D) revealed that almost all articles employed a standardised measure of problem gambling (87.5%) and employed a current measure of problem gambling (87.5%). Many had follow-up periods longer than five years (58.3%) and did not have any sponsorship from the gambling industry (83.3%). Most reported non-adjusted effect sizes (66.7%), however, only 25.0% provided r as effect size estimates. The majority conducted the first assessment in adolescence or young adulthood (12–25 years of age; 75.0%) and used a representative sample (75.0%). Finally, 37.5% of the articles had their first assessment during the age of 12–17 years and their follow-up assessment after the age of 18 years.

3.5. Quantitative synthesis of early risk and protective factors

In this review, the included articles explored the associations between 88 thematic factors and problem gambling. However, 55 factors (25 individual, 17 relationship, 12 community, one societal) were investigated in only one sample and were therefore ineligible for inclusion in the quantitative synthesis of the findings (see Appendix E). The remaining 33 factors (29 individual, two relationship, two community) were included in the quantitative synthesis of findings. No societal factors were explored in a sufficient number of articles for inclusion in this quantitative synthesis.

Table 1 presents summary statistics for the Stouffer's p analyses and meta-analyses, including the I^2 statistic to indicate the amount of variation across articles due to heterogeneity and the Egger's test as an index of publication bias. The results relating to the sensitivity analyses for each of these thematic factors is presented in Appendix F. Stouffer's p-values and effect sizes (r) employed for the meta-analysis for each included association in the synthesis of findings are presented in Appendix G, and forest plot diagrams for each meta-analysis and sensitivity analysis are presented in Appendix H.

3.5.1. Significant early risk factors

Both the Stouffer's method and meta-analyses revealed that frequency of alcohol use, antisocial behaviours (including deviancy and theft), cannabis use, depressive symptoms, illicit drug use, impulsivity, male gender, number of gambling activities in the previous 12 months, peer antisocial behaviours (including deviancy), poor academic performance, problem gambling severity, sensation seeking, tobacco use, and violence reported at the first evaluation were significantly positively associated with subsequent problem gambling. Although the Stouffer's method failed to support the hypothesis that undercontrolled temperament reported at the first evaluation was significantly positively associated with subsequent problem gambling, a meta-analysis found evidence of a significant positive association with subsequent problem gambling. A brief description of the quantitative synthesis for each of these factors is provided below.

Table 1
Summary of findings for Stouffer's p and effect sizes.

Thematic factors	N of articles	N associations in Stouffer's p	N associations in meta-analysis	Stouffer's p	r (95% CI)	p value for r	I² (95% CI)	Eggers test two tailed p
Activation control	1	2	2	0.3741	−0.03 (−0.19, 0.12)	0.7189	0.00 (0.00, 81.75)	n/a
Age	2	2	0	0.1310	n/a	n/a	n/a	n/a
Aggression	2	3	3	0.5677	−0.03 (−0.31, 0.24)	0.8183	84.53 (39.64, 99.63)	0.8783
Alcohol use frequency	2	3	3	<0.0001	0.19 (0.15, 0.22)	<0.0001	0.00 (0.00, 95.74)	0.5442
Antisocial behaviours	4	6	6	0.0105	0.07 (0.01, 0.14)	0.0264	64.35 (0.00, 95.64)	0.3581
Anxiety symptoms	2	4	4	0.2802	0.00 (−0.06, 0.06)	0.9653	0.00 (0.00, 90.65)	0.8218
Attention problems	1	2	2	0.6192	−0.08 (−0.33, 0.16)	0.5145	59.99 (0.00, 99.96)	n/a
Big early gambling loss	2	2	0	0.1701	n/a	n/a	n/a	n/a
Big early gambling win	2	2	2	0.5000	0.03 (−0.29, 0.36)	0.8416	95.01 (74.92, 100)	n/a
Cannabis use	2	3	3	0.0064	0.15 (0.12, 0.19)	<0.0001	0.00 (0.00, 95.45)	0.6247
Depressive symptoms	6	7	7	0.0008	0.15 (0.03, 0.27)	0.0164	94.35 (84.77, 98.91)	0.2677
Dispositional attention	1	2	2	0.4342	−0.03 (−0.23, 0.18)	0.8059	42.3 (0.00, 99.94)	n/a
Early gambling onset	4	4	4	0.0093	0.13 (−0.01, 0.28)	0.0762	85.76 (55.16, 98.99)	<0.0001
Illicit drug use	5	7	7	<0.0001	0.14 (0.11, 0.17)	<0.0001	2.83 (0.00, 73.14)	0.206
Impulsivity	6	7	7	<0.0001	0.21 (0.11, 0.30)	<0.0001	87.89 (67.59, 97.63)	0.0844
Male gender	6	6	6	<0.0001	0.24 (0.16, 0.33)	<0.0001	88.81 (69.05, 98.42)	0.0188
Negative affect	2	3	3	0.0479	0.14 (−0.17, 0.45)	0.3650	90.41 (65.25, 99.74)	<0.0001
Number of gambling activities	2	3	3	0.0004	0.19 (0.14, 0.24)	<0.0001	0.20 (0.00, 98.05)	0.1561
Parent supervision	2	3	3	<0.0001	−0.10 (−0.18, −0.03)	0.0079	60.48 (0.00, 99.05)	0.892
Peer antisocial behaviours	2	3	3	<0.0001	0.12 (0.07, 0.16)	<0.0001	34.81 (0.00, 97.54)	0.1079
Poor academic performance	3	4	4	<0.0001	0.24 (0.09, 0.39)	0.0021	80.68 (22.26, 99.31)	0.0016
Problem gambling severity	5	5	5	<0.0001	0.40 (0.26, 0.54)	<0.0001	96.61 (90.5, 99.58)	0.5333
Psychological distress	2	2	2	0.4145	0.05 (−0.07, 0.18)	0.4184	78.95 (0.00, 99.98)	n/a
Religious attendance	2	2	2	0.5917	0.09 (−0.11, 0.29)	0.3698	98.68 (93.34, 100)	n/a
Safety related risk taking	1	2	2	0.0471	0.14 (−0.01, 0.29)	0.0767	0.00 (0.00, 99.61)	n/a
Sensation seeking	2	2	2	0.0009	0.02 (0.01, 0.04)	0.0081	0.00 (0.00, 99.85)	n/a
Sexual risk taking	1	2	2	0.0433	0.14 (−0.01, 0.29)	0.0766	0.00 (0.00, 99.73)	n/a
Social problems	1	2	2	0.9016	−0.16 (−0.32, −0.01)	0.0374	0.00 (0.00, 99.88)	n/a
Socio-economic status	3	3	3	0.0037	−0.07 (−0.11, −0.03)	0.0006	0.00 (0.00, 75.74)	0.9064
Suicidal ideation	1	2	2	0.7180	−0.03 (−0.19, 0.13)	0.7079	0.00 (0.00, 98.7)	n/a
Tobacco use	2	3	3	0.0022	0.14 (0.10, 0.18)	<0.0001	0.00 (0.00, 0.00)	0.8912
Undercontrolled temperament	1	2	2	0.0849	0.22 (0.13, 0.31)	<0.0001	50.28 (0.00, 99.95)	n/a
Violence	2	4	4	0.0033	0.12 (0.06, 0.17)	<0.0001	0.00 (0.00, 80.46)	0.5535

3.5.2. Alcohol use frequency

Alcohol use frequency displayed a small mean effect size with subsequent problem gambling. There was no heterogeneity in effect size estimates between associations and no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using non-standardised measures of problem gambling and adjusted data.

3.5.3. Antisocial behaviours

Antisocial behaviours displayed a small mean effect size with subsequent problem gambling. There was high heterogeneity in effect size estimates between associations but no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using non-standardised measures of problem gambling,

industry sponsorship, adjusted data, effect size estimates other than r, and non-representative samples.

3.5.4. Cannabis use

Cannabis use displayed a small mean effect size with subsequent problem gambling. There was no heterogeneity in effect size estimates between associations and no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using non-standardised measures of problem gambling and adjusted data.

3.5.5. Depressive symptoms

Depressive symptoms displayed a small mean effect size with subsequent problem gambling. There was very high heterogeneity in effect size estimates between associations but no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using non-standardised measures of problem gambling, lifetime measures of problem gambling, follow-up periods shorter than five years, industry sponsorship, adjusted data, first assessment during childhood, and effect size estimates other than r. Although the mean effect size was lower when restricting to articles that conducted the follow-up assessment after the legal gambling age, the overlap in confidence intervals suggests this result is not inconsistent with the overall meta-analytic effect.

3.5.6. Illicit drug use

Illicit drug use displayed a small mean effect size with subsequent problem gambling. There was almost no heterogeneity in effect size estimates between associations and no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using non-standardised measures of problem gambling, follow-up periods shorter than five years, adjusted data, follow-up assessment before the legal gambling age, effect size estimates other than r, and non-representative samples.

3.5.7. Impulsivity

Impulsivity displayed a small to medium mean effect size with subsequent problem gambling. There was high heterogeneity in effect size estimates between associations but no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using lifetime measures of problem gambling, follow-up periods shorter than five years, industry sponsorship, follow-up assessment before the legal gambling age, and effect size estimates other than r. Although articles in which the first assessment was conducted during adolescence or young adulthood reported smaller estimates relative to results from all articles, the overlap in confidence intervals suggests this result is not inconsistent with the overall meta-analytic effect.

3.5.8. Male gender

Male gender displayed a medium mean effect size with subsequent problem gambling. There was high heterogeneity in effect size estimates between associations and a significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using non-standardised measures of problem gambling, lifetime measures of problem gambling, follow-up periods shorter than five years, industry sponsorship, adjusted data, first assessment during childhood, and follow-up assessment before the legal gambling age.

3.5.9. Number of gambling activities

The number of gambling activities displayed a small to medium mean effect size with subsequent problem gambling. There was almost no heterogeneity in effect size estimates between associations and no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using follow-up periods shorter than five years, follow-up assessment before the legal gambling age, effect size estimates other than r, and non-representative samples.

3.5.10. Peer antisocial behaviours

Peer antisocial behaviours displayed a small mean effect size with subsequent problem gambling. There was relatively low heterogeneity in effect size estimates between associations and no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using non-standardised measures of problem gambling, adjusted data, effect size estimates other than r, and non-representative samples.

3.5.11. Poor academic performance

Poor academic performance displayed a medium mean effect size with subsequent problem gambling. There was high heterogeneity in effect size estimates between articles and a significant publication bias. A sensitivity analysis suggested that these results are robust to the inclusion of articles using industry sponsorship. Although sensitivity analyses suggested that articles with follow-up periods longer than five years and articles in which the follow-up assessment was conducted after the legal gambling age reported smaller estimates relative to results from all articles, the overlap in confidence intervals suggests these results are not inconsistent with the overall meta-analytic effect.

3.5.12. Problem gambling severity

Problem gambling severity displayed a strong mean effect size with subsequent problem gambling. There was very high heterogeneity in effect size estimates between associations but no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using lifetime measures of problem gambling, industry sponsorship, adjusted data, first assessment during childhood, follow-up assessment before the legal gambling age, and non-representative samples. Although a sensitivity analysis suggested that articles using effect size estimates of r reported smaller effect size estimates relative to results from all articles, the overlap in confidence intervals suggests these results are not inconsistent with the overall meta-analytic effect.

3.5.13. Sensation seeking

Sensation seeking displayed a small mean effect size with subsequent problem gambling. There was high heterogeneity in effect size estimates between articles. Sensitivity analyses were not conducted due to insufficient data.

3.5.14. Tobacco use

Tobacco use displayed a small mean effect size with subsequent problem gambling. There was no heterogeneity in effect size estimates between associations and no significant publication bias. A sensitivity analysis suggested that these results are robust to the inclusion of articles using adjusted data.

3.5.15. Undercontrolled temperament

Undercontrolled temperament displayed a small to medium mean effect size with subsequent problem gambling. There was moderate heterogeneity between articles. Sensitivity analyses were not conducted due to insufficient data.

3.5.16. Violence

Violence displayed a small mean effect size with subsequent problem gambling. There was no heterogeneity in effect size estimates between associations and no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using effect size estimates other than r and non-representative samples.

3.5.17. Significant early protective factors

Both the Stouffer's method and meta-analyses revealed that parent supervision and socio-economic status reported at the first evaluation were significantly negatively associated with subsequent problem

gambling. Although the Stouffer's method failed to support the hypothesis that social problems at the first evaluation were significantly positively associated with subsequent problem gambling, a meta-analysis revealed that social problems displayed a significant negative association with subsequent problem gambling. A brief description of the quantitative synthesis for each of these factors is provided below.

3.5.18. Parent supervision

Parent supervision displayed a small mean effect size with subsequent problem gambling. There was moderate heterogeneity in effect size estimates between associations but no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using lifetime measures of problem gambling, effect size estimates other than r, and non-representative samples.

3.5.19. Social problems

Social problems displayed a small mean effect size with subsequent problem gambling. There was no heterogeneity in effect size estimates between articles. Sensitivity analyses were not conducted due to insufficient data.

3.5.20. Socio-economic status

Socio-economic status displayed a small mean effect size with subsequent problem gambling. There was no heterogeneity in effect size estimates between associations and no significant publication bias. Sensitivity analyses suggested that these results are robust to the inclusion of articles using effects size estimates other than r.

3.5.21. Non-significant factors

Both the Stouffer's method and meta-analyses revealed that activation control (the capacity to perform an action when there is a strong tendency to avoid it; Ellis & Rothbart, 2001), aggression, anxiety symptoms, attention problems, a big early gambling win, dispositional attention, psychological distress (including internalising symptoms), religious attendance, and suicidal ideation at the first evaluation were not significantly associated with subsequent problem gambling. Although the Stouffer's method supported the hypotheses that early gambling onset, negative affect, safety-related risk taking, and sexual risk taking reported at the first evaluation were significantly positively associated with subsequent problem gambling, meta-analyses found that these factors were not significantly associated with subsequent problem gambling. Although meta-analyses were not conducted due to insufficient data, the Stouffer's method also failed to support the hypotheses that age and a big early gambling loss at the first evaluation were significantly positively associated with subsequent problem gambling.

4. Discussion

This is the first systematic review to identify factors that increase the risk, or are protective, for the development of gambling problems. This review used robust, replicable and reliable procedures to systematically identify and synthesise all available longitudinal evidence relating to risk and protective factors measured during childhood, adolescence, and young adulthood. The findings add new evidence that there are particular factors from this developmental period that longitudinally predict the development of problem gambling. The findings from 15 studies in 23 articles identified 18 thematic factors (15 thematic risk factors and three thematic protective factors) for which there is a sufficient evidence base to posit a longitudinal association with problem gambling.

4.1. Early risk factors for problem gambling

The review identified 15 longitudinal thematic risk factors for the development of gambling problems. These included 13 individual factors (alcohol use frequency, antisocial behaviours, depression, male

gender, cannabis use, illicit drug use, impulsivity, number of gambling activities, problem gambling severity, sensation seeking, tobacco use, violence, uncontrolled temperament), one relationship factor (peer antisocial behaviours), and one community factor (poor academic performance). No early risk factors for the development of problem gambling classified in the societal level of the socio-ecological model were identified in the review.

Meta analyses revealed that the significant thematic risk factors identified in the present review typically had small to medium effect sizes. Although considerable reduction in the number of independent factors is common when multivariate analyses are used to identify longitudinal predictors of gambling behaviour (Scholes-Balog et al., 2014), many of the thematic factors identified in the present review appeared robust to this issue as they maintained significant effects in multivariate analyses. In this sense, they meet Loxley et al.'s (2004) expanded definition of risk factors representing theoretically independent domains.

The only socio-demographic thematic risk factor was male gender, which was among the strongest thematic risk factors, with a significant medium mean effect size. Although legislative changes involving the expansion of the gaming industry have significantly altered the male-dominated gambling culture in many jurisdictions (Dowling, 2013), the findings of the present review suggest that males are still at considerably higher risk of developing gambling problems relative to their female counterparts. Gender subgroup analyses were precluded from the present review due to the small number of articles including gender-specific associations. A better understanding of the gender differences in the risk and protective factors associated with the development of problem gambling may allow for the design of more effective, gender-sensitive prevention and intervention programs. It has, however, been argued that gender may not be a direct predictor but rather a proxy for other risk factors such as violence and illicit drug use (Nelson, LaPlante, LaBrie, & Shaffer, 2006). This gender-as-proxy hypothesis implies that although gender uniquely contributes to gambling patterns, gendered explanations are unlikely to maintain any predictive power across time and settings, once more direct risk factors are included. It has therefore been suggested that gambler profiles based on demographic, economic, and health-related factors are more helpful in predicting gambling behaviour in a manner that can inform the design of prevention and intervention programs.

The gambling behaviour of children and adolescents emerges in the present review as an important longitudinal individual thematic risk factor for the development of problem gambling. Problem gambling severity was the strongest of all thematic risk factors identified in the review, with a significant medium to large effect size. In addition, the number of gambling activities in which youth participated was a strong thematic risk factor, with a small to medium effect size. These findings are consistent with a growing body of evidence that the severity of the gambling behaviour is one of the strongest predictors of outcome in the treatment (Dowling, 2009; Merkouris, Thomas, Browning, & Dowling, 2016). This information suggests that screening accompanied with early intervention may provide an effective strategy for preventing gambling problems.

Several thematic risk factors relating to alcohol and substance use were also identified in the present review, with small to medium effect sizes for alcohol use frequency, cannabis use, illicit drug use, and tobacco use. These findings are consistent with the cross-sectional literature that has also found that adolescents displaying gambling-related problems are at increased risk for alcohol or substance use (e.g. Delfabbro et al., 2006; Gupta & Derevensky, 1998; Hardoon & Derevensky, 2002; Jacobs, 2000; Langhinrichsen-Rohling, Rohde, Seeley, & Rohling, 2004; Nower et al., 2004; Stinchfield, 2000) and that a significant proportion of individuals simultaneously drink and gamble (Baron & Dickerson, 1999; Giacopassi, Stitt, & Vandiver, 1998).

Several theories have been advanced to explain the association between substance use disorders and problem gambling (Baron & Dickerson, 1999; Cooney, Litt, Morse, Bauer, & Gaupp, 1997; Cronce &

Corbin, 2010; Giacopassi et al., 1998; Kyngdon & Dickerson, 1999). These include the cross-substance coping response hypothesis (negative reinforcement may promote simultaneous use as a part of a self-regulation strategy, whereby substance use can alleviate the aversive effects of gambling, and vice versa), theories based on positive reinforcement principles (the positively rewarding effects of substance use or gambling are enhanced when the two behaviours are engaged in simultaneously or that acute cross-tolerance results in increased involvement in gambling to provide alternative rewards), the cross-substance cue reactivity model (repeated pairings of gambling cues with substance use behaviour and vice versa are thought to result in these cues acquiring conditioned stimulus properties), and the attention allocation model (substances impair the ability to process information and restrict attention to only the most salient internal and environmental cues, a phenomenon known as alcohol myopia). Further prospective naturalistic research investigating drinking, other substance use and gambling episodes at the event level would enhance our understanding of the distribution of these episodes as they occur in real life.

In this review, antisocial behaviours (including delinquency and theft), violence, peer antisocial behaviours (including deviancy), and poor academic performance were significant longitudinal thematic risk factors for gambling problems. Although these risk factors generally displayed relatively small effect sizes, poor academic performance in young people displayed the strongest association with subsequent problem gambling, with a medium effect size. Taken together, these findings are consistent with previous cross-sectional research that suggests that problem gambling behaviour is part of a constellation of other antisocial, risk-taking, violent, and delinquent behaviours in adolescence, particularly for males (Jacobs, 2000; Stinchfield, 2000; Vitaro et al., 2001).

The present findings also identified several personality characteristics of young people as risk factors for the development of gambling problems, including impulsivity, sensation seeking, and undercontrolled temperament. Impulsivity and undercontrolled temperament were among the strongest thematic risk factors identified in the present review, displaying small to medium mean effect sizes. These findings align with the cross-sectional evidence base that has consistently identified dispositional characteristics including impulsivity, excitability, disinhibition, intensity-seeking, and risk-propensity as concurrent risk factors for problem gambling, particularly for male youth (Dickson et al., 2008; Gupta & Derevensky, 1998; Nower et al., 2004; Vitaro et al., 1997, 1999; Vitaro et al., 2001). Taken together, these findings suggest that the tendency to be impatient, overactive, impulsive, and easily distracted, with an inability to foresee negative consequences and to stop responding despite unfavorable contingencies puts youth at risk for developing gambling problems.

Another important finding from the present review was that there were non-significant longitudinal associations between many internalising symptoms (anxiety symptoms, psychological distress, negative affect, and suicidal ideation) and subsequent gambling problems. Moreover, while the longitudinal association between early depression and problem gambling was significant, the effect size was relatively small and many of the included articles failed to find a significant relationship between depression and problem gambling (Edgerton et al., 2014; Lee et al., 2011; Scholes-Balog et al., 2014; Shenassa et al., 2012; Yücel et al., 2015). Taken together, these findings suggest that the relationship between internalising symptoms and problem gambling, at least in adolescence and young adulthood, is not as strong as the cross-sectional literature (Delfabbro et al., 2006; Dickson et al., 2008; Gupta & Derevensky, 1998; Jacobs, 2000; Langhinrichsen-Rohling et al., 2004) would suggest. They indicate that internalising symptoms and problem gambling may co-exist because internalising symptoms are, in fact, consequences of problem gambling behaviour or that the two problems co-exist because they share common causes. Alternatively, it may be the result of a longitudinal association between internalising symptoms and problem gambling in

a sub-sample of problem gamblers being "washed out" in estimates from full samples (Scholes-Balog et al., 2015). Future prospective research using person-centred methods, such as latent class analysis or event-related approaches, may help to clarify the exact nature of these relationships.

4.2. Early protective factors for problem gambling

The review identified only three early thematic protective factors for the development of gambling problems: parent supervision, socio-economic status, and social problems. There were small, but significant, mean effects for each of these protective factors. The findings of the included articles, however, were mixed for both parent supervision and socio-economic status. These inconsistent findings are reflected in cross-sectional adolescent literature for both parent supervision (Chalmers & Willoughby, 2006; Magoon & Ingersoll, 2006; Vachon et al., 2004) and socio-economic status (Delfabbro et al., 2006; Molde, Pallesen, Bartone, Hystad, & Johnsen, 2009; Welte, Barnes, Tidwell, & Hoffman, 2008). Contrary to expectations, social problems were a significant protective factor in the subsequent development of problem gambling, suggesting that youth who get along with, and are liked by, their peers are more at risk for gambling problematically. Yücel et al. (2015) explain that socializing with peers may represent one pathway to problem gambling development. Further longitudinal research exploring the role of different aspects of these three early protective factors in the development of problem gambling is required. Moreover, there is a clear need for additional research exploring the role of other protective factors, particularly those from the community and societal domains, in the development of problem gambling.

4.3. Factors with a minimal evidence base

Non-significant effects were identified for 14 individual thematic factors (activation control, age, aggression, anxiety symptoms, attention problems, big early loss, big early win, dispositional attention, early gambling onset, negative affect, psychological distress, safety-related risk taking, sexual risk taking, and suicidal ideation) and one community thematic factor (religious attendance). Moreover, there were 55 factors representing all levels of the socio-ecological model that were investigated in only one article. Many of these factors displayed significant risk or protective relationships with subsequent problem gambling. For example, several individual factors (such as rebelliousness, never married status, ADHD, and gambling participation on various gambling activities), relationship factors (such as family conflict, family history of antisocial behaviour, friends' use of drugs, peer rewards for antisocial involvement, and parental gambling history), and community factors (such as low school commitment) have displayed significant risk relationships with subsequent problem gambling in at least one article. Similarly, several individual factors (such as belief in the moral order, education, and constraint) and relationship factors (such as family rewards for prosocial involvement) have displayed significant protective relationships with subsequent problem gambling in at least one article. These factors would therefore be good candidates for testing in future prospective research.

4.4. Strengths and limitations of the existing evidence base

The risk of bias assessment and associated sensitivity analyses revealed several strengths of the available evidence base. Most articles employed a standardised measure of current problem gambling, did not have any sponsorship from the gambling industry, and conducted the first assessment in adolescence or young adulthood. Approximately three-quarters of the included articles employed community-representative samples and reported non-adjusted effect sizes in the analyses. Over half of the included articles had follow-up periods longer than five years and publication bias estimates were generally low. Moreover,

the sensitivity analyses revealed that the results of the review were generally robust to the inclusion of articles using non-standardised measures of problem gambling, lifetime measures of problem gambling, industry sponsorship, first assessment during childhood, non-representative samples, adjusted effect sizes, follow-up assessment before the legal gambling age, and follow-up periods shorter than five years.

Despite these strengths, the review identified a relatively limited evidence base from which to draw conclusions about risk and protective factors for problem gambling. There was a limited number of articles eligible for inclusion in the review and a limited number of factors eligible for inclusion in the quantitative synthesis of findings. Most of the factors were classified in the individual level of the socio-cultural model, with much smaller proportions in the relationship level, community level, and societal level. There is a clear need for future research to explore risk and protective factors in these levels of the socio-ecological framework.

Relatedly, the emphasis of most of the included articles was on the identification of risk factors, rather than protective factors. Moreover, few studies have explored the role of protective factors that operate by decreasing the probability of problem gambling development in the presence of risk, such as by interacting with a risk factor to mitigate or buffer its effects (Coie et al., 1993; Dickson et al., 2008; Farrington & Ttofi, 2011; Loxley et al., 2004; Lussier et al., 2014). In statistical terms, these protective factors imply a mitigating-buffering moderation effect, so that the strength of the relationship between a risk factor and problem gambling decreases when the level of the protective factor is high (Dickson et al., 2008; Lussier et al., 2014). It is clearly more difficult to identify factors that longitudinally play a compensatory or protective role in the development of problem gambling than factors that play a risk role. For example, Scholes-Balog et al. (2015) found that none of the 15 hypothesised protective factors across the individual, relationship, and community domains displayed a significant association with subsequent problem gambling in young adults. Moreover, they identified no statistically significant protective factors that buffered the relationship between internalising symptoms and subsequent problem gambling.

A notable feature of the findings was significant variability in the estimates for approximately one-third of the thematic factors. Although a strength of this systematic review is that it was able to comprehensively explore the degree to which the effect size estimates fluctuated as a function of methodological considerations using sensitivity analyses, none of these potentially relevant factors consistently explained these variations and there was large imprecision in the sensitivity analysis estimates given the small number of articles included. As more studies become available, future updates of this review will allow for more robust examination of the factors identified for sensitivity analyses in the current review and may consider the effect of other sample characteristics (such as sample size, gender composition, age, level of problem severity, and ethnic composition), measurement factors (such as informant, method and quality of risk or protective factor measurement), or methodological considerations (such as rates of attrition, jurisdiction, use of weighted data, year of publication, and publication bias).

Articles were often limited by sample sizes that are too small to capture a sufficient number of more severe problem gamblers and relatively high rates of attrition over the study period. Many articles therefore employed a low threshold definition of problem gambling, including those at lower levels of risk, to obtain adequate numbers of affected individuals. Even using this procedure, the small numbers of problem gamblers in many of the articles may have contributed to the relatively small effect sizes identified for most of the risk and protective factors. There is also some evidence that non-contacted participants at follow-up evaluations are likely to display higher rates of problem gambling and other pathological outcomes relative to their successfully contacted counterparts (Fröberg et al., 2015; Slutske et al., 2003).

Many of the articles assumed that gambling behaviour is absent at the first evaluation period and only measured gambling problems at one later point in time. Not only does this preclude the drawing of conclusions regarding changes in problem gambling status across time, it precludes the examination of prospective cross-lagged links among problem gambling and other factors. In addition, the majority of the final evaluations were conducted in adolescence and young adulthood. This indicates the need for further research with longer follow-up periods which will allow for the examination of how these early risk and protective factors predict problem gambling in mid to late adulthood.

There are several other methodological and reporting limitations that may be important to consider when designing future research. Most of the included articles reported on research conducted in North America, many employed non-standardised measurement of predictors, and many did not report important study characteristics. The included articles were also subject to the limitations of self-report methodology, including socially desirable responding. Moreover, several of the thematic risk factors (e.g., gender, early onset of gambling) were time invariant predictors and it is therefore possible that the relationship these variables have to problem gambling can also be explored using cross-sectional studies. Finally, it must be noted that this review attempts to identify factors involved in the development of problem gambling, rather than gambling involvement per se. It may be that the factors that influence the involvement in gambling are different from those that are involved in the development of gambling problems; for example, there is some evidence that there is a different set of factors associated with the frequency of gambling than the likelihood of gambling disorder among high-frequency gamblers (Hodgins et al., 2012). Further research attempting to differentiate between the factors that contribute to a greater probability of involvement in gambling and the factors associated with the development of gambling problems for high-frequency gamblers is required.

4.5. Implications for research translation

These limitations notwithstanding, the findings of the current systematic review provide important new insights regarding risk and protective factors in childhood, adolescence, and young adulthood that influence the development of problem gambling. The current findings have implications for the development of programs to prevent problem gambling. The accurate identification of consistent evidence for modifiable characteristics within individuals, peers, parents, families, and communities that can be targeted to lower future risks for gambling problems is necessary for the development of effective prevention and intervention initiatives. The findings of this systematic review and meta-analysis suggest that risk factors with medium to strong effects in longitudinally predicting gambling problems included: problem gambling severity, male gender, and poor academic performance. Risk factors that had smaller effects as longitudinal predictors of gambling problems included: number of gambling activities, impulsivity, sensation seeking, undercontrolled temperament, antisocial behaviours, violence, peer antisocial behaviours, depressive symptoms, alcohol use frequency, cannabis use, illicit drug use, and tobacco use. The range and diversity of influences suggests the potential to include multiple early risk factors in population-level surveys in order to tailor a strategic mix of individual, school and family-level prevention programs to reduce the factors that are elevated within a specific community (Hawkins et al., 2008). Approaches of this type have been shown to be effective in preventing the development of adolescent substance misuse and antisocial behaviour (Hawkins et al., 2009).

Interestingly, the problem gambling risk factors identified in the present review are similar to those for other problem behaviours such as alcohol, tobacco, marijuana use, and delinquency (Bond, Toumbourou, Thomas, Catalano, & Patton, 2005; Hemphill et al., 2011; Vitaro et al., 2001; Wanner et al., 2009). These findings suggest that some of the identified early risk factors indirectly influence gambling through their influence on alcohol use (Scholes-Balog et al., 2014). The present findings are consistent with problem behaviour theory,

which suggests that adolescents who are prone to one problem behaviour are prone to other problem behaviours (Donovan, Jessor, & Costa, 1991). The findings are also consistent with the syndrome model of addiction, which views addiction as a syndrome with multiple potential presentations (Shaffer et al., 2004). Regardless of their mechanisms, the similarity in risk factors between these problem behaviours highlight the need for global prevention efforts that target multiple problem behaviours, not just problem gambling (Scholes-Balog et al., 2014; Shenassa et al., 2012; Vitaro et al., 2001; Winters et al., 1995; Winters et al., 2002).

Involvement in a greater number of gambling activities had consistent small to medium longitudinal effects and problem gambling severity had strong effects in predicting later problems with gambling. These findings suggest the importance of screening gambling behaviour in young people in order to target brief intervention strategies to address high-risk profiles for gambling problems (Winters et al., 2002). Strategies of this type have been successful as early interventions to reduce youth alcohol and drug problems (Tanner-Smith & Lipsey, 2015). Schools serve as places where these broad-based interventions can be implemented efficiently and effectively.

The findings of this review also suggest that prevention and intervention initiatives should encourage protective factors related to parent supervision and socio-economic status. While interventions for modifying socio-economic status are less obvious than those for increasing parental supervision, there is evidence that interventions addressing the underlying determinants of low socio-economic status (for example, enhancing education pathways) improve healthy child development while also reducing the adolescent antisocial behaviours associated with problem gambling (Toumbourou et al., 2007). There remains, however, insufficient investigation of protective factors related to problem gambling to determine whether they reflect those for other addictive behaviours (e.g., Scholes-Balog et al., 2015). Further research efforts are therefore required to identify protective factors that reduce the development of gambling problems in young people.

5. Conclusions

This systematic review and meta-analysis identified typically small to medium effects for a range of early factors that predict the development of problem gambling. Overall, this review identified 13 individual thematic risk factors (alcohol use frequency, antisocial behaviours, depression, male gender, cannabis use, illicit drug use, impulsivity, number of gambling activities, problem gambling severity, sensation seeking, tobacco use, violence, undercontrolled temperament), one relationship thematic risk factor (peer antisocial behaviours), one community thematic risk factor (poor academic performance), one individual thematic protective factor (socio-economic status), and two relationship thematic protective factors (parent supervision, social problems) that were significantly associated with subsequent problem gambling. A further 15 thematic factors were not significantly associated with subsequent problem gambling (activation control, age, aggression, anxiety symptoms, attention problems, big early loss, big early win, dispositional attention, early gambling onset, negative affect, psychological distress, religious attendance, safety-related risk taking, sexual risk taking, and suicidal ideation).

This systematic review highlighted the relatively limited evidence base related to early risk and protective factors for the development of problem gambling. Based on the socio-ecological model, the majority of the thematic factors were classified in the individual level, with fewer thematic factors classified in the relationship, community and societal level. Furthermore, the majority of the included articles focused on the identification of risk factors rather than protective factors. Importantly, the findings of this review emphasize the need for future longitudinal research to investigate relationship level, community level and societal level risk and protective factors associated with the development of subsequent problem gambling.

The identification of such factors will inform the development of effective prevention and intervention programs for problem gambling. The findings of this review suggest that initiatives should aim to counteract risk factors related to gambling behaviours, alcohol and drug use, other antisocial and risk taking behaviours, impulsivity and other undercontrolled dispositional characteristics, and depression symptoms, particularly for young males. Moreover, the results indicate that prevention and intervention initiatives should reinforce protective factors related to parent supervision, socio-economic status and social problems. Interestingly, the risk factors identified in this review are similar to those for other problem behaviours, such as alcohol, tobacco use, marijuana use, and delinquency. These findings highlight the need for global prevention efforts that target multiple problem behaviours, not just problem gambling, as well as the importance of screening young people with these high-risk profiles for gambling problems.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.cpr.2016.10.008.

References[*]

American Psychiatric Association (APA) (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Ariyabuddhiphongs, V. (2013). Adolescent gambling: A narrative review of behavior and its predictors. *International Journal of Mental Health and Addiction*, 11(1), 97–109.

Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, 55(5), 469–480.

Arnett, J. J., Žukauskiene, R., & Sugimura, K. (2014). The new life stage of emerging adulthood at ages 18-29 years: Implications for mental health. *Lancet Psychiatry*, 1(7), 569–576.

Baron, E., & Dickerson, M. (1999). Alcohol consumption and self-control of gambling behaviour. *Journal of Gambling Studies*, 15(1), 3–15.

Blinn-Pike, L., Worthy, S. L., & Jonkman, J. N. (2010). Adolescent gambling: A review of an emerging field of research. *The Journal of Adolescent Health*, 47(3), 223–236.

Bond, L., Toumbourou, J. W., Thomas, S. A., Catalano, R. F., & Patton, G. C. (2005). Individual, family, school and community risk and protective factors for depressive symptoms in adolescents: A comparison of risk profiles for substance use and depressive symptoms. *Prevention Science*, 6(2), 73–88.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). Converting among effect sizes. *Introduction to meta-analysis* (pp. 45–49).

Breyer, J. L., Botzet, A. M., Winters, K. C., Stinchfield, R. D., August, G., & Realmuto, G. (2009*). Young adult gambling behaviors and their relationship with the persistence of ADHD. *Journal of Gambling Studies*, 25(2), 227–238.

Cairns, K. E., Yap, M. B., Pilkington, P. D., & Jorm, A. F. (2014). Risk and protective factors for depression that adolescents can modify: A systematic review and meta-analysis of longitudinal studies. *Journal of Affective Disorders*, 169, 61–75.

---

[*] References of included articles.

Chalmers, H., & Willoughby, T. (2006). Do predictors of gambling involvement differ across male and female adolescents? *Journal of Gambling Studies, 22*(4), 373–392.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159.

Coie, J. D., Watt, N. F., West, S. G., Hawkins, J. D., Asarnow, J. R., Markman, H. J., ... Long, B. (1993). The science of prevention. A conceptual framework and some directions for a national research program. *American Psychologist, 48*(10), 1013–1022.

Cooney, N. L., Litt, M. D., Morse, P. A., Bauer, L. O., & Gaupp, L. (1997). Alcohol cue reactivity, negative-mood reactivity, and relapse in treated alcoholic men. *Journal of Abnormal Psychology, 106*(2), 243–250.

Cronce, J. M., & Corbin, W. R. (2010). Effects of alcohol and initial gambling outcomes on within-session gambling behavior. *Experimental and Clinical Psychopharmacology, 18*(2), 145–157.

Dahlberg, L. L., & Krug, E. G. (2002). Violence: A global public health problem. In E. Krug, L. L. Dahlberg, J. A. Mercy, A. B. Zwi, & R. Lozano (Eds.), *World report on violence and health* (pp. 1–56). Geneva, Switzerland: World Health Organization.

Darlington, R. B., & Hayes, A. F. (2000). Combining independent *p* values: Extensions of the Stouffer and binomial methods. *Psychological Methods, 5*(4), 496–515.

Delfabbro, P., King, D., & Griffiths, M. D. (2014*). From adolescent to adult gambling: An analysis of longitudinal gambling patterns in South Australia. *Journal of Gambling Studies, 30*(3), 547–563.

Delfabbro, P., Lahn, J., & Grabosky, P. (2006). Psychosocial correlates of problem gambling in Australian students. *Australian and New Zealand Journal of Psychiatry, 40*(6–7), 587–595.

Derevensky, J. L., Gupta, R., & Winters, K. (2003). Prevalence rates of youth gambling problems: Are the current rates inflated? *Journal of Gambling Studies, 19*(4), 405–425.

Development Core Team, R. (2015). *R: A language and environment for statistical computing.* Vienna, Austria: R Foundation for Statistical Computing.

Dickson, L. M., Derevensky, J. L., & Gupta, R. (2002). The prevention of gambling problems in youth: A conceptual framework. *Journal of Gambling Studies, 18*(2), 97–159.

Dickson, L. M., Derevensky, J. L., & Gupta, R. (2008). Youth gambling problems: Examining risk and protective factors. *International Gambling Studies, 8*(1), 25–47.

Dixon, R. W., Youssef, G. J., Hasking, P., Yücel, M., Jackson, A. C., & Dowling, N. A. (2016). The relationship between gambling attitudes, involvement, and problems in adolescence: Examining the moderating role of coping strategies and parenting styles. *Addictive Behaviors, 58*, 42–46.

Donovan, J. E., Jessor, R., & Costa, F. M. (1991). Adolescent health behavior and conventionality-unconventionality: An extension of problem-behavior theory. *Health Psychology, 10*(1), 52–61.

Dowling, N. A. (2009). Client characteristics associated with treatment attrition and outcome in female pathological gambling. *Addiction Research and Theory, 17*(2), 205–219.

Dowling, N. A. (2013). The cognitive-behavioral treatment of female problem gambling. In D. C. S. Richard, A. Blaszczynski, & L. Nower (Eds.), *The Wiley-Blackwell handbook of disordered gambling.* Chichester, UK: John Wiley & Sons Ltd.

Dussault, F., Brendgen, M., Vitaro, F., Wanner, B., & Tremblay, R. E. (2011*). Longitudinal links between impulsivity, gambling problems and depressive symptoms: A transactional model from adolescence to early adulthood. *Journal of Child Psychology and Psychiatry, 52*(2), 130–138.

Edgerton, J. D., Melnyk, T. S., & Roberts, L. W. (2014*). Problem gambling and the youth-to-adulthood transition: Assessing problem gambling severity trajectories in a sample of young adults. *Journal of Gambling Studies, 30*(3), 1–23.

Egger, M., Smith, G. D., & Phillips, A. N. (1997). Meta-analysis: Principles and procedures. *British Medical Journal, 315*(7121), 1533–1537.

Ellis, L. K., & Rothbart, M. K. (April 2001). Revision of the early adolescent temperament questionnaire. *Paper presented at the poster presented at the biennial meeting of the Society for Research in Child Development, Minneapolis, MN.*

Faigin, C. A., Pargament, K. I., & Abu-Raiya, H. (2014*). Spiritual struggles as a possible risk factor for addictive behaviors: An initial empirical investigation. *The International Journal for the Psychology of Religion, 24*(3), 201–214.

Farrington, D. P., & Ttofi, M. M. (2011). Protective and promotive factors in the development of offending. In T. Bliesener, A. Beelmann, & M. Stemmler (Eds.), *Antisocial behavior and crime: Contributions of developmental and evaluation research to prevention and intervention* (pp. 71–88). Cambridge, MA: Hogrefe Publishing.

Fröberg, F., Modin, B., Rosendahl, I. K., Tengström, A., & Hallqvist, J. (2015*). The association between compulsory school achievement and problem gambling among Swedish young people. *The Journal Of Adolescent Health: Official Publication Of The Society For Adolescent Medicine, 56*(4), 420–428.

Giacopassi, D., Stitt, B. G., & Vandiver, M. (1998). An analysis of the relationship of alcohol to casino gambling among college students. *Journal of Gambling Studies, 14*(2), 135–149.

Gupta, R., & Derevensky, J. L. (1998). An empirical Examinination of Jacobs' general theory of addictions: Do adolescent gamblers fit the theory? *Journal of Gambling Studies, 14*(1), 17–49.

Hardoon, K., & Derevensky, J. L. (2002). Child and adolescent gambling behavior: Current knowledge. *Clinical Child Psychology and Psychiatry, 7*, 263–281.

Hawkins, J. D., Brown, E. C., Oesterle, S., Arthur, M. W., Abbott, R. D., & Catalano, R. F. (2008). Early effects of communities that care on targeted risks and initiation of delinquent behavior and substance use. *Journal of Adolescent Health, 43*(1), 15–22.

Hawkins, J. D., Oesterle, S., Brown, E. C., Arthur, M. W., Abbott, R. D., Fagan, A. A., & Catalano, R. F. (2009). Results of a type 2 translational research trial to prevent adolescent drug use and delinquency: A test of communities that care. *Archives of Pediatrics and Adolescent Medicine, 163*(9), 789–798.

Hemphill, S. A., Heerde, J. A., Herrenkohl, T. I., Patton, G. C., Toubourou, J. W., & Catalano, R. F. (2011). Risk and protective factors for adolescent substance use in Washington State, the United States and Victoria, Australia: A longitudinal study. *Journal of Adolescent Health, 49*(3), 312–320.

Higgins, J. P. T., & Green, S. (2011). Cochrane handbook for systematic reviews of interventions version 5.1.0 [updated March 2011]. *The cochrane collaboration* (Available from www.cochrane-handbook.org).

Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *British Medical Journal, 327*(7414), 557–560.

Hodgins, D. C., Schopflocher, D. P., Martin, C. R., el-Guebaly, N., Casey, D. M., Currie, S. R., ... Williams, R. J. (2012). Disordered gambling among higher-frequency gamblers: Who is at risk? *Psychological Medicine, 42*(11), 2433–2444.

Jackson, A. C., Dowling, N., Thomas, S. A., Bond, L., & Patton, G. (2008). Adolescent gambling behaviour and attitudes: A prevalence study and correlates in an Australian population. *International Journal of Mental Health and Addiction, 6*(3), 325–352.

Jacobs, D. F. (2000). Juvenile gambling in North America: An analysis of long term trends and future prospects. *Journal of Gambling Studies, 16*(2–3), 119–152.

Juni, P., Witschi, A., Bloch, R., & Egger, M. (1999). The hazards of scoring the quality of clinical trials for meta-analysis. *JAMA, 282*(11), 1054–1060.

Kazdin, A. E., Kraemer, H. C., Kessler, R. C., Kupfer, D. J., & Offord, D. R. (1997). Contributions of risk-factor research to developmental psychopathology. *Clinical Psychology Review, 17*(4), 375–406.

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with the terms of risk. *Archives of General Psychiatry, 54*(4), 337–343.

Kyngdon, A., & Dickerson, M. (1999). An experimental study of the effect of prior alcohol consumption on a simulated gambling activity. *Addiction, 94*(5), 697–707.

Langhinrichsen-Rohling, J., Rohde, P., Seeley, J. R., & Rohling, M. L. (2004). Individual, family, and peer correlates of adolescent gambling. *Journal of Gambling Studies, 20*(1), 23–46.

Lee, G. P., Storr, C. L., Ialongo, N. S., & Martins, S. S. (2011*). Compounded effect of early adolescence depressive symptoms and impulsivity on late adolescence gambling: A longitudinal study. *Journal of Adolescent Health, 48*(2), 164–169.

Lee, G. P., Stuart, E. A., Ialongo, N. S., & Martins, S. S. (2014*). Parental monitoring trajectories and gambling among a longitudinal cohort of urban youth. *Addiction, 109*(6), 977–985.

Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry, 144*(9), 1184–1188.

Liu, W., Lee, G. P., Goldweber, A., Petras, H., Storr, C. L., Ialongo, N. S., & Martins, S. S. (2013*). Impulsivity trajectories and gambling in adolescence among urban male youth. *Addiction, 108*(4), 780–788.

Loxley, W., Toumbourou, J. W., Stockwell, T., Haines, B., Scott, K., Godfrey, C., ... Williams, J. (2004). *The prevention of substance use, risk and harm in Australia: A review of the evidence.* Canberra: Population Health Division, Australian Government Department of Health and Ageing.

Lussier, I., Derevensky, J. L., Gupta, R., Bergevin, T., & Ellenbogen, S. (2007). Youth gambling behaviors: An examination of the role of resilience. *Psychology of Addictive Behaviors, 21*(2), 165–173.

Lussier, I., Derevensky, J., Gupta, R., & Vitaro, F. (2014). Risk, compensatory, protective, and vulnerability factors related to youth gambling problems. *Psychology of Addictive Behaviors, 28*(2), 404–413.

Magoon, M. E., & Ingersoll, G. M. (2006). Parental modeling, attachment, and supervision as moderators of adolescent gambling. *Journal of Gambling Studies, 22*(1), 1–22.

Merkouris, S. S., Thomas, S. A., Browning, C. J., & Dowling, N. A. (2016). Predictors of outcomes of psychological treatments for disordered gambling: A systematic review. *Clinical Psychology Review, 48*, 7–31.

Messerlian, C., Gillespie, M., & Derevensky, J. L. (2007). Beyond drugs and alcohol: Including gambling in a high-risk behavioural framework. *Journal of Paediatrics and Child Health, 12*(3), 199–204.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine, 151*, 264–269.

Molde, H., Pallesen, S., Bartone, P., Hystad, S., & Johnsen, B. H. (2009). Prevalence and correlates of gambling among 16 to 19-year-old adolescents in Norway. *Scandinavian Journal of Psychology, 50*(1), 55–64.

Neal, P., Delfabbro, P., & O'Neil, M. (2005). *Problem gambling and harm: Towards a national definition.* Melbourne: Gambling Research Australia.

Nelson, S. E., LaPlante, D. A., LaBrie, R. A., & Shaffer, H. J. (2006). The proxy effect: Gender and gambling problem trajectories of Iowa gambling treatment program participants. *Journal of Gambling Studies, 22*(2), 221–240.

Nower, L., Derevensky, J. L., & Gupta, R. (2004). The relationship of impulsivity, sensation seeking, coping, and substance use in youth gamblers. *Psychology of Addictive Behaviors, 18*(1), 49–55.

Parker, J. D. A., Taylor, R. N., Eastabrook, J. M., Schell, S. L., & Wood, L. M. (2008). Problem gambling in adolescence: Relationships with internet misuse, gaming abuse and emotional intelligence. *Personality and Individual Differences, 45*(2), 174–180.

Scholes-Balog, K. E., Hemphill, S. A., Dowling, N. A., & Toumbourou, J. W. (2014*). A prospective study of adolescent risk and protective factors for problem gambling among young adults. *Journal of Adolescence, 37*(2), 215–224.

Scholes-Balog, K. E., Hemphill, S. A., Toumbourou, J. W., & Dowling, N. A. (2015*). Problem gambling and internalising symptoms: A longitudinal analysis of common and specific social environmental protective factors. *Addictive Behaviors, 46*, 86–93.

Shaffer, H. J., & Hall, M. N. (2002). The natural history of gambling and drinking problems among casino employees. *The Journal of Social Psychology, 142*(4), 405–424.

Shaffer, H. J., & Korn, D. A. (2002). Gambling and related mental disorders: A public health analysis. *Annual Review of Public Health, 23*, 171–212.

Shaffer, H. J., LaPlante, D. A., LaBrie, R. A., Kidman, R. C., Donato, A. N., & Stanton, M. V. (2004). Toward a syndrome model of addiction: Multiple expressions, common etiology. *Harvard Review of Psychiatry, 12*(6), 367–374.

Shead, N. W., Derevensky, J. L., & Gupta, R. (2010). Risk and protective factors associated with youth problem gambling. *International Journal of Adolescent Medicine and Health*, *22*(1), 39–58.

Shenassa, E. D., Paradis, A. D., Dolan, S. L., Wilhelm, C. S., & Buka, S. L. (2012*). Childhood impulsive behavior and problem gambling by adulthood: A 30-year prospective community-based study. *Addiction*, *107*(1), 160–168.

Slutske, W. S., Caspi, A., Moffitt, T. E., & Poulton, R. (2005*). Personality and problem gambling: A prospective study of a birth cohort of young adults. *Archives of General Psychiatry*, *62*(7), 769–775.

Slutske, W. S., Jackson, K. M., & Sher, K. J. (2003). The natural history of problem gambling from age 18 to 29. *Journal of Abnormal Psychology*, *112*(2), 263–274.

Slutske, W. S., Moffitt, T. E., Poulton, R., & Caspi, A. (2012*). Undercontrolled temperament at age 3 predicts disordered gambling at age 32: A longitudinal study of a complete birth cohort. *Psychological Science*, *23*(5), 510–516.

Stinchfield, R. (2000). Gambling and correlates of gambling among Minnesota public school students. *Journal of Gambling Studies*, *16*(2–3), 153–173.

Stouffer, S. A., Suchman, E. A., DeVinney, L. C., Star, S. A., & Williams, R. M. (1949). *The American soldier: Adjustment during army life (studies in social psychology in World War II)*. Princeton: Princeton University Press.

Stroup, D. F., Berlin, J. A., Morton, S. C., Olkin, I., Williamson, G. D., Rennie, D., ... Thacker, S. B. (2000). Meta-analysis of observational studies in epidemiology: A proposal for reporting. Meta-analysis of observational studies in epidemiology (MOOSE) group. *JAMA*, *283*(15), 2008–2012.

Tanner-Smith, E. E., & Lipsey, M. W. (2015). Brief alcohol interventions for adolescents and young adults: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment*, *51*, 1–18.

Toumbourou, J. W., Hemphill, S. A., Tresidder, J., Humphreys, C., Edwards, J., & Murray, D. (2007). Mental health promotion and socio-economic disadvantage: Lessons from substance abuse, violence and crime prevention and child health. *Australian Journal of Health Promotion*, *18*(3), 184–190.

Turner, N. E., Macdonald, J., Bartoshuk, M., & Zangeneh, M. (2008). Adolescent gambling behaviour, attitudes, and gambling problems. *International Journal of Mental Health and Addiction*, *6*(2), 223–237.

Uecker, J. E., & Stokes, C. E. (2015*). Religious background and gambling among young adults in the United States. *Journal of Gambling Studies*, *1*(32), 341–361.

Vachon, J., Vitaro, F., Wanner, B., & Termblay, R. E. (2004). Adolescent gambling: Relationships with parent gambling and parenting practices. *Psychology of Addictive Behaviors*, *18*(4), 398–401.

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, *36*(3), 1–48.

Vitaro, F., Arseneault, L., & Tremblay, R. E. (1997*). Dispositional predictors of problem gambling in male adolescents. *American Journal of Psychiatry*, *154*(12), 1769–1770.

Vitaro, F., Arseneault, L., & Tremblay, R. E. (1999*). Impulsivity predicts problem gambling in low SES adolescent males. *Addiction*, *94*(4), 565–575.

Vitaro, F., Brendgen, M., Ladouceur, R., & Tremblay, R. E. (2001*). Gambling, delinquency, and drug use during adolescence: Mutual influences and common risk factors. *Journal of Gambling Studies*, *17*(3), 171–190.

Volberg, R. A., Gupta, R., Griffiths, M. D., Olason, D. T., & Delfabbro, P. (2010). An international perspective on youth gambling prevalence studies. *International Journal of Adolescent Medicine and Health*, *22*(1), 3–38.

Wanner, B., Vitaro, F., Carbonneau, R., & Tremblay, R. E. (2009*). Cross-lagged links among gambling, substance use, and delinquency from midadolescence to young adulthood: Additive and moderating effects of common risk factors. *Psychology of Addictive Behaviors*, *23*(1), 91–104.

Weinstock, J., & Petry, N. M. (2008). Pathological gambling college students' perceived social support. *Journal of College Student Development*, *49*(6), 625–632.

Welte, J. W., Barnes, G. M., Tidwell, M. C., & Hoffman, J. H. (2008). The prevalence of problem gambling among U.S. adolescents and young adults: Results from a national survey. *Journal of Gambling Studies*, *24*(2), 119–133.

Williams, R. J., Volberg, R. A., & Stevens, R. M. G. (2012). *The population prevalence of problem gambling: Methodological influences, standardized rates, jurisdictional differences, and worldwide trends: Report prepared for the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care.*

Winters, K., Stinchfield, R., Botzet, A., & Anderson, N. (2002*). A prospective study of youth gambling behaviors. *Psychology of Addictive Behaviors*, *16*(1), 3–9.

Winters, K., Stinchfield, R., & Kim, L. G. (1995*). Monitoring adolescent gambling in Minnesota. *Journal of Gambling Studies*, *11*(2), 165–183.

Yücel, M., Whittle, S., Youssef, G. J., Kashyap, H., Simmons, J. G., Schwartz, O., ... Allen, N. B. (2015*). The influence of sex, temperament, risk-taking and mental health on the emergence of gambling: A longitudinal study of young people. *International Gambling Studies*, *15*(1), 108–123.