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Effects of Affective and Anxiety Disorders on Outcome in Problem Gamblers Attending Routine Cognitive–Behavioural Treatment in South Australia

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Abstract This study evaluated the influence of 12-month affective and anxiety disorders on treatment outcomes for adult problem gamblers in routine cognitive–behavioural therapy. A cohort study at a state-wide gambling therapy service in South Australia. Primary outcome measure was rated by participants using victorian gambling screen (VGS) 'harm to self' sub-scale with validated cut score 21+ (score range 0–60) indicative of problem gambling behaviour. Secondary outcome measure was Work and Social Adjustment Scale (WSAS). Independent variable was severity of affective and anxiety disorders based on Kessler 10 scale. We used propensity score adjusted random-effects models to estimate treatment outcomes for sub-populations of individuals from baseline to 12 month follow-up. Between July, 2010 and December, 2012, 380 participants were eligible for inclusion in the final analysis. Mean age was 44.1 (SD = 13.6) years and 211 (56 %) were males. At baseline, 353 (92.9 %) were diagnosed with a gambling disorder using VGS. For exposure, 175 (46 %) had a very high probability of a 12-month affective or anxiety disorder, 103 (27 %) in the high range and 102 (27 %) in the low to moderate range. For the main analysis, individuals experienced similar clinically significant reductions (improvement) in gambling related outcomes across time ($p < 0.001$). Individuals with co-varying patterns of problem gambling and 12 month affective and anxiety disorders who present to a gambling help service for treatment in metropolitan South Australia

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gain similar significant reductions in gambling behaviours from routine cognitive–behavioural therapy in the mid-term.

Keywords Problem gambling · Cognitive–behavioural therapy · Co-morbidity · Treatment outcomes

Introduction

Problematic gambling that is persistent and recurrent may adversely affect individual psychosocial, health, and mental functioning and jeopardise family and vocational pursuits (American Psychiatric Association 2013). The ubiquity of different gambling forms including online and community based electronic gaming machines (EGMs) makes gambling easily accessible (Petry and Hodgins 2012). Gambling disorder is a serious public health concern at an international level with population prevalence rates averaging 2 % and occurring more frequently in younger populations (Becona 1996; Bondolfi et al. 2000; Delfabbro 2009; Shaffer and Hall 2001; Wardle et al. 2007; Wong and Ernest 2003). It is now recognised as an addiction in DSM-5 (American Psychiatric Association 2013).

Treatment approaches are similar to those for other addictions such as substance use disorders and include psychological, peer-support, and pharmacological interventions (Daughters et al. 2003; Jackson et al. 2003). To date, the best evidence for gambling treatments exists for psychological interventions where variations of cognitive–behavioural therapy (CBT) have been the most researched (Cowlishaw et al. 2012). Several CBT programs reported in the gambling intervention literature have been underpinned by two dominant approaches to explaining gambling behaviour (Carlbring et al. 2010; Dowling 2006; Raylu and Oei 2010). The cognitive approach focuses on teaching the concept of randomness, increasing awareness of inaccurate perceptions and restructuring erroneous gambling beliefs (Ladouceur et al. 2003, 2001; Sylvain et al. 1997).The behavioural approach (exposure-based) uses techniques that target gambling related psychobiological states (e.g. urge to gamble) (Battersby et al. 2008; Oakes et al. 2008; Barry Tolchard et al. 2006). Of all gambling intervention types, the current CBT evidence-base is considered most reliable for guiding clinical practice (Problem Gambling Research and Treatment Centre (PGRTC) 2011).

Previous studies have shown that CBT programs can be effectively delivered in diverse clinical populations of problem gamblers (Pasche et al. 2013; Smith et al. 2010; Wong et al. 2014). A possible threat to the effectiveness of CBT in everyday gambling help services are co-morbid mental disorders such as depression and anxiety that commonly occur in problem gamblers (Lorains et al. 2011; Winters and Kushner 2003). However, it is unclear as to the extent of the impact due to a deficiency of evidence and extant findings being mixed. For example, in a study involving a cohort of problem gamblers who engaged in CBT, it was found that participants with higher levels of general psychological distress were more likely to relapse during treatment (Jimenez-Murcia et al. 2007). Conversely, a more recent investigation suggested that participants with a range of co-occurring conditions experienced similar improvements in outcomes during the first six sessions of CBT treatment (Soberay et al. 2014).

Despite previous best efforts to determine the influence of co-morbid conditions on treatment outcomes, the evidence-base remains limited for numerous reasons. Firstly, the few studies conducted to date were comprised of relatively small sample sizes and

generalizability of findings has been constrained in terms of the population of interest. Secondly, studies have used observational data where the distribution of measured risk factors has potentially been unbalanced between different levels of exposure or co-morbid conditions hence lending to unreliable estimates. Thirdly, explanatory models have failed to capture additional information from the variability in sub-populations of co-morbid severity in response to treatment. Finally, no investigations to date have examined how individual trajectories of response to treatment vary across intervention and follow-up. For example, it may be that some groups of participants experience a faster rate of recovery early in treatment but have similar outcomes to other levels of co-morbid severity in the longer term.

Therefore, to support and extend the existing research-base we attempted to address the following questions: how do individual problem gamblers respond to routine CBT treatment across time, and do outcomes significantly vary within and between sub-populations of individuals with affective and anxiety disorders?

Methods

Study Design

The effects of affective and anxiety disorders on outcomes in treatment-seeking problem gamblers is a multi-site cohort design that followed clients with a gambling disorder under routine CBT conditions over 12 months. Recruitment occurred from July 2010 to October 2012, and data collection continued until December 2012. Baseline assessments were conducted at first presentation to an outpatient gambling treatment centre and follow-up assessments were performed at treatment-end, 1, 3, 6, and 12 months. The availability of follow-up data was, at least partly, influenced by the proximity of the first presentation date of participants and completion of treatment to time of final data collection. The study was approved by the Southern Adelaide Health Service/Flinders University Human Research Ethics Committee.

Service and Participants

In South Australia (total population 1.6 million) gambling disorders are mainly a result of the widespread availability of 12,688 live gaming machines in venues in nearly all towns and cities across the state (Government of South Australia:Consumer and Business Services 2012). To help mitigate this problem, the Statewide Gambling Therapy Service (SGTS) offers free cognitive–behavioural treatment for help-seeking problem gamblers. The service is funded through the Gamblers Rehabilitation Fund and administered by the Department for Communities and Social Inclusion and the Office for Problem Gambling in South Australia.

The outpatient SGTS programme was inaugurated in 2007 and offers one-on-one therapy for problem gamblers at the key metropolitan sites of Salisbury (North of Adelaide city), Port Adelaide (Northwest), and Bedford Park (South). In addition, visiting services have been provided in major rural communities where data showed high levels of gambling activity. The service is staffed by a psychiatrist and therapists with professional registration in psychology, nursing or social work. All therapists have masters level qualifications in cognitive-behaviour therapy (Battersby et al. 2008) and receive monthly supervision with a senior clinician who has extensive experience in CBT treatments for problem gamblers.

Of 672 treatment-seeking adults who attended a baseline assessment with a clinician during the recruitment period, 101 (15 %) were excluded due to either incomplete baseline data (n = 56), less than 30 participants per service site (n = 10) or having an inpatient episode (n = 35). The reason for this was to enhance model estimation stability and the generalizability of findings. Furthermore, to minimise potential for a baseline effect, only participants with at least one follow-up measure were included for analysis. The final dataset consisted of records for 380 participants at the three metropolitan service sites. For participants excluded, 170/191 (89 %) attended 3 or less treatments and were slightly younger than the cohort group (mean = 41.2 y, SD = 12.8 vs mean = 44.1y, SD = 13.6) ($p = 0.016$). When stratifying age into quartiles, those in the interval 45–55 years and 55+ years had a greater likelihood of attending four or more therapy sessions than clients 18–33 years ($\chi^2_{(2)} = 11.5, p = 0.003$) but not so for 33–45 year olds ($p = 0.869$). For duration of problem gambling, a significantly lower proportion of drop-outs self-reported a period of 5+ years (94/191, 49.2 % vs. 220/380, 57.9 %) ($p = 0.049$). No statistically significant differences were found on all other baseline variables.

Assessment and Treatment

On first presentation to SGTS clients are provided with a screening interview to assess suitably for admission into the treatment programme. The interview is comprised of a gambling focused cognitive behavioural assessment including DSM-5 criteria for identifying problem gambling (American Psychiatric Association 2013). The SGTS has previously developed a CBT treatment manual for up to 12 60-min individual weekly sessions (Battersby et al. 2008). It has shown to be associated with significant clinical benefits at the individual level (Oakes et al. 2008) and in a cohort of treatment-seeking problem gamblers (Smith et al. 2010). Furthermore, a previous randomised controlled trial conducted at SGTS to investigate core components of CBT showed that manualised cognitive and behavioural therapies were feasible treatments on their own (Battersby et al. 2013).

In routine delivery of cognitive–behavioural therapy at SGTS, cognitive therapy is used initially to increase awareness of inaccurate perceptions and restructure erroneous gambling beliefs (Ladouceur et al. 2001). It is based on the principle that problem gamblers hold erroneous perceptions of randomness; erroneous beliefs (e.g. 'luck helps me win') and inaccurate perceptions (e.g. 'gambling makes things better for me') (Ladouceur et al. 2001; Raylu and Oei 2004) which are rewarded, learned, and become habitual. Cognitive therapy has been shown to be clinically efficacious in treating a range of mental health conditions (Beck and Dozois 2011).

The behavioural component of the CBT program then focuses on the treatment of clients' urge to gamble using exposure therapy (ET) (Battersby et al. 2008; Oakes et al. 2008; Tolchard et al. 2006). It is grounded in a classical conditioning paradigm and cue-exposure with extinction processes (e.g. elimination of gambling urge) has been proposed as more beneficial than other behavioural types of therapy, for example aversive therapy in treating gambling addiction (Brown 1987). It has been shown to be clinically effective in treating psychological conditions such as post-traumatic stress disorder (PTSD) (Nemeroff et al. 2006) and specific phobias (Ougrin 2011).

The principles of ET are applied using graded tasks so the urge to gamble experienced at various stages of treatment is manageable. The initial procedure comprises a therapist guiding the client through a scene, which is usually audiotaped and then instructing the client to imagine a typical gambling scenario (imaginal exposure). The client is asked to

rate his or her urge to gamble at regular intervals while verbalizing the scenario and to stay with the urge until habituation occurs. Once the client has habituated to the urge in imagination, clients habituate to their urge to gamble using a variety of live tasks at gambling venues (in vivo exposure) to challenge the triggers of their urges (Battersby et al. 2008).

Baseline Variables

Socio-demographics

Gender, age, relationship and employment status as well as data for self- reported duration of gambling problem (<2, 2–5, 5+ years) and primary form of gambling (electronic gaming machines (EGMs), TAB/racing, casino games, raffles/bingo/bingo tickets, scratch tickets/X-lotto/Powerball, Keno, private gambling, e.g. card games, sports betting and other) were collected.

Independent Variable: Kessler 10 Scale (K10)

This questionnaire was developed to produce a global measure of "psychological distress", based on questions about the level of anxiety and depression symptoms that the client has been experiencing, ranging from few or minimal symptoms to extreme levels of distress (Andrews and Slade 2001; Slade et al. 2011). The K10 is framed for individuals to respond in terms of how they have been feeling in the past 4 weeks. Higher scores indicate greater distress. Interpreting levels of psychological stress is guided by the stratification of scores as: 10–19, problem gambler may currently not be experiencing significant feelings of distress; 20–29, mild distress consistent with a diagnosis of a mild depression and/or anxiety; and 30–50, severe distress consistent with a diagnosis of a severe depression and/or anxiety disorder.

Outcome Variables

Using the SGTS protocol for client outcome evaluation, assessments were conducted at service-sites prior to the start of first screening session with a therapist, every 4 weeks during intervention period and treatment-end. Follow-up assessments were conducted mostly by mail at 1, 3, 6, and 12 months. The psychometric properties for each measure are described in the following section.

Primary Outcome

Victorian gambling screen (VGS). In order to detect change in problem gambling severity on a continuum during treatment and at follow up, the VGS was utilised as a primary outcome measure. The VGS is a self- reported questionnaire measuring the extent gambling behaviour has impeded an individual's life. The screen comprises three sub-scales (enjoyment of gambling, harm to partner and harm to self) with a total of 21 items. For purposes of this study, only the 'harm to self' sub-scale was used as an outcome measure. Items on the self-harm subscale relate to the person's experiences in the previous 4 weeks and therefore enhance sensitivity to treatment outcomes on a continuum. This sub-scale has been validated for use in Australia by Ben-Tovim, Esterman, Tolchard, Battersby & Flinders Technologies (2001) (Ben-Tovim et al. 2001). Reliability and validity of the VGS have been confirmed in a clinical population of

problem gamblers (Tolchard and Battersby 2010). The 'harm to self' sub-scale scores range from 0 = no harm to self to 60 = high harm to self. Concurrent validity indicates the scale correlates very highly with the South Oaks Gambling Screen (SOGS) (R = 0.97), but extends the score range. The VGS has also shown similar properties in construct validity as the Canadian Problem Gambling Index (CPGI) on a number of problem gambling correlates (e.g. 'self-rating of problem'; 'wanted help'; and 'suicidal tendencies') (McMillen and Wenzel 2006). A score of 21+ on the VGS identifies a person as a problem gambler. An outcome study involving treatment seeking problem gamblers found a significant reduction (improvement) in VGS scores with concurrent improvements on other psychometric measures including cognitions, urges, psychological disturbance, and work and social functioning (Smith et al. 2010).

Secondary Outcome

Work and Social Adjustment Scale (WSAS). The WSAS is a self-report questionnaire used to measure an individual's perspective of their functional ability/impairment. The scale contains five items to explore the degree to which the participant's gambling problem affected their ability to function in the following areas: work, home management, social leisure, private leisure and family and relationships. Each question is answered using a 0–8 scale ("not at all" to "very severely"), with higher scores corresponding to a higher degree of severity. Scores below 10 are indicative of a subclinical population; 10–20, significant functional impairment but less severe clinical symptomatology; and 20 +, moderately severe (or worse) impairment. Research into the validity of the scale suggests that WSAS correlates closely with the severity of depression and obsessive–compulsive disorder symptoms at 0.76 and 0.61 and is sensitive to patient differences and change following treatment (Mundt et al. 2002).

Statistical Methods

All statistical analyses were conducted using Stata 13 (StataCorp 2013).

Baseline Data

Demographic and clinical characteristics were compared across K10 strata (Low/moderate, High, Very high) using oneway ANOVA for continuous variables and Pearson Chi square tests for categorical variables. For each K10 stratum, the likelihood of Composite International Diagnostic Interview-defined ICD-10 diagnosis of an affective disorder or anxiety disorder in the previous 12 months was calculated for the study sample. A Bayesian approach was used as recommended by Slade et al. (2011) where prior probabilities for comorbid anxiety and affective disorders were 37.4 and 37.9 % respectively (Lorains et al. 2011). Post-test odds for each condition were then calculated from the product of pre-test odds (prior probability of condition/(1−prior probability of condition)) and stratum specific likelihood ratios based on Australian normative data (Slade et al. 2011).

Selection Bias Control

Because this study used observational data it was probable that co-morbid conditions were related to covariates that also effected gambling related outcomes. Therefore, we utilised measured covariates to make co-morbidity and outcome independent once we conditioned

on those covariates. This was achieved by the propensity score method using ordinal logistic regression where the probability of an individual being in K10 stratum was conditional on baseline covariates (d'Agostino 1998; Längle et al. 2012).

Statistical Analyses of Co-morbid Effects

Random-effects models were fitted for repeated measures of each outcome using all observed data and missing values were assumed to be missing at random (Gueorguieva and Krystal 2004; West et al. 2007). Whilst the data collection protocol specified measurements at *n* occasions, the random-effects models calculated maximum likelihood estimates using an EM (expectation–maximisation) algorithm (Dempster et al. 1977). This meant that the complete data consisted of observed data and unobservable random parameters plus errors that characterised individual trajectories of change and their deviation from a population trend (Laird et al. 1987).

Fixed effects in models were co-morbid group (Low/moderate, High, Very high), time (months) as a continuous variable, study-site, interaction between co-morbid group and time, interaction between study-site and time, and propensity scores for two of the three baseline co-morbid groups. A quadratic term for time was also tested to allow for possible non-linear effects. Random effects in the model were at study participant level and slope. This allowed observed responses to be compared within participants and hence provided estimates closer to a causal framework than when comparing between individuals. Co-morbid group was introduced to the random effects component to assess for heteroskedastic effects or variance in sub-populations. This was done by creating interaction terms between co-morbid group and time to allow variability of random intercepts and slopes to differ between groups to give a three-fold repeated-level specification for the outcome measurement on each participant (Rabe-Hesketh and Skrondal 2012).

To identify any relationship between random intercept and random slope, patterns of residuals were investigated by comparing restricted and unrestricted models. Using variance–covariance patterns of independent structure (residuals assumed to have one unique variance parameter per random effect and all covariances zero) versus unstructured (all variances and covariances distinctly estimated) the correlation between intercept and slope was tested using a likelihood-ratio test.

Results

Baseline Data

Baseline characteristics for N = 380 participants are presented in Table 1. When stratifying VGS at cut score 21 there were 353 (92.9 %) classified as problem gamblers. For participants that did not meet problem gambling criteria according to self-reported VGS, 15/27 (55.6 %) had ratings between 16 and 20 and 13/27 had ratings between 2 and 15. For participants' perspectives of their functional ability/impairment using WSAS it was found that 132 (34.7 %) were in the sub-clinical range of impairment, 152 (40 %) with significant impairment, and 96 (25.3 %) in the moderate to severe range.

Using Australian normative data on the K10 (Slade et al. 2011), the probability of a study individual who scored very high on K10 ($n = 175$) of having a 12-month affective disorder was 91.5 % and for an anxiety disorder 87.8 %. For remaining strata, probabilities of affective and anxiety disorders were 77.4 and 73.9 % in the high range ($n = 103$); 47.9

Table 1 Characteristics of 380 help seeking problem gamblers, before cognitive–behavioural treatment, registered in a South Australian gambling therapy service registry between 2011 and 2012, according to level of psychological distress

Variable	Psychological distress (K10)			p value[a]
	Low/moderate ($n = 102$)	High ($n = 103$)	Very high ($n = 175$)	
Age (years)	45.3 (15.1)	43.4 (13.0)	43.7 (13.1)	0.178
Gender				
Female	39 (23.1)	43 (25.4)	87 (51.5)	0.145
Male	63 (29.9)	60 (28.4)	88 (41.7)	
Relationship				
No partner	54 (24.3)	62 (27.9)	106 (47.8)	0.422
Partner	48 (30.4)	41 (26.0)	69 (43.7)	
Employment				
Employed	65 (28.6)	66 (29.1)	96 (42.3)	0.200
Unemployed	37 (24.2)	37 (24.2)	79 (51.6)	
Duration of gambling problem				
≤ 5 years	46 (28.8)	44 (27.5)	70 (43.8)	0.702
> 5 years	56 (25.5)	59 (26.8)	105 (47.7)	
Primary form of gambling				
Electronic gaming machines	79 (26.1)	85 (28.1)	139 (45.9)	0.327
Horse/dog racing	17 (34)	13 (26)	20 (40)	
Other	5 (22.7)	3 (13.6)	14 (63.6)	
VGS	31.3 (10.6)	38.6 (9.8)	44.0 (8.4)	0.022
WSAS	6.6 (6.3)	13.4 (7.6)	19.2 (9.3)	<0.001

K10 Kessler 10 Scale, *VGS* Victorian Gambling Screen harm to self subscale, *WSAS* Work and Social Adjustment Scale

Data are mean (SD), or n (%)

[a] From oneway analysis of variance for continuous variables and Pearson Chi square test for categorical variables

and 51.5 % in the moderate range ($n = 64$); and 15.3 and 23.1 % in the low range ($n = 38$), respectively.

For propensity score estimation the final ordinal logistic regression comprised of independent variables age, gender, baseline VGS and WSAS scores, and employment status. The fit of this model was not significantly different from the initial full model where all baseline covariates were included ($p = 0.408$) whilst smaller AIC (Akaike's information criteria) values (652.6 vs. 657.6) and BIC (Bayesian information criteria) values (680.2 vs. 704.8) suggested a better fitting model. The model did not appear to violate the proportional odds assumption ($p = 0.422$). Predicted probabilities were then calculated for each individual within each stratum to form propensity scores.

Participant Flow

The participation pattern of cross-sectional time-series data for outcome VGS included an average number of observations per site of 538 (range 352–807) and 4.2 per individual

(range 2–13). Median final follow-up for individuals was approximately 31 weeks (IQR 12–56).

The distribution of face-to-face therapy sessions for individuals was 56 (14.7 %) attended 3 or less sessions; 152 (40 %) between 4 and 7 sessions; 123 (32.4 %) between 8 and 12 sessions; and 49 (12.9 %) received 13 or more sessions. There was no significant difference in frequencies of therapy sessions across K10 strata of psychological distress ($p = 0.473$). Of those that attended 3 or less sessions, over 60 % had only one follow-up measure.

Estimates of Treatment Outcome

Table 2 provides random-effects model estimates of treatment outcomes as measured by VGS and WSAS for increasing severity of psychological distress as measured on K10. For both outcomes, the propensity score adjusted model provided a better fit of the data compared to an unadjusted model ($p < 0.001$). An omnibus test for fixed-effects (population level) suggested that exposure variable K10 and covariates explained a significant amount of variation in both VGS ($\chi^2_{(12)} = 585.5,\ p < 0.001$) and WSAS ($\chi^2_{(12)} = 651.9, p\ < 0.001$). For random–effects (individual level), omnibus likelihood ratio tests suggested evidence for between-participant variance and between levels of psychological distress variance that was not being explained by the fixed-effects for baseline (intercept) and rate of change (slope) in VGS scores ($\chi^2_{(6)} = 168.08,\ p < 0.001$) and WSAS scores ($\chi^2_{(6)} = 196.10,\ p < 0.001$). Additionally, for both outcome measures, models that allowed for heteroskedasticity in random effects due to co-morbidity better explained individual deviations from a population average than homoskedastic models ($p < 0.001$).

Overall, participants in the Low/moderate group were predicted to have an average value of VGS that was 3.70 units lower than similar participants from the previous month. The interaction between exposure variable K10 and time (months) was significant ($p = 0.019$). The average value of reduction (improvement) in VGS scores was an additional 0.25 units in the High group and 0.67 units in the Very high group to the Low/moderate group. Compared to the Low/moderate group, the rate of improvement in VGS scores in the Very high group was significantly greater ($p = 0.006$) but not in the High group ($p = 0.277$). Figure 1 shows predicted mean margins by time for fixed-effects.

Using Table 2 to interpret individual rates of therapeutic change from fixed population means, intervals were formed within which 95 % of the random slopes were expected to lie. In the Low/moderate group, the adjusted mean VGS slope from fixed-effects (population level) was −3.70, and therefore the interval -3.70 ± 1.96 × 0.81was obtained, so 95 % of individuals VGS scores were between −5.29 units to −2.11 units lower than similar participants from the previous month. In the High group, this range was between −4.43 and −2.97 units and in the Very high group, between −4.76 and −2.64 units.

There was an overall significant improvement across time in work and social functioning as measured by WSAS ($p < 0.001$). The Low/moderate participants were predicted to have an average value of −1.05 units lower than similar participants from the previous month. Participants in High and Very high categories experienced significantly greater improvements to the Low group by an additional −0.23 units and −0.59 units respectively ($p < 0.001$). Furthermore, participants in the Very high group had a significantly higher rate of improvement compared to those in the High group ($p = 0.004$). Using a similar approach to abovementioned VGS scores to obtain estimates at the individual level, 95 % of Low/moderate participant WSAS scores were between −1.56 units to −0.54 units lower

Table 2 Association between individual gambling related symptoms and psychological distress over time in random-effects models

Outcome	VGS	WSAS
Fixed-effects, parameter estimates (95 % CI)		
K10 group		
Low/moderate	Referent	Referent
High	3.27 (0.35 to 6.18)	1.92 (0.50 to 3.34)
Very high	3.12 (0.08 to 6.17)	2.93 (0.57 to 4.41)
Months	−3.70 (−4.17 to −3.15)	−1.05 (−1.29 to −0.81)
K10 group*months		
Low/moderate	Referent	Referent
High	−0.25 (−0.70 to 0.20)	−0.23 (−0.43 to −0.02)
Very high	−0.67 (−1.15 to −0.19)	−0.59 (−0.83 to −0.34)
Study site*months		
Flinders	Referent	Referent
Port	−0.15 (−0.62 to 0.33)	−0.05 (−0.28 to 0.17)
Salisbury	0.02 (−0.40 to 0.44)	0.08 (−0.12 to 0.29)
Heteroskedastic random − effects for K10 groups, standard deviation (95 % CI)		
Low/moderate		
Intercept	1.85 (0.11 to 30.85)	1.32 (0.35 to 4.94)
Slope	0.81 (0.53 to 1.25)	0.26 (0.13 to 0.51)
High		
Intercept	5.30 (3.58 to 7.86)	2.62 (1.73 to 3.97)
Slope	0.37 (0.10 to 1.45)	0.21 (0.07 to 0.65)
Very High		
Intercept	3.54 (2.71 to 4.62)	1.60 (1.18 to 2.18)
Slope	0.54 (0.38 to 0.78)	0.38 (0.28 to 0.53)

VGS Victorian Gambling Screen, *WSAS* Work and Social Adjustment Scale, *K10* Kessler 10 scale

Models adjusted for nonlinear effect of time and propensity scores for the probability of being in high or very high categories of psychological distress instead of low/moderate at baseline (coefficients not shown)

than similar participants from the previous month. In the High group, this range was between −1.46 units and −0.64 units and in the Very high group, between −1.79 units and −0.31 units.

Discussion

Commensurate with previous studies we found that co-morbidity was common in the current sample of treatment-seeking adults for problem gambling (Hodgins et al. 2005; Smith et al. 2011; Soberay et al. 2014). Our findings from propensity score adjusted models showed that participants with higher probabilities of 12-month affective and anxiety disorders reported similar or better improvements in gambling related outcomes to those in the lower range. Furthermore, those in the lower to moderate group experienced more variation from an average rate of improvement across the 12 month period than individuals with a higher likelihood of co-morbidity.

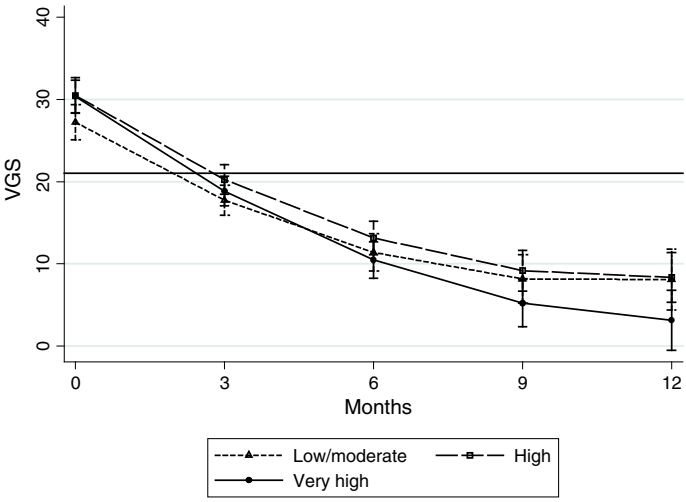

Fig. 1 Predictive margins of psychological distress with 95 % CI. Lower scores indicate a reduction (improvement) in gambling symptom severity. Horizontal line is VGS (Victorian Gambling Screen) cut score of 21 + and indicative of problem gambler

From a clinical perspective, the important finding was that co-morbid groups showed similar improvements in outcome across time. The study participants had mostly received three or more routine sessions of cognitive restructuring and behavioural (exposure-based) therapy. Empirical evidence for these core techniques in gambling addiction is at a nascent stage but reputable in anxiety disorders, depression, and other addictions. Exposure alone for example has been found to be as effective as cognitive or combined CBT for anxiety disorders (Marks et al. 1998) and cognitive therapy has been found to be as efficacious as behavioural activation for depression (Jacobson et al. 1996). Traditional CBT approaches have also been successful in treating co-occurring depression and substance use disorders (Hides et al. 2010). Furthermore, CBT treatment for depression alone in alcoholics has produced better reductions in somatic depressive symptoms and depressed and anxious mood than standard alcohol treatment and also better alcohol related outcomes between 3 and 6 months follow-up (Brown et al. 1997).

There are only a few reported studies concerning the effects of co-varying problem gambling and other psychopathology on CBT outcomes. One study suggested that treatment outcomes were adversely affected by psychological distress where the outcome of interest was relapse during a 16 week treatment period (Jimenez-Murcia et al. 2007). However, because an end-point analysis was used it was probable that additional information was lost such as that from a participant's recovery following a lapse or relapse. Another study showed that increased depressive symptoms were linked to problem gambling during treatment and follow-up but was limited to a single binary outcome measure predicated on a continuous measure and therefore less sensitive to change in gambling behaviour (Smith et al. 2011). Also, in both the abovementioned studies treatment effect sizes neighboured on the null hypothesis thus restricting any meaningful clinical interpretation. More recently it has been found that psychosocial functioning did not significantly vary by frequency of co-occurring conditions, including affective and anxiety disorders. However, these findings were limited to the first six sessions of CBT treatment (Soberay et al. 2014).

A consistent theme from previous studies has been a call for future research to utilise randomised controlled trials (RCT) to investigate gambling and co-morbidity. However, conducting an RCT in a community-based gambling help service would be problematic particularly from an ethical stance and limited availability of resources (Winters and Kushner 2003). Therefore, a key strength of this current study was an analytic approach conducted within a counterfactual framework to account for selection bias. This meant that the probability of being in a co-morbid disorder stratum was conditional on a number of important socio-demographic variables.

For example, it has been found that gender is associated with psychological distress (Slade et al. 2011) and that gender has an effect on gambling treatment outcomes (Crisp et al. 2000; Petry et al. 2006). By accounting for these effects, more consistent estimates may be obtained across future studies involving gambling disorders. Similarly, investigations of other mental conditions such as panic disorder could also benefit from analysing observational data within this framework to provide more valid and precise estimates (Kampman et al. 2008). Furthermore, we employed random-effects modelling to account for individual trajectories of change across the study period of 12 months on outcomes related to gambling behaviour and functional ability. This study also extends the existing evidence-base in that it involved a substantially larger sample of treatment-seeking problem gamblers (N = 380) than studies previously reported.

A limitation of this study was that co-morbidity and potential confounders were modelled as time-invariant variables. Future research should investigate the influence of co-morbidity as a time-varying exposure when controlling for potential confounding in observational data. A further limitation was that co-morbidity was self-reported using the K10 instrument that may have resulted in measurement error. Also, there was potential for Berkson's bias (Berkson 1946) where treatment seeking problem gamblers typically present with more co-morbid conditions (Winters and Kushner 2003). However, participant numbers were soundly distributed across co-morbid strata relative to Australian normative data to enable conclusions to be drawn with confidence. Further studies may consider clinician assessed co-morbid conditions for both current and lifetime disorders. Finally, use of probability weights did not account for unknown confounders. We attempted to minimise unmeasured confounding by including those established as potential confounders in the previous gambling intervention literature. However, unmeasured factors, including SES (socio-economic status) may be associated with psychological disturbance and causally related to gambling related outcomes.

Future cohort studies have the potential to capture additional information concerning risk factors, confounders and outcomes by involving linked data collections across different jurisdictions. Some data collections provide information on co-morbid related exposures such as pharmaceutical prescriptions and health service use and other collections comprise outcomes, for example treatment outcomes. These datasets could be used to maximum advantage given the range of expertise of gambling researchers and flourishing networks at both national and international levels. Using robust statistical methods with linked data sets would enable the support of related fields, including gambling-help services, clinical knowledge and surveillance of gambling problems and related co-morbidity.

In conclusion, the present study, has demonstrated that individuals experiencing a range of co-varying patterns of problem gambling and 12-month affective and anxiety disorders who present to a gambling help service for treatment in metropolitan South Australia gain similar therapeutic benefits from routine cognitive–behavioural therapy in the mid-term.

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Conflict of interest None.

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