Differences in pathological gambling prevalence estimates: facts or artefacts?

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Abstract

The paper aims at investigating whether survey methodology has recently converged to justify the common practice of comparing prevalence estimates and interpreting differences within and between countries. To this end, prevalence studies of problem (PrG) and pathological gambling (PG) published in peer-reviewed journals between 2000 and 2010 were critically reviewed. A systematic computer-based literature search was conducted within various databases and major gambling journals. In a two-step search process, a total of 39 studies reporting current prevalence data of non-clinical national samples from different countries were identified. Analyses revealed wide ranges in estimated PrG/PG rates for adults, adolescents, and college students, whereas similar estimates were reported in two studies on PrG/PG in seniors. Despite the discussion on methodological consistency in the field of gambling research, comparability of the reported estimates was found to be still highly limited by major variation between studies with regard to survey description, administration format, exclusion criteria, assessment instrument, cut-off scores, sample frame, and reference period. The interpretation of differences in PrG and PG prevalence estimates within and between countries may be improved by using valid and reliable instruments and by applying comparable survey methodology in well-defined populations. *Copyright © 2011 John Wiley & Sons, Ltd.*

Introduction

Gambling, in general, is understood as placing a value on a bet, game or event with an unpredictable outcome which is determined by chance (Bolen and Boyd, 1968). For most people gambling is an entertaining leisure activity, but a minority of the population develops serious problems as a consequence of their gambling behaviour. Pathological gambling (PG) is specified as an impulse-control disorder (not elsewhere classified) in both the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV; American Psychiatric Association, 1994) and the International Classification of Diseases, 10th revision

(ICD-10; World Health Organization, 1991). Less severe forms of gambling-related problems are often labelled “problem gambling” (PrG; Toce-Gerstein *et al.*, 2003; Volberg, 2001) although this category is not officially implemented in either classification system.

Studies on prevalence of PrG and PG are needed to understand the size of the problem and its relation to gambling supply, to monitor trends, to detect subgroups with elevated risks, and to better allocate and evaluate resources for prevention and health care. According to a recent literature review, 0.15% to 3.5% of the adult population in North America, Europe, Australia/New Zealand

and Asia showed past-year PG throughout the years 2000 to 2005 (Stucki and Rihs-Middel, 2007). The prevalence of past-year PrG was estimated at 0.4% to 4.7%. National prevalence estimates are commonly compared between countries to assess the relative extent of the problem in different regions. For example, Ólason *et al.* (2006b, p. 49) reported that “the prevalence of problem gambling among adolescents and adults is less widespread in the Nordic countries than elsewhere”. Bonke and Borregaard (2009, p. 658) stated that “for all age groups, there are more Norwegians than Danes who are problem or pathological gamblers”. Such comparisons may help to evaluate the impact of gambling policies and exposure to gambling opportunities on the number of pathological gamblers.

However, in order to analyse differences in prevalence rates and to draw meaningful conclusions, the methods used in studies estimating PrG/PG have to be comparable. For instance, a cross-validation study using two different instruments to measure PG (Stinchfield, 2002) revealed substantially higher PG rates resulting from the South Oaks Gambling Screen (SOGS; Lesieur and Blume, 1987) as compared to a DSM-IV based instrument. The importance of assessment instruments was also highlighted in a review by Stucki and Rihs-Middel (2007). Furthermore, PG estimates from two studies conducted in Germany in 2006 (Bühner *et al.*, 2007; Buth and Stöver, 2008) using the same instrument but differing in various other methodological aspects were found to differ by a factor of three. While expecting a single true annual prevalence of PG, these results point to a substantial impact of survey methodology on the estimation of PrG/PG. In fact, methodological aspects such as survey description, administration format, and exclusion criteria have been found to influence prevalence rates of gambling-related problems (Williams and Volberg, 2009).

Even though the impact of survey methodology on differences in PG estimates is well recognized in gambling research (Derevensky and Gupta, 2000; Hardoon and Derevensky, 2002; Jackson *et al.*, 2009; Jonsson, 2006; Molde *et al.*, 2008; Volberg *et al.*, 2001; Williams and Volberg, 2009), prevalence rates are still compared within and across countries and differences are interpreted in relation to external factors. Given the evidence of methodological biases on results, one may ask whether convergence in survey methodology has recently progressed to an extent justifying comparability.

The present paper investigates comparability of recent national and regional prevalence estimates of PrG/PG by analysing differences in survey methodology. To this end, prevalence estimation studies of PrG/PG in non-clinical populations published between 2000 and 2010 were reviewed and variation in methodological aspects such as

survey description, administration format, exclusion criteria, assessment instruments, and choice of cut-off scores was examined.

Methods

A systematic computer-based literature search was performed within the databases of Medline, PsychINFO, PubMed, Web of Science and scholar.google. To detect relevant prevalence studies of PrG/PG, the terms “gambling” and “prevalence” were used. The search was conducted with the same terms in English, French, German, Italian, and Spanish in order to obtain as many prevalence studies as possible and to avoid English publication bias. Additionally, the journals *International Gambling Studies*, *International Journal of Mental Health and Addiction*, *Journal of Gambling Issues*, and *Journal of Gambling Studies* as well as the reference list of all obtained studies were scanned for further studies.

In order to be included in the present review, studies had (1) to be published in peer-reviewed journals between January 2000 and December 2010, (2) to mention at least one prevalence estimate in the study's abstract, (3) to investigate non-clinical populations, and (4) to be available to the authors no later than February 2011. If estimates of the same studies were reported in several publications, they were counted only once ($n = 3$). A total of 79 studies was obtained by this selection procedure. Due to large difficulties in measuring concurrent occurrence of symptoms in a given year over life span, we constrained our analysis to studies using reference periods of 12 months prior to the survey. Thus, in a second step, (5) all studies reporting only lifetime estimates ($n = 17$), estimates referring to shorter periods ($n = 2$) or longitudinal data ($n = 1$) were excluded. If (6) the reference period was not specified precisely and the screening instrument was known to measure lifetime prevalence, lifetime rates were assumed and the study was disregarded ($n = 9$). Furthermore, (7) studies were also excluded if prevalence rates had not been divided into separate values for PrG and PG, i.e. merely one was provided for both ($n = 10$). Finally, (8) non-representative samples of the adult total population ($n = 1$).

In total, PrG/PG rates of 39 studies were included in the present review. Similar to earlier research (Shaffer *et al.*, 1999), studies were grouped based on the investigated population (adults, adolescents, college students, and seniors). Conformance in fundamental factors such as time period of study implementation and characteristics of respondents (e.g. gender and age) was implicitly considered a basic requirement. In order to assess the authenticity of differences in PrG/PG estimates, comparability of estimates

was evaluated by analysing differences between studies regarding survey description, administration format, exclusion criterion, assessment instrument, cut-off scores, and further methodological aspects such as sample frame and reference period. If the study did not inform about the kind of survey description, corresponding authors were contacted in order to obtain this information. No study was excluded because of missing information.

Results

Study characteristics

An overview of study characteristics of the 39 studies is given in Table 1. Gambling problems were mostly studied in the adult total population ($n = 17$) and adolescents ($n = 17$), followed by college students ($n = 3$) and seniors ($n = 2$). The majority of studies were conducted in English ($n = 33$) and in North America ($n = 19$). Sample sizes ranged from 104 to 34,770 participants with respondents being at least eight years old at the time of survey participation.

In most cases, surveys were described to participants to be on gambling ($n = 17$). Unfortunately, this information could not be obtained for the majority of the reported studies ($n = 19$). Data were mostly collected using self-administered questionnaires ($n = 23$), especially in adolescent populations ($n = 16$). The questionnaire was completed online in one study (Molde *et al.*, 2008). In contrast, adult populations were commonly surveyed by telephone interviews ($n = 12$). Mixed methods were also applied, e.g. collecting data by Internet and telephone (Buth and Stöver, 2008) or by telephone in the first and postal questionnaires in the second data collection phase (Brodbeck *et al.*, 2009; Johansson and Götestam, 2003). Response rates varied heavily between studies (26–100%). Exclusion criteria were only used in a minority of studies ($n = 12$), mainly in studies on PG in the adult total population ($n = 8$). Furthermore, various screening and diagnostic instruments assessing PrG/PG were utilized. Predominantly, the South Oaks Gambling Screen (Revised) [SOGS(-R); Lesieur and Blume, 1987, 1993; $n = 10$], the Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (Text Revised) [DSM-IV(-TR); American Psychiatric Association, 1994, 2000; $n = 8$] or, in adolescents, the South Oaks Gambling Screen, Revised for Adolescents (SOGS-RA; Winters *et al.*, 1993a; $n = 11$) were applied. Some studies employed different instruments simultaneously ($n = 8$).

Prevalence estimates of PrG and PG

Overall prevalence rates for the adult total population range from 0.1% to 4.5% for PrG and from 0.02% to

2.0% for PG (Table 2; $n = 17$). Studies on adolescents report prevalence rates for PrG (sometimes called “at risk gambling”) between 1.8% and 15.1%. Prevalence rates for PG (sometimes named “PrG”) vary from 0.4% to 26.0% (Table 3; $n = 17$). Studies on college students (Table 4; $n = 3$) indicate prevalence rates between 2.1% and 46.5% for PrG and between 0.8% and 6.0% for PG whereas PG is prevalent in 1.2% of seniors (PrG: 1.6%; Table 4; $n = 2$).

Comparability of prevalence estimates: methodological considerations

Contrasting estimated PrG/PG rates of all 39 presented studies revealed that the methodology of estimating prevalence of gambling problems has not converged towards any standard. Thus, only a few prevalence rates are to some extent comparable regarding the aforementioned methodological aspects. For the adult total population we only found two studies from Bondolfi *et al.* (2000, 2008) meeting the criteria, the second study being a follow-up of the first (Table 2). All others vary on at least one essential feature. Similar difficulties were encountered for the comparison of PrG/PG estimates of studies on college students and seniors. Research on PrG/PG in adolescents seems to be somewhat more consistent: In 10 studies, data were collected without exclusion criteria, using a questionnaire of the SOGS-RA, applying the same cut-off score, and mostly being described as being a study on gambling (Table 3). Still, further methodological factors need to be considered.

Survey description

The kind of survey description is found to impact on prevalence rates by triggering participation of subjects that are interested in the topic surveyed (Williams and Volberg, 2009). In case of “gambling studies”, more gamblers tend to participate as they are genuinely more interested in this topic. As consequence of their gambling, they are more likely to have gambling problems resulting, in turn, in higher PrG/PG rates found in “gambling studies”. Still, it is likely that there are different mechanisms and rationales for participation when a survey is conducted in a classroom setting. The influence of survey description might be less based on intrinsic interest in a topic when all potential respondents participate in the survey, i.e. when the response rate is high.

Administration format

Even though none of the reported studies explicitly analysed the impact of administration format on prevalence

Table 1 Summary statistics of prevalence studies on PrG and PG

	Adult	Adolescents	College students	Seniors	Total
Total	17	17	3	2	39
Language					
English	14	14	3	2	33
French	—	1	—	—	1
German	2	—	—	—	2
Spanish	1	2	—	—	3
Region					
Asia	1	—	—	—	1
Australia	1	1	—	—	2
Europe	9	8	—	—	17
North America	6	8	3	2	19
Sample Size	809–34,770	104–13,549	585–20,739	810–1000	104–34,770
Age (years)	≥15	≥8	—	≥55	≥8
Survey description					
Gambling	6	7	3	1	17
Other	4	—	—	—	4
Missing	7	10	—	1	19
Administration format					
Personal interview	3	—	—	—	3
Internet	1	—	—	—	1
Telephone	12	2	—	1	15
Written questionnaire	3	16 ^a	3	1	23
Mixed mode	2	1	—	—	3
Exclusion criteria					
No	9	16	2	—	27
Any	8	1	1	2	12
Instruments					
CPGI/PGSI	2	—	1	—	3
DIS-IV	1	1	—	—	2
DSM-IV(-TR)	6	1	1	—	8
DSM-IV-J	—	1	1	—	2
DSM-IV-MR-J	—	6	—	—	6
GA20	—	—	1	—	1
MAGS	—	1	—	—	1
NODS	3	—	—	—	3
SOGS(-R)	8	—	—	2	10
SOGS-RA	—	11	1	—	12
More than one instrument	3	4	1	—	8

^aOne being completed online (Molde *et al.*, 2008).

Note: CPGI/PGSI, Canadian Problem Gambling Index/Problem Gambling Severity Index (Ferris and Wynne, 2001); DIS-IV, Diagnostic Interview Schedule IV (Robins *et al.*, 1996); DSM-IV(-TR), Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (Text Revised) (American Psychiatric Association, 1994, 2000); DSM-IV-J, Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, adapted for Juveniles (Fisher, 1992); DSM-IV-MR-J, Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, Multiple Response adapted for Juveniles (Fisher, 2000); GA20, Gamblers Anonymous Twenty Questions (Gamblers Anonymous); MAGS, Massachusetts Gambling Screen (Shaffer *et al.*, 1994); NODS, National Opinion Research Centre DSM-IV Screen for Gambling Problems (Gerstein *et al.*, 1999); SOGS(-R), South Oaks Gambling Screen (Revised) (Lesieur and Blume, 1987, 1993); SOGS-RA, South Oaks Gambling Screen, Revised for Adolescents (Winters *et al.*, 1993a).

Table 2 Past year prevalence of PrG and PG in the adult total population: 2000–2010 (*n* = 17)

Author (year)	State, region	Year	<i>n</i>	Age	Survey description	AF	RR (%)	EC	Instrument	Counted items (<i>n</i>)	Cut-off scores			
											PrG	PG	PrG (%)	PG (%)
Bakken <i>et al.</i> (2009)	Norway	2007	3482	16–74	NA	Q	96.4	LTG	NODS	17	3–4	≥5/10	0.4	0.3
Becoña Iglesias (2004)	Spain, Galicia	2001	1624	≥18	Survey on habit behaviour	I	91.6	Gambled ≥90€ in 2001	NODS	17	3–4	≥5/10	0.25	0.31
Bondolfi <i>et al.</i> (2008)	Switzerland	2005	2803	≥18	Gambling behaviour	T	47.0	—	SOGS	20	3–4	≥5/20	0.8	0.5
Bondolfi <i>et al.</i> (2000)	Switzerland	1998	2526	Adult	Gambling behaviour	T	59.0	—	SOGS	20	3–4	≥5/20	2.2	0.8
Brodbeck <i>et al.</i> (2009)	Switzerland	2007	6047	≥18	Gambling	T Q	52.2	- Gambled weekly in the past month - Ever tried to control gambling - Ever gambled ≥ 500CHF (US\$400) - Regularly gambled ≥ 300CHF (US\$250) - Gambled regularly for ≥2 hours/day - Gambled ≥ weekly or >50€/month in the PY	NODS	17	3–4	≥5/10	0.1	0.02
Buth and Stöver (2008)	Germany	2006	7981	18–65	NA	T Q*	NA	Gambled ≥ weekly or >50€/month in the PY	DSM-IV	19	3–4	≥5	0.64	0.56
Bühringer <i>et al.</i> (2007)	Germany	2006	7817	18–64	"Life and health 2009"	Q	48.0	Gambled >50€/month in the PY	DSM-IV(-TR)	19	3–4	≥5/10	0.3	0.2
Cox <i>et al.</i> (2005)	Canada Alberta British Columbia Manitoba New Brunswick	2002	34,770	≥15	NA	I	77.0	—	CPGI/PGSI	9	3–7	≥8/9	—	—
													1.7	0.5
													1.4	0.5
													2.3	0.6
													1.1	0.4

Table 2. Continued

Author (year)	State, region	Year	n	Age	Survey description	AF	RR (%)	EC	Instrument	Counted items (n)	Cut-off scores			
											PrG	PG	PrG (%)	PrG (%)
	Newfoundland												1.4	0.5
	Nova Scotia												1.1	0.9
	Ontario												1.6	0.4
	PEI												1.4	0.5
	Quebec												1.3	0.4
	Saskatchewan												1.9	1.0
Cox <i>et al.</i> (2004)	Canada,	2000–	1489	≥18	NA	T	70.5	LTG	DSM-IV	NA	1–4	≥5/10	4.5	0.7
	Winnipeg	2001							SOGS	20	3–4	≥5/20	1.9	1.36
Doiron and Nicki (2001)	Canada, PEI	—	809	—	NA	T	43.0	PYG	SOGS	20	3–4	≥5/20	1.1	2.0
Gill <i>et al.</i> (2006)	Australia, South Australia	2001	6045	≥18	“Health, lifestyle and social survey about South Australians”	T	73.1	Gambled ≥ fortnightly in the PY	SOGS (modified)	20	—	A	—	2.0
Götestam and Johansson (2003)	Norway	1997	2014	≥18	NA	T	47.8	—	DSM-IV	10	3–4	≥5/10	0.45	0.15
Kessler <i>et al.</i> (2008)	USA	2001–2003	9282	≥18	“National survey of health and stress”	I	70.9	—	DSM-IV	16	—	≥5/10	—	0.3
Ladouceur <i>et al.</i> (2005)	Canada, Quebec	2002	8842	≥18	Gambling behaviour	T	60.8	—	CPGI/PGSI (4225)	9	4–7	≥8/9	1.0	0.7
									SOGS (4603)	20	3–4	≥5/20	0.9	0.9
									Total (8828)				0.9	0.8
Volberg <i>et al.</i> (2001)	Sweden	—	7139	15–74	“Study on gambling and gambling addiction”	T	72.0	—	SOGS-R	20	3–4	≥5/20	1.4	0.6

Table 2. Continued

Author (year)	State, region	Year	n	Age	Survey description	AF	RR (%)	EC	Instrument	Counted items (n)	Cut-off scores			
											PrG	PG	PrG (%)	PG (%)
Welte <i>et al.</i> (2001)	USA	1999–2000	2638	≥18	"Survey of gambling"	T	65.4	—	DIS-IV	13	3–4	≥5/10	2.2	1.3
Wong and So (2003)	China, Hong Kong	2001	2004	15–64	NA	T	57.4	—	SOGS-R	20	3–4	≥5/20	3.6	1.9
									DSM-IV	10	3–4	≥5/10	4.0	1.8

Note: A = SOGS-M ≥ 5 + self-rating of gambling-related problem ≥ 5 on a 1–10 scale; AF, administration format; CPGL, Canadian Problem Gambling Index; DIS-IV, Diagnostic Interview Schedule IV; DSM-IV(-TR), Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (Text Revised); EC, exclusion criteria; I, personal interview; LTG = gambled ≥ 1/life; NA, not available; NODS, National Opinion Research Centre DSM-IV Screen for Gambling Problems; PEI, Prince Edward Islands; PG, pathological gambling; PGSI, Problem Gambling Severity Index; PrG, problem gambling; PY, past year; PYG = gambled ≥ 1 time/past year; Q, self-administered questionnaire; Q*, self-administered questionnaire being completed online; RR, response rate; SOGS(-R), South Oaks Gambling Screen (Revised); T, telephone interview.

estimates, research suggests that estimates do differ according to administration format. For instance, studies on mode effects in alcohol research indicate that fewer respondents admit alcohol consumption in telephone interviews as compared to self-administered questionnaires (Gmel, 2000; Kraus and Augustin, 2001). For depression scores, similar differences between telephone interviews and self-administration mode have been reported (Aquilino, 1998). The effect seems to be associated with the degree of anonymity provided (higher in self-administration), resulting in more valid responding to questions on sensitive, socially undesirable behaviour such as e.g. illicit drug use (Lessler and O'Reilly, 1997; Richman *et al.*, 1999). However, some research supports the opposite assumption that social desirability bias is smaller and reports are more truthful in personal than in telephone interviews (Holbrook *et al.*, 2003). Latest findings in gambling research confirm the influence of administration format on PG rates and point to higher prevalence estimates in personal interviews, presumably being due to more truthful answers (Williams and Volberg, 2009).

Exclusion criteria

The reported studies applied a variety of different exclusion criteria as screening items such as (1) having ever gambled in life (Bakken *et al.*, 2009; Cox *et al.*, 2004; Welte *et al.*, 2008), (2) having participated in any kind of gambling activity in the past year (Doiron and Nicki, 2001; Huang *et al.*, 2007; Philippe and Vallerand, 2007; Wiebe and Cox, 2005), (3) having gambled a certain amount of money in the past year (Becona Iglesias, 2004; Bühringer *et al.*, 2007), (4) having either gambled weekly or spent a certain amount of money in the past year (Buth and Stöver, 2008) or (5) having either (a) gambled weekly, (b) ever tried to control gambling, (c) ever spent a certain amount of money, (d) did so regularly or (e) gambled regularly for a certain time period a day (Brodbeck *et al.*, 2009).

Given that a tendency to conceal the extent of gambling involvement is characteristic of PG, subjects concerned may not answer truthfully to screening questions about their gambling behaviour (Petry, 2003). Thus, applying an exclusion criterion may result in false negative classifications, i.e. respondents may meet diagnostic criteria but have not been screened for gambling problems (Williams and Volberg, 2009) potentially limiting generalizability of results.

Similar effects of exclusion criteria on research outcome are also known from other research areas. For instance, a study on alcohol treatment outcome found that generalizability of results might be compromised by the use of exclusion criteria because subjects included in the

Table 3 Past year prevalence of PrG and PG in adolescents: 2000–2010 (*n* = 17)

Author (year)	State, region	Year	<i>n</i>	Age	Population sampled	Survey description	AF	RR (%)	EC Instrument	Counted items (<i>n</i>)	Cut-off scores			
											PrG	PG	PrG	PG
											(%)	(%)	(%)	(%)
Adlaf and Ialomiteanu (2000)	Canada, Ontario	1999	2371	15.0	Students	Alcohol, drugs, general health, gambling, and video games	Q	100.0	— SOGS-RA	12	2–3	≥4/12	7.5	5.8
Arbinaga (2000)	Spain, Punta Umbría	1999	130	8–17	—	NA	Q	NA	— SOGS-RA	12	2–3	≥4/12	11.5	5.4
Becoña Iglesias <i>et al.</i> (2001)	Spain, Galicia	—	2790	14–21	Secondary education	NA	Q	NA	— SOGS-RA	12	2–3	≥4/12	8.2	5.6
Fortin <i>et al.</i> (2001)	Canada, Quebec	—	104	12–19	Youth centre members	NA	Q	NA	— DSM-IV-MR-J	12	—	≥4/9	—	7.7
Hardoon <i>et al.</i> (2004)	Canada, Ontario	—	2336	12–19	34 schools	Gambling behaviour	Q	NA	— DSM-IV-MR-J	12	2–3	≥4/9	8.0	4.9
Johansson and Götestam (2003)	Norway	1999	3237	12–18	—	NA	T Q	T 45.6 Q 44.6 45.2	— DSM-IV	10	3–4	≥5/10	3.46	1.76
Langhinrichsen-Rohling <i>et al.</i> (2004)	USA, Alabama, Mississippi, Oregon	—	1672	16.5	HSC students	NA	Q	AL 95.4 M 94.8 OR 91.5	— SOGS-RA	12	—	≥3/12 ≥4/12 ≥5/12 ≥6/12	— — — —	8.2 4.8 2.9 2.3
Magoon and Ingersoll (2006)	USA, Midwest	—	116	14–19	HSC students	NA	Q	26.0	— SOGS-RA	12	—	≥4/12 A	— 26.0	10.0
Molde <i>et al.</i> (2008)	Norway	2004	1285	16–19	HSC, 115 classes	Gambling behaviour and sleep habits	Q*	69.8	— MAGS	10	3–4.5	≥5/10	1.9	2.5
Moodie and Finnigan (2006)	Scotland, Glasgow	—	1980	11–16	12 schools	“Youth gambling study”	Q	75.4 (50.0–96.0)	— DSM-IV-J	12	2–3	≥4/9	15.1	9.0

Table 3. Continued

Author (year)	State, region	Year	n	Age	Population sampled	Survey description	AF	RR (%)	EC	Instrument	Counted items (n)	Cut-off scores			
												PrG	PG	PrG	PG
Ólason <i>et al.</i> (2006a)	Iceland, Reykjavik region, Akureyri	—	750	16–18	Students	Gambling participation	Q	100.0	—	DSM-IV-MR-J SOGS-RA	12 12	2–3 2–3	≥4/9 ≥4/12	3.2 4.4	2.0 2.7
Ólason <i>et al.</i> (2006b)	Iceland, Reykjavik	2003–2004	3511	13–15	23 schools	Gambling participation	Q	84.0 (75.0–94.0)	—	DSM-IV-MR-J SOGS-RA	12 12	2–3 2–3	≥4/9 ≥4/12	3.7 4.1	1.9 2.8
Poulin (2000)	Canada	1998	13,549	15.2	719 classes	NA	Q	98.0	—	SOGS-RA	12	2–3	≥4/12	3.8	2.2
												B	C	8.2	6.4
Skokauskas and Satkeviciute (2007)	Lithuania, Kaunas	—	835	10–18	Students, 24 SC	NA	Q	96.0	—	DSM-IV-MR-J SOGS-RA	9 12	2–3 2–3	≥4/9 ≥4/12	9.1 10.5	4.2 5.2
Splevins <i>et al.</i> (2010)	Australia, Sydney	—	252	12–18	Four private secondary schools	NA	Q	85.0	—	DSM-IV-MR-J	9	2–3	≥4/9	13.1	6.7
Wickwire <i>et al.</i> (2010)	USA, Tennessee	—	1076	13–19	HSC	N.A	Q	NA	—	SOGS-RA	12	2–3	≥4	14.6	12.7
Welte <i>et al.</i> (2008)	USA	2005–2007	2274	14–21	—	“National survey of youth and gambling”	T	NA	LTG	DIS-IV SOGS-RA	14 12	3–4 2–3	≥5/10 ≥4/12	1.8 4.4	0.4 2.1

Note: A = (i) at least weekly gambling + SOGS-RA ≥ 2 or (ii) daily gambling; AF, administration format; B = (i) weekly or daily gambling + SOGS-RA = 1 or (ii) gambling less than weekly + SOGS-RA score ≥ 1 ; C = (i) at least weekly gambling + SOGS-RA ≥ 2 or (ii) daily gambling; CPGI/PGSI, Canadian Problem Gambling Index/Problem Gambling Severity Index; DIS-IV, Diagnostic Interview Schedule IV; DSM-IV(-TR), Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (Text Revised); DSM-IV-J, Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, adapted for Juveniles; DSM-IV-MR-J, Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, Multiple Response adapted for Juveniles; EC, exclusion criteria; GA20, Gamblers Anonymous Twenty Questions; HSC, high school; LTG = gambled ≥ 1 /life; MAGS, Massachusetts Gambling Screen; NA, not available; PG, pathological gambling; PrG, problem gambling; Q, self-administered questionnaire; Q*, self-administered questionnaire being completed online; RR, response rate; SOGS(-R), South Oaks Gambling Screen (Revised); SOGS-RA, South Oaks Gambling Screen Revised for Adolescents; T, telephone interview.

Table 4 Past year prevalence of PrG and PG in college students ($n=3$) and seniors ($n=2$): 2000–2010

Author (year)	State, region	Year	n	Age	Population sampled	Survey description	AF	RR (%)	EC	Instrument	Counted items (n)	Cut-off scores			
												PrG	PG	PrG	PG
College students															
Derevensky and Gupta (2000)	Canada, Montreal region	—	980	18.5	Junior college	Gambling behaviour	Q	NA	—	DSM-IV-J GA 20 SOGS-RA	12	1–3	≥4/12	12.7	3.4
											20	1–6	≥7/20	46.5	6.0
											12	1–3	≥4/12	22.7	5.3
Huang <i>et al.</i> (2007)	Canada	—	20,739	—	College athletes	"NCAA national study on collegiate sports wagering and associated health-risk behaviours"	Q	65.0–75.0	PYG	DSM-IV(-TR)	10	3–4	≥5/10	2.1	0.8
Williams <i>et al.</i> (2006)	Canada, Southern Alberta	2001–2003	585	21.7	University students	Gambling knowledge, attitudes, and behaviour	Q	95.0	—	CPGI/PGSI	9	3–7	≥8/9	6.2	1.4
Seniors															
Philippe and Vallerand (2007)	Canada, Montreal area	2001	810	≥55	—	NA	Q	NA	PYG	SOGS-R	20	3–4	≥5/20	1.6	1.2
Wiebe and Cox (2005)	Canada, Manitoba	—	1000	≥60	—	"Gambling activities and attitudes"	T	NA	PYG	SOGS-R	20	3–4	≥5/20	1.6	1.2

Note: AF, administration format; CPGI/PGSI, Canadian Problem Gambling Severity Index; DSM-IV(-TR), Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (Text Revised); DSM-IV-J, Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, adapted for Juveniles; EC, exclusion criteria; GA20, Gamblers Anonymous Twenty Questions; NA, not available; PG, pathological gambling; PGSI, Problem Gambling Severity Index; PrG, problem gambling; PYG = gambled ≥1 time/past year; Q, self-administered questionnaire; RR, response rate; SOGS(-R), South Oaks Gambling Screen (Revised); SOGS-RA, South Oaks Gambling Screen, Revised for Adolescents; T, telephone interview.

study were fundamentally different from patients actually treated in clinical practice (Humphreys and Weisner, 2000). Research on the use of exclusion criteria in studies on eating disorders revealed that 16% to 26% of treatment-seeking patients would have been excluded from up to 54% of the studies depending on the exclusion criterion applied (Mitchell *et al.*, 1997).

Assessment instrument

In order to judge comparability of prevalence rates, it is necessary to probe whether different instruments assess the same underlying construct, that is, measure fundamentally the same. Additionally, differences between instruments in nomenclature, operationalization and scoring need to be investigated. As long as different aspects of gambling-related problems are measured, prevalence rates based on different instruments cannot be comparable.

Underlying construct. DSM-IV(-TR) based instruments assess PG according to the 10 diagnostic criteria: preoccupation with gambling, tolerance, loss of control, withdrawal, gambling as a way of escaping, returning after losing money, lying to conceal the extent of involvement, illegal acts, family and academic disruptions as well as financial bailout. Contrary to strictly DSM-IV(-TR) based instruments, the SOGS(-R) only partly relies on behavioural oriented items to assess gambling problems. It rather emphasizes subjective items including gambling-related debts. More precisely, almost half of the 20 items are concerned with sources of money for gambling as opposed to two out of 10 DSM-IV criteria. Furthermore, the items of the SOGS(-R) are based on the DSM-III criteria for PG (American Psychiatric Association, 1980), thus, assessing PG according to different characteristics. Important changes made to the psychiatric criteria from DSM-III to DSM-IV – such as the inclusion of the concepts of tolerance and withdrawal – were not incorporated in the SOGS(-R) (Stinchfield, 2002; Weinstock *et al.*, 2007).

The Canadian Problem Gambling Index (CPGI; Ferris and Wynne, 2001) bases its assessment of gambling problems upon behavioural symptoms as in DSM-IV and SOGS, but additionally focuses on environmental as well as cognitive and emotional factors associated with gambling problems. In order to assess severity of gambling problems, the Problem Gambling Severity Index (PGSI), a CPGI subscale of nine mostly DSM-IV and SOGS based items, is commonly used. Since being developed by Gamblers Anonymous based on difficulties experienced by their members, some items of the Gamblers Anonymous Twenty Questions (GA20; Gamblers Anonymous) are also very

different from the DSM-IV criteria. The 20 items comprise personal, social as well as financial consequences of gambling and are intended to help gamblers to assess existence and severity of gambling problems. Differing in again another way, the Massachusetts Gambling Screen (MAGS; Shaffer *et al.*, 1994) assesses gambling problems by identifying various difficulties resulting from gambling including biological, psychological and social problems. In the reported study, only the 12-item DSM-IV subscale was used to estimate prevalence of PrG/PG instead of both subscales which comprise a total of 26 items (see Currie *et al.*, 2009, for an overview on instruments and included items).

A similar diversity in underlying construct is also found in instruments adapted to identify PG during adolescence. Even though the SOGS-RA, for example, for which original SOGS items were reworded to be more age-appropriate, does not emphasize money as the original SOGS(-R) does, it still focuses on frequency of gambling additional to behavioural indices, again resulting in differences compared to DSM-IV(-TR). Contrary to its denotation, the Diagnostic and Statistical Manual of Mental Disorders, Fourth edition, adapted for Juveniles (DSM-IV-J; Fisher, 1992) does not correspond to the official 10 DSM-IV criteria, but is rather based on nine preliminary ones proposed for adults by Lesieur and Rosenthal (1991), missing the official criterion 3 (loss of control). A revised version of the DSM-IV-J, the Diagnostic and Statistical Manual of Mental Disorders, 4th edition, Multiple Response adapted for Juveniles (DSM-IV-MR-J; Fisher, 2000), is however based on the official DSM-IV criteria, excluding criterion 10 (bail out).

Nomenclature, operationalization and scoring. Apart from variation in underlying construct, another reason for differences in prevalence estimates across instruments may be differences in nomenclature (e.g., PG, excessive, compulsive or disordered gambling), operationalization and scoring of PrG/PG (Winters and Anderson, 2000). DSM-IV(-TR) based instruments consider “PG” when at least five out of 10 criteria are met, whereas “PrG” is commonly assumed when three or four criteria are fulfilled. Although DSM-IV(-TR) based instruments share the same scoring system and underlying construct, substantial variability remains in question wording and number of items referring to each criterion due to different operationalizations (Tables 2–4). Whereas the National Opinion Research Centre DSM-IV Screen for Gambling Problems (NODS; Gerstein *et al.*, 1999) assesses the DSM-IV criteria using 17 questions, Stinchfield (2002) employs 19 items. The Diagnostic Interview Schedule IV (DIS-IV; Robins *et al.*, 1996), however, is only composed of 13 items mapping into the diagnostic criteria.

Opposed to DSM-IV(-TR) based instruments, the SOGS (-R) considers gambling to be “some problem” and “probable PG” when one to four and five or more of the 20 items are endorsed. The term “probable PG” is used by the authors due to diagnostic limitations of screening questionnaires. While the 12 items of the CPGI/PGSI (three omitted for scoring) screen for “moderate PrG” (score of three to seven out of nine) and “severe PrG” (score of ≥ 8 out of nine) as facets of problem behaviour, the GA20 considers “PG” when seven out of 20 items are confirmed (Custer and Custer, 1978). Equivalently to DSM-IV(-TR), a score of five or more out of 10 on the MAGS is assumed to represent “PG” (“PrG”: score of three to 4.5).

Concerning instruments for adolescents, the 16 questions of the SOGS-RA (omitting four items for scoring) assess “PrG” when at least four out of 12 items are fulfilled. Due to be based on nine criteria, a total score of at least four out of nine instead of out of 10 criteria is indicative of “probable PG” (on the 12-item DSM-IV-J) and “PrG” (on the nine-item DSM-IV-MR-J), respectively. For the last three instruments, mostly a score of two to three is considered to reflect “at risk gambling”. As pointed out by Jacques and Ladouceur (2003), some recent studies using the DSM-IV-J have incorrectly classified “probable PG” if four out of 12 questions instead of out of nine criteria have been answered affirmatively (Derevensky and Gupta, 2000; Table 3). This leads to overestimating PG because the chance of respondents to confirm four out of 12 questions, and thus to be classified as PG, is elevated by 33%.

Lack of congruence between instruments. The fact that different constructs are indeed measured is confirmed when comparing classification congruence of instruments. For instance, only poor congruence in the classification of PrG/PG was found between the SOGS and the NODS, with the NODS providing a stricter measure of gambling problems (Hodgins, 2004). Similarly, the SOGS is also known to result in up to 50% more PG diagnoses in the general population than another DSM-IV-TR based instrument (Stinchfield, 2002), for which the SOGS has been criticized (Cox *et al.*, 2004; Thompson *et al.*, 2005). As for instruments on adolescents, the DSM-IV-J is found to measure PG more conservatively than the SOGS-RA and the GA20 (Derevensky and Gupta, 2000), but less strictly than the DSM-IV-MR-J (Hardoon *et al.*, 2004).

As long as this lack of congruence based on fundamental differences between instruments in underlying construct, nomenclature and scoring exists, it is not surprising that prevalence estimates may vary by instrument. Moreover, the diversity of instruments rather points to discrepancies in what is meant by “gambling problems” which needs to

be resolved in order to enable comparability of prevalence estimates.

Cut-off scores

Apart from the use of various instruments that measure diverse aspects of gambling problems, using different cut-off scores for PrG/PG – even when the same instrument was employed – might additionally influence prevalence rates (Cox *et al.*, 2005; Ladouceur *et al.*, 2005). For example, in the case of the SOGS-RA, narrow as well as broad criteria have been applied (Magoon and Ingersoll, 2006; Poulin, 2000). Using a narrow definition, a score of two to three is considered to indicate “at risk gambling”, and a score of at least four “PrG” (Winters *et al.*, 1995). Broader criteria combine SOGS-RA score and highest level of gambling frequency (Winters *et al.*, 1993b). The latter procedure is likely to result in higher prevalence estimates (Magoon and Ingersoll, 2006; Poulin, 2000). Furthermore, countries habitually use different cut-off scores to classify and define the extent of gambling problems. In Australian gambling research, for instance, meeting five criteria of the SOGS is considered PrG (Schofield *et al.*, 2004). However, in most other studies this particular SOGS score defines PG. To know exactly on what conditions gambling behaviour is considered “problematic” or “pathological” is absolutely necessary since modifications of threshold values cause serious changes in estimated PrG/PG rates (Currie *et al.*, 2009; Langhinrichsen-Rohling *et al.*, 2004; Poulin, 2000; Schofield *et al.*, 2004).

Further methodological considerations

Apart from the aforementioned methodological aspects, other features might contribute to differences in rates as well. For instance, variation in *sample frame* might influence estimates due to systematically excluding certain respondents from survey participation. This exclusion might be the result of (a) different *sampling procedures* applied such as random sampling or quota schedule (as has been found in the reported studies; not displayed). Or due to (b) the particular *region* of the country the sample was drawn from limiting results to the specific area. This is especially important because significant differences in regional prevalence of PrG/PG have been reported in Canada (Cox *et al.*, 2005; Poulin, 2000). Sample composition is also well-known to be influenced by (c) mode of *data collection* (not to be confused with the genuine influence of administration format on prevalence rates). In telephone surveys, for instance, particular populations are most likely excluded because of not having a phone connection, among others the homeless or psychiatric inpatients, or because of language deficits and communication problems (i.e., certain

ethnic groups). Since gambling participation and gambling problems have been reported to be common in these subgroups (Cuadrado, 1999; Shaffer *et al.*, 1999; Shaffer *et al.*, 2002), their exclusion may result in underestimating the prevalence of PrG/PG in the general population. Similar difficulties exist for other modes of data collection. For example, the use of self-administered questionnaires requires adequate literacy of respondents and surveys conducted online are known to be representative only for those subpopulations that have access to the Internet and are able to use it (Pötschke and Simonson, 2001).

Another methodological aspect influencing PrG/PG estimates is the *reference period* chosen for PrG/PG estimates. While selection criteria used in this review ruled out studies which did not assess PrG/PG in the past year, numerous studies exist that apply a different time period of prevalence rates of PrG/PG (Ladouceur *et al.*, 2007; Schofield *et al.*, 2004; Sellman *et al.*, 2002). It has to be kept in mind that shorter base periods yield more conservative prevalence estimates than longer periods (Shaffer and Hall, 2001).

Conclusions

The aim of this review was to examine whether convergence in survey methodology has recently progressed to an extent justifying the common practice of comparing and interpreting differences in PrG/PG prevalence estimates between and within countries. To this end, recent prevalence estimation studies on PrG/PG were critically reviewed with regard to variation in survey methodology. Analyses revealed wide ranges in estimated PrG/PG rates for adults, adolescents, and college students, whereas similar estimates were reported in two studies on PrG/PG in seniors. Comparability of the reported estimates has not improved and was found to be still highly limited by major variation between studies with regard to survey description, administration format, exclusion criteria, assessment instrument, cut-off scores, sample frame, and reference period. Overall, our analyses showed that the discussion on methodological consistency has been disregarded in the field of gambling studies as the existing diversity in survey methods and assessment instruments still hampers comparability.

Intuitively, one would assume that variation in gambling prevalence rates in a particular population within or across countries is merely the result of differences in availability of and access to gambling. In fact, there is evidence that greater accessibility is related to higher gambling participation, more money spent on gambling and an increased number of persons with gambling-related

problems (Jacobs, 2000; Ladouceur, 1996; Lester, 1994; Pavalko, 2004). The UK, for instance, is exceptional in granting children access to gambling possibilities and indeed, the use of electronic gambling machines is found to be more common among youths in the UK (Fisher, 1999; Moodie and Finnigan, 2006) than in the US and Canada (Gerstein *et al.*, 1999; Gupta and Derevensky, 1998). Moreover, prevalence of gambling-related problems is found to be twice as high in Scottish adolescents (Moodie and Finnigan, 2006) when compared to Canadian youths (Hardoon *et al.*, 2004). This difference seems to support the idea that variation in estimates is merely due to differences in the availability of gambling for adolescents. Since both studies were conducted at similar times with similar instruments, the authors of the Scottish study assumed that their prevalence estimates could be compared to the Canadian results (Moodie and Finnigan, 2006). However, they also admit that the observed differences might not exclusively be due to different legislation but might also be the result of using the DSM-IV-J, a less conservative instrument than the DSM-IV-MR-J used by Hardoon *et al.* (2004).

When comparing prevalence rates of PrG/PG in the adult total population, it is important to note that estimates are generally rather low (PG: 0.15–2.0%). Thus, even small differences expressed in percentages amount to essential differences in terms of absolute numbers. Comparability issues are an even greater concern for estimates of PrG. Although PrG is frequently assigned if three or four DSM-IV criteria are met, no explicit classification exists. Due to this lack of diagnostic standards, PrG is not well-defined in terms of a gambling behaviour that causes serious problems without reaching the threshold of pathology. In addition, some authors argue that diagnostic instruments used in general population surveys to measure PG only screen for gambling-related problems and consequently always use the term “PrG” instead of “PG” no matter the severity of gambling-related problems (Fisher, 2000).

As possible limitations of our analyses and conclusions, it should be noted that only studies published in peer-reviewed journals were included in the review. Similar to other reviews (Blinn-Pike *et al.*, 2007; Johansson *et al.*, 2009), we omitted grey literature (reports, information on government websites, etc.) because the quality and validity of this kind of data are difficult to assess. Furthermore, although the most relevant characteristics of survey methodology have been included in this review, the authors are aware that further methodological conditions exist that may impact on the comparability of prevalence estimates such as interviewer or non-response effects.

Additionally, in attempting to investigate difficulties in comparing prevalence estimates of PrG/PG, we have purposely deferred a comprehensive description of psychometric properties of each instrument in service of this effort.

Keeping these limitations in mind, the question remains how existing differences in the prevalence of PrG/PG within and between countries can be detected. Clearly, considering assessment instrument alone, as has been done in earlier research (Stucki and Rihs-Middel, 2007), is not enough to ensure comparability of PrG/PG estimates. Even though the use of instruments assessing the same underlying construct seems to be most important, prevalence studies still also differ in a variety of other methodological factors which may impact on prevalence rates. Future studies need to compare countries, regions and cultures with existing differences in gambling policies by using instruments with the same underlying construct, same cut-off scores as well as a similar survey description, administration format, and exclusion criteria in well-defined populations. In particular, cross-national studies with a common methodological protocol would contribute

to and improve comparability of data on gambling. This is especially important as the impact of legislation, supply and accessibility on gambling behaviour and related problems is not yet well understood.

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