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Implications of gambling problems for family and interpersonal adjustment: results from the Quinte Longitudinal Study

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ABSTRACT

Aims To evaluate (1) whether gambling problems predict overall trajectories of change in family or interpersonal adjustment and (2) whether annual measures of gambling problems predict time-specific decreases in family or interpersonal adjustment, concurrently and prospectively. **Design** The Quinte Longitudinal Study (QLS) involved random-digit dialling of telephone numbers around the city of Belleville, Canada to recruit 'general population' and 'at-risk' groups (the latter oversampling people likely to develop problems). Five waves of assessment were conducted (2006–10). Latent Trajectory Modelling (LTM) estimated overall trajectories of family and interpersonal adjustment, which were predicted by gambling problems, and also estimated how time-specific problems predicted deviations from these trajectories. **Setting** Southeast Ontario, Canada. **Participants** Community sample of Canadian adults ($n = 4121$). **Measurements** The Problem Gambling Severity Index (PGSI) defined at-risk gambling (ARG: PGSI 1–2) and moderate-risk/problem gambling (MR/PG: PGSI 3+). Outcomes included: (1) family functioning, assessed using a seven-point rating of overall functioning; (2) social support, assessed using items from the Non-support subscale of the Personality Assessment Inventory; and (3) relationship satisfaction, measured by the Kansas Marital Satisfaction Scale. **Findings** Baseline measures of ARG and MR/PG did not predict rates of change in trajectories of family or interpersonal adjustment. Rather, the annual measures of MR/PG predicted time-specific decreases in family functioning (estimate: -0.11, $P < 0.01$), social support (estimate: -0.28, $P < 0.01$) and relationship satisfaction (estimate: -0.53, $P < 0.01$). ARG predicted concurrent levels of family functioning (estimate: -0.07, $P < 0.01$). There were time-lagged effects of MR/PG on subsequent levels of family functioning (estimate: -0.12, $P < 0.01$) and social support (estimate: -0.24, $P < 0.01$). **Conclusions** In a longitudinal study of Canadian adults, moderate-risk/problem gambling did not predict overall trajectories of family or interpersonal adjustment. Rather, the annual measures of moderate-risk/problem gambling predicted time-specific and concurrent decreases in all outcomes, and lower family functioning and social support across adjacent waves.

Keywords Community sample, family functioning, gambling, Latent Trajectory Modelling (LTM), longitudinal, relationship satisfaction, social support.

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INTRODUCTION

Recent decades have witnessed large expansions in the availability of gambling across developed nations [1–4], which have occurred given legislative changes that were highly conducive to commercial gambling industries and rapid developments in gambling technologies. In many countries, these environments have provided for changing patterns of gambling participation, and escalations in problematic behaviours that reflect persistent maladaptive gambling that precedes onset of gambling-related harms [5]. The terms 'pathological gambling' or 'gambling disorder' are used typically with reference to associated conditions that meet criteria for psychiatric diagnoses under ICD-10 [6] or DSM-5 [7], respectively. In contrast, the term 'problem gambling' may describe a broader spectrum of difficulties that are defined by occurrences of gambling-related harms, and these range from moderate problems to severe harms [5].

Gambling-related harms include adverse consequences for individuals, as well as interpersonal harms and impacts on families or primary support networks [8]. These 'collateral' effects are presumed to be widespread, with speculation that approximately seven people are affected directly by the problem gambling of an individual [9]. Perceived consequences of gambling problems for families, in particular, have been considered in qualitative studies of partners and children, which suggest impacts on emotional and mental health [10–13]. They are consistent with quantitative studies of gamblers or family members seeking treatment or help services [14–16]. In contrast, there are fewer studies using quantitative data from non-clinical samples. These include investigations of self-selected respondents that document high marital distress among partners of problem gamblers [17], and family dysfunction as reported by problem gamblers themselves [18]. Population-based studies also suggest high rates of mental health problems among people who self-identify as having a family member with a gambling problem [19,20]. We know of only two population-based studies of family or interpersonal dynamics as reported by problem gamblers, and these suggest associations with marital violence [21] and low social support (among men) [22]. All these studies involved data collected at a single point in time.

There remains a strong need for further research on the interpersonal implications of gambling problems, involving studies of non-clinical samples with longitudinal methods. The latter can situate explanatory factors and outcomes prospectively in time. They can also indicate processes that underlie associations, and may be operationalized through models of long- and short-term effects. It seems plausible, for example, that gambling problems will precipitate enduring losses of trust in relationships, such that influences on the long-term course of family or interpersonal adjustment will be observed. However, it may also be that relationships are resilient to stressors [23,24], and will recover following short-term crises. Testable models of analogous effects can be derived from literature on developmental criminology, which distinguishes between variables that are 'distal' versus 'proximal' risk factors [25]. In both cases there is a focus on change in one variable, which is described by within-person trajectories that vary across individuals (antisocial behaviour, for example, follows a typical trajectory of desistance from late adolescence onwards, although individuals vary in rates of decline) [26]. In this context, distal factors explain differences in overall trajectories (substance misuse, for example, has effects on overall rates of decline in antisocial behaviour, and may 'launch' individuals into long-term trajectories of deviance) [25]. Proximal factors, in contrast, account for short-term deviations from normative trajectories. For example, in the context of overall declines in antisocial conduct, there is also evidence of short-term influences of substance misuse on time-specific levels of deviant behaviour. This means that antisocial behaviour is higher than expected, given usual trajectories, at times when individuals are also misusing substances [25].

This study extends the literature on the interpersonal implications of gambling problems through analyses of data from the Quinte Longitudinal Study (QLS) [27], a prospective survey of Canadian adults assessed annually from 2006–2010. Specific aims were to:

1 Evaluate influences of gambling problems on long-term trajectories of family adjustment (family functioning, relationship satisfaction) and interpersonal functioning (social support); and
2 Examine whether annual measures of gambling problems have short-term effects and predict time-specific decreases in family or interpersonal adjustment, when measured concurrently and prospectively across waves.

METHOD

Sample and procedure

The QLS cohort was originally intended to inform assessments of social and economic impacts of the new Quinte Exhibition and Raceway (QER-II). This venue was intended for construction in the city of Belleville, in southeast Ontario, Canada, and would replace an existing racetrack with a venue that included slot machines. Ultimately, the QER-II was never constructed, and the study was terminated in 2007. However, the cohort was maintained under a revised mandate of evaluating the course and aetiology of gambling and associated problems.

The sampling frame comprised a pool of numbers with area codes and prefixes that were estimated to fall within 70 km of Belleville. Sampling was conducted in 2006 via random-digit dialling, and involved recruitment of 'general population' and 'at risk' groups. For both, eligible participants aged > 18 years were asked to participate in a brief survey about the proposed QER-II. For the general population group, any respondents indicating continued residence in the area were invited to participate in a longitudinal study in return for $220. The 'at-risk' group was recruited similarly, except that preliminary surveys included items about gambling activity and expected patronage of the QER-II. The latter were intended to identify adequate numbers of respondents (for statistical purposes) that might develop gambling problems during the study. These 'at-risk' participants were asked to participate only if they had: spent $10 or more in a typical month on lottery, instant win tickets, bingo, casino table games or games of skill; played slot machines or bet on horse racing in the past year; or intended to use the QER-II. Most participants completed measures online, with small numbers completing paper surveys.

There were 115 331 numbers called during preliminary surveys, which yielded contact with 87 976 individuals. There were 34 453 respondents who agreed to this survey, and 19 330 people were invited to the longitudinal study. The response rate to the latter was 21.3%, yielding n = 4121. Table 1 shows their socio-demographic characteristics. Williams *et al.* [27] report comparisons with the 2006 Canadian census, and indicate minor differences according to age (ages 18–24 were under-represented), relationship status (married or common-law relationships were over-represented) and education (post-secondary education was over-represented). Gambling problems were over-represented [27].

Respondents were invited to four additional surveys at yearly intervals. Sample sizes (with retention rates, as fractions of baseline numbers) were: n = 3937 at wave 2 (96.2%); n = 3900 at wave 3 (94.6%); n = 3827 at wave 4 (92.9%); and n = 3798 at wave 5 (92.1%). Attrition analyses were conducted comprising models of participation at wave 5 according to baseline variables [27]. Participants who were male, unmarried and had poor health were the main factors distinguishing non-respondents at wave 5. However, the amount of variance explained was small (Nagelkerke R^2 = 5.3%) and suggested minor biases from attrition.

Table 1 Socio-demographic characteristics and problem gambling interpretative categories for the Quinte Longitudinal Study (QLS) sample at baseline (n = 4121).

Variable	*n*	*%*
Gender (female)	2254	54.7
Age (years)		
17–29	579	14.0
30–44	1353	32.8
45–64	1731	42.0
65+	458	11.1
Relationship status		
Married/common law	2944	71.4
Divorced/separated/widowed	686	16.6
Never married	491	11.9
Education		
Some post-school education or higher	2836	68.8
High school	823	20.0
Less than high school	462	11.2
Employment		
Employed (full-time/part-time)	2634	63.9
Not in labour force	1292	31.4
Unemployed	195	4.7
Annual personal income		
$0–20 000	392	9.5
$20 001–39 999	990	24.0
$40 000–69 999	1290	31.3
$70 000+	1320	32.0
Gambling problems (past-year)		
PGSI = 0	2877	69.8
PGSI = 1–2	807	19.6
PGSI = 3–7	283	6.9
PGSI = 8+	52	1.3

PGSI = Problem Gambling Severity Index.

Measures

Gambling problems were measured using the Problem Gambling Severity Index (PGSI) [28], which was administered if respondents had, in the past year, gambled on 3 or more days, or won (lost) more than $10. The PGSI comprises nine items about past year experiences (0 = never, 3 = almost always), and has high internal consistency (Cronbach's α = 0.90) and strong associations with comparable measures [29]. The PGSI items are summated conventionally to derive interpretive categories: no problems (PGSI = 0), low-risk (PGSI = 1–2), moderate-risk (PGSI = 3–7) and problem gambling (PGSI = 8+). However, there may be small numbers identified using the PGSI 8+ criteria, and it is common to collapse across moderate-risk and problem gamblers to increase precision of statistical estimates [30,31]. For this reason, we also merged categories and considered a heterogeneous category of moderate-risk/problem gambling (MR/PG: PGSI 3+). Low-severity gambling problems were termed at-risk gambling (ARG: PGSI 1–2).

Family functioning was measured using a single item developed for the QLS: 'How would you rate your overall family functioning in the past 12 months?'. This was scored on a seven-point scale (1 = very poor, 7 = excellent), with high scores indicating better functioning. Although usage of a single-item measure is suboptimal, it remains comparable with analogous studies of self-rated health [32] and sensory functioning [33].

Social support was assessed using five items from the non-support scale of the Personality Assessment Inventory [34]. The subscale consists of eight items that are scored on a four-point response scale (0 = false, not at all true, 3 = very true). They have shown moderate internal consistency ($\alpha > 0.70$) [35,36] and convergence with alternative measures [37]. Notwithstanding, there are few item-level evaluations of this subscale, and psychometric analyses were thus conducted to evaluate dimensionality and measurement invariance [38]. These indicated five items that measured a unidimensional construct and demonstrated 'scalar' invariance (details available from the primary author), the latter indicating scores that reflected a stable construct on a consistent metric over time [38]. These items were: (1) 'most people I'm close to are very supportive'; (2) 'if I'm having problems, I have people I can talk to'; (3) 'people I know care about me'; (4) 'my friends are available if I need them'; and (5) 'I like being around

my family'. Cronbach's α ranged from 0.81 to 0.86 across waves. Items were summated and higher scores indicated greater social support.

Relationship satisfaction was evaluated among respondents who were married or in common-law relationships, using the Kansas Marital Satisfaction Scale (KMS) [39]. This consists of three items (e.g. 'How satisfied are you with your [common-law] marriage?') scored on a seven-point scale (1 = extremely dissatisfied, 7 = extremely satisfied). The KMS has excellent psychometric properties [40], and preliminary analyses supported scalar invariance in this data (details available from the primary author). Cronbach's α ranged from 0.92 to 0.94 across waves. Items were summated and higher scores indicated higher relationship satisfaction.

Comorbid mental health problems included major depression, generalized anxiety and substance use problems. Depression and generalized anxiety were defined according to DSM-IV criteria, and measured using a short form of the Composite International Diagnostic Interview [41]. Substance use problems were assessed using 17 items adapted primarily from the Alcohol, Smoking and Substance Involvement Screening Test [42]. These were administered if respondents used substances at least weekly, and evaluated problems across financial, mental or physical health, interpersonal, legal, school or work domains. This study identified problems if respondents answered 'yes' to any item indicating a substance use problem. Details can be found elsewhere [27].

Data analyses

Data-file preparation was conducted using SPSS version 21, while MPlus version 7.2 was used for subsequent analyses in a latent trajectory modelling (LTM) [43] framework. The latter involved a series of confirmatory factor analysis models, with repeated measures of family or interpersonal adjustment, respectively, specified as indicators of latent variables that summarized the underlying parameters of change. These parameters were then regressed on indicators of gambling problems. Robust maximum likelihood (MLR) was used to estimate models, while multiple imputation techniques ($k = 30$ data sets) managed intermittent data.

From a heuristic perspective, the LTM is based on the premise that repeated measurements from individuals over time can be described by underlying individual trajectories [43] (analogous to regression lines that yield 'best fit' to observed data). These trajectories may vary across individuals, and people differ in terms of attributes such as starting point and rate of change. A linear model, for example, may describe trajectories through two factors: an intercept (initial level) and slope (constant rate of change). In statistical terms, the factor means express characteristics of the average trajectory (e.g. mean rate of change, when pooled across respondents). Factor variances indicate between-person differences, and how individuals vary in patterns of change. More complex models may include additional (e.g. quadratic) factors that describe curvature in trajectories.

Once adequately fitting descriptive (i.e. unconditional) models are identified, these can be extended through 'conditional' models including explanatory variables. The latter are analogous to predictor variables in standard regression, except that these predictors explain variance in trajectories [43]. This variance includes: (a) between-person variability in attributes of overall trajectories (e.g. rates of change) and (b) time-specific variance that reflects deviations between observed scores and estimated trajectories (i.e. the line of 'best fit'). The former (between-person) variability can be regressed on predictors that also vary between people, and are known as 'time-invariant covariates' (because they are unchanging or were measured during particular waves of interest; e.g. study baseline). In contrast, the latter (time-specific) variance can be regressed on explanatory variables that are also measured repeatedly and change over time, with these changes explaining the time-specific scores (which may be higher or lower than expected, given the underlying trajectory). These explanatory variables correspond to notions of 'distal' and 'proximal' factors, respectively [25].

Model testing procedures were based on Hussong *et al.* [25], and initially involved estimation of descriptive models of change in family or interpersonal adjustment. For each outcome, a linear model was estimated first, while subsequent models included a quadratic factor that tested for curvature in trajectories. Model fit was evaluated according to standard criteria [Comparative Fit Index (CFI) > 0.95, Tucker–Lewis Index (TLI) > 0.95, Standardized Root Mean Square Residual (SRMR) < 0.05, Root Mean Square Error of Approximation (RMSEA) < 0.05] [44], while the Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) were used for model comparison [45]. Conditional models were then estimated that included gambling problems as explanatory variables. Distal effects on long-term trajectories were evaluated through models with time-invariant covariates. In these models, the latent parameters describing overall change (e.g. linear slope) were regressed on dummy variables indicating ARG and MR/PG at baseline. Proximal effects on time-specific levels of family or interpersonal adjustment were evaluated through subsequent models with time-varying covariates. These regressed the repeated measures of family or interpersonal adjustment on repeated measures of ARG and MR/PG, in addition to latent change parameters. Predictors included ARG and MR/PG when measured concurrently with family or interpersonal adjustment, depression, generalized anxiety and substance use problems. They also included ARG

and MR/PG measured at the preceding wave. These 'time-lagged' covariates evaluated whether gambling problems at one wave predicted levels of family or interpersonal adjustment measured 1 year later.

RESULTS

Models of family functioning and social support considered data from the total sample ($n = 4121$), while analyses of relationship satisfaction were based on respondents in married or common-law relationships ($n = 3262$). These drew from all available information from respondents reporting relationships during at least one wave. Most of these (80.5%) provided data at four or five waves, with covariance coverage statistics exceeding 75%.

Unconditional models of change are displayed in Table 2. As shown, the linear models provided good fit to data on family functioning and social support, and were adequate representations of relationship satisfaction (according to all indices except the SRMR, which was marginal). Parameter estimates indicated that family functioning and relationship satisfaction were high at baseline, but declined for the sample as a whole. The slope for social support indicated flat trajectories and general stability across the study. Variance estimates suggested between-person differences in all these change parameters. Quadratic models demonstrated improved fit (indicated by lower values of χ^2_{MLR}, AIC and BIC), and suggested modest curvature in trajectories. Quadratic models were thus accepted as best-fitting, although linear accounts were approximate and interpretable.

Table 3 shows conditional models of family or interpersonal adjustment, which specified ARG and MR/PG at baseline as predictors of overall trajectories of family or interpersonal adjustment. Given that linear models were adequately fitting, we focused on these initially. Results showed that ARG and MR/PG were both related to all intercept factors, and thus lower starting levels of family functioning, social support and relationship satisfaction. However, there were no significant associations with latent slopes, and thus no effects of ARG or MR/PG at baseline on overall rates of change. Quadratic models (not shown) indicated no effects of ARG and MR/PG on levels of curvature in trajectories.

Models with time-varying covariates were estimated subsequently, and evaluated whether annual measures of ARG and MR/PG predicted time-specific levels of family or interpersonal adjustment. These were based on best-fitting models of quadratic change, with effects of covariates that were constrained to equivalence across waves. Results are displayed in Table 4. As shown, the repeated measures of MR/PG predicted concurrent levels of all measures of family or interpersonal adjustment, which were lower than expected given underlying trajectories, during waves when individuals reported MR/PG. Repeated measures of ARG predicted concurrent levels family functioning, but not social support or relationship satisfaction. MR/PG had significant time-lagged effects, and predicted lower levels of family functioning and social support when measured at subsequent waves. All relationships were independent of major depression, generalized anxiety and substance use problems.

DISCUSSION

The main findings were that MR/PG was not related significantly to overall rates of change or curvature in trajectories of family or interpersonal adjustment. Rather, the results indicated that annual measures of MR/PG predicted time-specific decreases in family and interpersonal adjustment when measured concurrently, and lower family functioning and social support at subsequent waves. These findings are consistent with prior cross-sectional studies [18,22], but extend this literature by situating the associations in models that also account for underlying trajectories. As far as we are aware, this is also the first study to establish time-lagged relationships, and thus situate the explanatory factors (i.e. gambling problems) and outcomes (e.g. family functioning) prospectively in time.

The study provided novel indications of processes that underlie associations, and were consistent with notions of proximal influences of gambling problems on time-specific levels of family or interpersonal adjustment. It suggests that gambling problems may function as interpersonal 'shocks' [25] that precede short-term crises in families and support networks. However, the absence of discernible effects on overall trajectories indicates that gambling problems do not necessarily 'launch' individuals into long-term patterns of interpersonal maladjustment. Such findings of proximal effects, but no distal influences, may be explained partly through notions of family resilience [23,24]. These emphasize the capacities of families to respond to crises through mechanisms of 'adaptation' (e.g. by modifying meaning structures), which maintain the functions and stability of the family system [46]. More generally, however, such models also highlight the dynamic nature of family systems, which result from complex interactions involving characteristics of individuals, relationships and environments. Given many factors that vary over time and may impact upon interpersonal systems, it also seems likely that distal effects will be obscured and difficult to discern.

Limitations

The findings should be interpreted in light of methodological limitations. The response rate was low (21.3%), and results may be affected by non-response bias. The sampling strategies were not systematic, and yielded over-

Table 2 Unconditional models of latent trajectories in family or interpersonal adjustment.

		Family functioning				*Social support*				*Relationship satisfaction*			
		Linear model		*Quadratic model*		*Linear model*		*Quadratic model*		*Linear model*		*Quadratic model*	
Latent factors		*Estimate*	*SE*	*Estimate*	*SE*	*Estimate*	*SE*	*Estimate*	*SE*	*Estimate*	*SE*	*Estimate*	*SE*
Intercept	Mean	5.57***	0.02	5.59***	0.02	12.34***	0.04	12.32***	0.04	17.38***	0.06	17.54***	0.07
	Variance	0.88***	0.03	0.96***	0.05	4.28***	0.14	4.30***	0.21	6.83***	0.39	8.08***	0.71
Slope	Mean	−0.03***	0.01	−0.07***	0.02	−0.01	0.01	0.02	0.03	−0.25***	0.02	−0.61***	0.07
	Variance	0.03***	0.00	0.20***	0.04	0.11***	0.01	0.71***	0.16	0.22***	0.04	3.20***	0.67
Quadratic	Mean			0.01***	0.00			−0.01	0.01			0.09***	0.02
	Variance			0.01***	0.00			0.04***	0.01			0.16***	0.04
Model fit	χ^2 (d.f.)	67.89	(10)	25.81	(6)	93.14	(10)	36.49	(6)	90.46	(10)	12.12	(6)
	CFI	0.99		1.00		0.99		1.00		0.96		1.00	
	TLI	0.99		0.99		0.99		0.99		0.96		1.00	
	SRMR	0.03		0.02		0.03		0.01		0.06		0.02	
	RMSEA	0.04		0.03		0.05		0.04		0.05		0.02	
	AIC (BIC)	58561	(58624)	58512	(58601)	87512	(87575)	87443	(87532)	88014	(88075)	87910	(87996)

Linear models summarize trajectories in terms of two latent factors: (1) intercept (initial level) and (2) slope (constant rate of change). Quadratic models include a third latent factor (3) quadratic (curvature in trajectories). Factor means: characteristics of average trajectories pooled across respondents. Factor variances: between-person differences. SE = standard error; CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; AIC (BIC) = Akaike's Information Criterion (Bayesian Information Criterion). ***$P < 0.001$.

Table 3 Conditional models (linear) with gambling problems at baseline at time-invariant covariates.

		Family functioning		*Social support*		*Relationship satisfaction*	
Effects		*Estimate*	*SE*	*Estimate*	*SE*	*Estimate*	*SE*
Intercept	*Mean*	5.64***	0.02	12.48***	0.04	17.56***	0.07
	Variance	0.86***	0.03	4.20***	0.14	6.74***	0.40
Slope	*Mean*	−0.03***	0.01	−0.02	0.01	−0.27***	0.02
	Variance	0.03***	0.00	0.10***	0.01	0.22***	0.05
Intercept ON	*ARG*	−0.18***	0.05	−0.33**	0.10	−0.45**	0.16
	MR/PG	−0.48***	0.07	−0.94***	0.15	−1.31***	0.26
Slope ON	*ARG*	0.02	0.01	0.03	0.02	0.05	0.05
	MR/PG	0.03	0.02	0.02	0.04	0.11	0.09
Model fit	χ^2 (d.f.)	83.26	(16)	101.51	(16)	101.21	(16)
	CFI	0.99		0.99		0.97	
	TLI	0.99		0.99		0.96	
	SRMR	0.03		0.02		0.04	
	RMSEA	0.03		0.04		0.04	
	AIC (BIC)	58497	(58586)	87476	(87564)	87954	(88040)

[a]Factor means: characteristics of average trajectories pooled across respondents. Factor variances: between-person differences. Effects denoted by ON indicated regression of latent factors (e.g. slope/constant rate of change) on explanatory variables. ARG: at-risk gambling (PGSI 1–2); MR/PG: moderate-risk/problem gambling (PGSI 3+); SE = standard error; CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; AIC (BIC) = Akaike's Information Criterion (Bayesian Information Criterion). $^{**}P < 0.01$; $^{***}P < 0.001$.

Table 4 Conditional models (quadratic) with gambling problems as time-varying covariates.

		Family functioning		*Social support*		*Relationship satisfaction*	
Effects		*Estimate*	*SE*	*Estimate*	*SE*	*Estimate*	*SE*
Intercept	Mean	5.70***	0.02	12.49***	0.04	17.76***	0.07
	Variance	0.85***	0.05	4.03***	0.20	7.68***	0.73
Slope	Mean	−0.07***	0.02	0.02	0.04	−0.61***	0.07
	Variance	0.18***	0.04	0.64***	0.15	3.11***	0.67
Quadratic	Mean	0.01*	0.00	−0.01	0.01	0.09***	0.02
	Variance	0.01***	0.00	0.04***	0.01	0.15***	0.04
Family/interpersonal adjustment ON							
Concurrent$_{(t)}$	ARG	−0.07**	0.02	−0.08****	0.05	−0.12	0.10
	MR/PG	−0.11**	0.04	−0.28**	0.09	−0.53**	0.17
	Depression	−0.37***	0.03	−0.45***	0.06	−0.83***	0.12
	Generalized anxiety	−0.37***	0.05	−0.68***	0.10	−0.46*	0.19
	Substance use problems	−0.32***	0.04	−0.46***	0.08	−0.86***	0.17
Lagged$_{(t-1)}$	ARG	−0.03	0.02	−0.03	0.05	−0.08	0.11
	MR/PG	−0.12**	0.04	−0.24**	0.08	−0.12	0.18
Model fit	χ^2 (d.f.)	374.27	(124)	313.61	(124)	258.28	(124)
	CFI	0.96		0.98		0.97	
	TLI	0.96		0.98		0.96	
	SRMR	0.04		0.03		0.02	
	RMSEA	0.02		0.02		0.02	
	AIC (BIC)	57889	(58022)	87128	(87261)	87779	(87907)

Factor means: characteristics of average trajectories pooled across respondents. Factor variances: between-person differences. Effects denoted by ON indicate regression of time-specific measures (family/interpersonal adjustment) on predictor variables (also time-specific) measured concurrently (t) or at preceding waves (t–1). ARG: at-risk gambling (PGSI 1–2), MR/PG: moderate-risk/problem gambling (PGSI 3+); SE = standard error; CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; AIC (BIC) = Akaike's Information Criterion (Bayesian Information Criterion). $^{*}P < 0.05$; $^{**}P < 0.01$; $^{***}P < 0.001$. $^{****}P < 0.10$).

representations of people with gambling problems (due to oversampling of 'at risk' individuals), and under-representations of certain socio-demographic groups (e.g. single people, minority groups, lower levels of educational attainment) [27]. There were no sampling weights and these characteristics were unadjusted in analyses. The

representativeness of the sample was affected further by missing and intermittent data. Implications for analyses of relationship satisfaction were particularly unclear, given that satisfaction scales were not administered if respondents were single during an assessment.

Family functioning was measured using a single item with no psychometric evidence. There was limited evidence for properties of the social support scale, and we thus conducted our own evaluations. These indicated use of a subset of items, which are not comparable with prior studies of this measure. Family and interpersonal measures were derived from self-reports, and different findings may be expected from other informants. The PGSI yielded small numbers of problem gamblers using conventional cut-off criteria, and we combined the moderate-risk and problem gambling categories. As such, the analyses evaluated a heterogeneous group including individuals who might not be problem gamblers according to clinician ratings [29]. Alternative cut-off criteria (PGSI 5+) [29] have been proposed and may yield different findings. Finally, the timing of study baseline was arbitrary with regard to histories of gambling, and may have occurred at any stage of a preliminary or recurrent episode. As such, the models of distal effects, which used baseline indicators of ARG and MR/PG, do not necessarily indicate effects of gambling problems at first onset.

CONCLUSIONS

This study indicated proximal effects on family and interpersonal adjustment, and suggests that gambling problems may function as precursors to short-term crises in families and support networks. It indicates the need for initiatives to assist families, in particular, during times of crisis. These initiatives may be situated in specialist treatment services, where interventions can include resources for family members to reduce distress, and help the gambler in accessing treatment [47]. There may also be scope for systemic therapies [48] that work conjointly with multiple family members. In conjunction, there is a need for initiatives to increase usage of specialist services. These include identification and referral programmes, which are positioned in health-care settings where gambling problems are over-represented [49]. Interpersonal effects of gambling problems may suggest that identification (e.g. case-finding) strategies should ask patients about gambling problems among family members. This would provide a greater yield of patients impacted by gambling, including family members, who may be particularly receptive to referrals to specialist services.

Declaration of interests

None.

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References

1. Smith G. The nature and scope of gambling in Canada. *Addiction* 2014; **109**: 706–10.
2. Delfabbro P., King D. Gambling in Australia: Experiences, problems, research and policy. *Addiction* 2012; **107**: 1556–61.
3. Orford J. Gambling in Britain: The application of restraint erosion theory. *Addiction* 2012; **107**: 2082–86.
4. Petry N. M., Blanco C. National gambling experiences in the United States: will history repeat itself? *Addiction* 2013; **108**: 1032–37.
5. Delfabbro P. Problem and pathological gambling: a conceptual review. *J Gambl Bus Econ* 2013; **7**: 35–53.
6. World Health Organization The ICD-10 Classification of Mental and Behavioural Disorders: Clinical Descriptions and Diagnostic Guidelines. Geneva: Author; 1992.
7. American Psychiatric Association The Diagnostic and Statistical Manual of Mental Disorders, 5th edn. Washington: Author; 2013.
8. Shaffer H. J., Korn D. A. Gambling and related mental disorders: a public health analysis. *Annu Rev Publ Health* 2002; **23**: 171–212.
9. Productivity Commission Australia's Gambling Industries, Report no. 10. AusInfo: Canberra; 1999.
10. Darbyshire P., Oster C., Carrig H. The experience of pervasive loss: children and young people living in a family where parental gambling is a problem. *J Gambl Stud* 2001; **17**: 23–45.
11. Kalischuk R. G. Cocreating life pathways: problem gambling and its impact on families. *Fam J* 2010; **18**: 7–17.
12. Holdsworth L., Nuske E., Tiyce M., Hing N. Impacts of gambling problems on partners: partners' interpretations. *Asian J Gambl Issu Public Health* 2013; **3**: 1–14.
13. Patford J. For worse, for poorer and in ill health: how women experience, understand and respond to a partner's gambling problems. *Int J Ment Health Addict* 2009; **7**: 177–89.
14. Dowling N., Smith D., Thomas T. The family functioning of female pathological gamblers. *Int J Ment Health Addict* 2009; **7**: 29–44.
15. Lorenz V. C., Yaffee R. A. Pathological gambling: psychosomatic, emotional and marital difficulties as reported by the gambler. *J Gambl Behav* 1986; **2**: 40–9.
16. Lorenz V. C., Yaffee R. A. Pathological gambling: psychosomatic, emotional and marital difficulties as reported by the spouse. *J Gambl Behav* 1988; **4**: 13–26.
17. Hodgins D. C., Shead N. W., Makarchuk K. Relationship satisfaction and psychological distress among concerned significant others of pathological gamblers. *J Nerv Ment Dis* 2007; **195**: 65–71.

18. Black D. W., Shaw M. C., McCormick B. A., Allen J. Marital status, childhood maltreatment, and family dysfunction: A controlled study of pathological gambling. *J Clin Psychiatry* 2012; **73**: 1293–97.
19. Wenzel H. G., Øren A., Bakken I. J. Gambling problems in the family—a stratified probability sample study of prevalence and reported consequences. *BMC Public Health* 2008; **8**: e412.
20. Salonen A. H., Castrén S., Alho H., Lahti T. Concerned significant others of people with gambling problems in Finland: a cross-sectional population study. *BMC Public Health* 2014; **14**: e398.
21. Afifi T. O., Brownridge D. A., MacMillan H., Sareen J. The relationship of gambling to intimate partner violence and child maltreatment in a nationally representative sample. *J Psychiatr Res* 2010; **44**: 331–7.
22. Afifi T. O., Cox B. J., Martens P. J., Sareen J., Enns M. W. Demographic and social variables associated with problem gambling among men and women in Canada. *J Psychiatry Res* 2010; **178**: 395–400.
23. Patterson J. M. Families experiencing stress: I. The Family Adjustment and Adaptation Response Model: II. Applying the FAAR model to health-related issues for intervention and research. *Fam Syst Med* 1988; **6**: 202–37.
24. Patterson J. M. Integrating family resilience and family stress theory. *J Marriage Fam* 2002; **64**: 349–60.
25. Hussong A. M., Curran P. J., Moffitt T. E., Caspi A., Carrig M. M. Substance abuse hinders desistance in young adults' antisocial behavior. *Dev Psychopathol* 2004; **16**: 1029–46.
26. Blonigen D. M. Explaining the relationship between age and crime: contributions from the developmental literature on personality. *Clin Psychol Rev* 2010; **30**: 89–100.
27. Williams RJ, Hann R, Schopflocher D, West B, McLaughlin P, White N, King K, Flexhaug T. Quinte Longitudinal Study of gambling and problem gambling. Report prepared for the Ontario Problem Gambling Research Centre, Guelph, Ontario; 2015.
28. Ferris J., Wynne H. The Canadian Problem Gambling Index. Canadian Centre on Substance Abuse: Ottawa; 2001.
29. Williams R. J., Volberg R. A. The classification accuracy of four problem gambling assessment instruments in population research. *Int Gambl Stud* 2014; **14**: 15–28.
30. Rush B. R., Bassani D. G., Urbanoski K. A., Castel S. Influence of co-occurring mental and substance use disorders on the prevalence of problem gambling in Canada. *Addiction* 2008; **103**: 1847–56.
31. Haydock M., Cowlishaw S., Harvey C., Castle D. Prevalence and correlates of problem gambling in people with psychotic disorders. *Compr Psychiatry* 2015; **58**: 122–29.
32. Sargent-Cox K. A., Anstey K. J., Luszcz M. A. Determinants of self-rated health items with different points of reference: implications for health measurement of older adults. *J Aging Health* 2008; **28**: 739–61.
33. Heine C., Browning C., Cowlishaw S., Kendig H. Trajectories of older adults' hearing difficulties: examining the influence of health behaviors and social activity over 10 years. *Geriatr Gerontol Int* 2013; **13**: 911–18.
34. Morey L. Professional Manual for the Personality Assessment Inventory. Psychological Assessment Resources: Odessa; 1991.
35. Karlin B. E., Creech S. K., Grimes J. S., Clark T. S., Meagher M. W., Morey L. C. The Personality Assessment Inventory with chronic pain patients: psychometric properties and clinical utility. *J Clin Psychol* 2005; **61**: 1571–85.
36. Schinka J. A. Personality Assessment Inventory scale characteristics and factor structure in the assessment of alcohol dependency. *J Pers Assess* 1995; **64**: 101–11.
37. Hopwood C. J., Creech S. K., Clark T. S., Meagher M. W., Morey L. C. The convergence and predictive validity of the Multidimensional Pain Inventory and the Personality Assessment Inventory among individuals with chronic pain. *Rehabil Psychol* 2007; **52**: 443–50.
38. Widaman K. F., Ferrer E., Conger R. D. Factorial invariance within longitudinal structural equation models: measuring the same construct across time. *Child Dev Perspect* 2010; **4**: 10–18.
39. Schumm W. R., Paff-Bergen L. A., Hatch R. C., Obiorah F. C., Copeland J. M., Meens L. D., *et al.* Concurrent and discriminant validity of the Kansas Marital Satisfaction Scale. *J Marriage Fam* 1986; **48**: 381–7.
40. Graham J. M., Diebels K. J., Barnow Z. B. The reliability of relationship satisfaction: a reliability generalization meta-analysis. *J Fam Psychol* 2011; **25**: 39–48.
41. Kessler R. C., Andrews G., Mroczek D., Ustun B., Wittchen H. U. The World Health Organization Composite International Diagnostic Interview Short-Form (CIDI-SF). *Int J Method Psychiatr* 1998; **7**: 171–85.
42. WHO ASSIST Working Group The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST): development, reliability and feasibility. *Addiction* 2002; **97**: 1183–94.
43. Curran P. J., Hussong A. M. The use of latent trajectory models in psychopathology research. *J Abnorm Psychol* 2003; **112**: 526.
44. Hu L., Bentler P. M. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Model* 1999; **6**: 1–55.
45. Kuha J. AIC and BIC: comparisons of assumptions and performance. *Sociol Method Res* 2004; **33**: 188–229.
46. Patterson J. M. Understanding family resilience. *J Clin Psychol* 2002; **58**: 233–246.
47. Makarchuk K., Hodgins D. C., Peden N. Development of a brief intervention for concerned significant others of problem gamblers. *Addict Disord Treat* 2002; **1**: 126–34.
48. Lee B. K. Congruence couple therapy for pathological gambling. *Int J Mental Health Addict* 2009; **7**: 45–67.
49. Cowlishaw S., Kessler D. Problem gambling in the UK: implications for health, psychosocial adjustment and health care utilization. *Eur Addict Res* 2016; **22**: 90–8.

