The Swedish Longitudinal Gambling Study (Swelogs): design and methods of the epidemiological (EP-) track

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Abstract

Swelogs (Swedish Longitudinal Gambling Study) epidemiological (EP-) track is a prospective study with four waves of data-collection among Swedish citizens aged 16–84 years at baseline. The major objectives of this track are to provide general population estimates of the prevalence and incidence of problem and at-risk gambling and enable comparisons with the first Swedish national study on gambling and problem gambling (Swegs) conducted in 1997/1998. The overall study (Swelogs) comprises three tracks of data collection; one epidemiological, one in-depth and one follow-up. It is expected to provide information that will inform the development of evidence-based methods and strategies to prevent the development of gambling problems. This paper gives an overview of the design of the epidemiological track, especially of its two first waves. The baseline wave, performed between October 2008 and August 2009, included 8165 subjects, of whom 6021 were re-assessed one year later. A stratified random sampling procedure was applied. Computer-supported telephone interviews were used as the primary method. Postal questionnaires were used to follow-up those not reached by telephone. The response rate was 55% in the first wave and 74% in the second. The interview and questionnaire data are supplemented by register data. © 2014 The Authors. *International Journal of Methods in Psychiatric Research* published by John Wiley & Sons Ltd.

Introduction

A large number of gambling participation and prevalence studies have been conducted over the past three decades (Abbott *et al.*, 2004; Williams *et al.*, 2012). Among other things these studies enable the estimation of the number of people who experience gambling problems and the identification of factors associated with these problems. However, because these studies are cross-sectional, the temporal sequence of associations between gambling

problems and factors associated with these problems is uncertain. Furthermore, identified current cases include people with recently developed as well as long-term problems and the circumstances under which problems arose in the past could well be different from those associated with current problems.

Prospective studies are necessary to generate reliable estimates of the incidence (onset) of problems, determine temporal sequence and changes in gambling and problem

gambling, and identify risk and protective factors for initial onset and other changes over time including remission and relapse. Such information is highly relevant to the identification of high-risk groups before problems develop and the design of preventative interventions. Only a modest number of incidence studies have been conducted in the mental health and addictions field, in large part due to the large sample size required to "capture" problem onset and the challenge and cost involved in following and re-assessing substantial numbers of participants (de Graaf *et al.*, 2000). This is especially the case with rare disorders such as problem gambling. To date there have been relatively few prospective studies of gambling or problem gambling and most have employed small, atypical samples. Nevertheless this small group of studies has been informative, challenging some core assumptions about the nature, development and measurement of problem gambling (Abbott and Clarke, 2007; Slutske, 2007). The Swedish Longitudinal Gambling Study (Swelogs) is the first study internationally to employ a sample of sufficient size and quality to be able to reliably assess the incidence of problem gambling and a number of other gambling and related factors in a general population.

The first Swedish national study on gambling and problem gambling (Swegs) was conducted in 1997/1998 (Rönnberg *et al.*, 1999; Volberg *et al.*, 2001). About a decade later the Swedish government identified the need to conduct a second national prevalence study and a longitudinal extension to provide incidence estimates and additional epidemiological information not hitherto available in the gambling field in Sweden or internationally. The Swedish National Institute of Public Health (SNIPH) was commissioned to carry out the study. The new study, Swelogs, was carefully designed to enable comparisons with the previous 1997/1998 study.

The primary purpose of Swelogs is to develop a knowledge base for evidence-based prevention methods and strategies to prevent the development of gambling problems. To achieve this purpose, five main objectives were identified:

(1) Measure the prevalence and incidence of problem gambling, their change over time and how they compare with other jurisdictions.
(2) Describe problem gambling in relation to changes in gambling behavior and gambling related environmental factors.
(3) Identify relevant target groups for preventive measures.
(4) Examine the health-related, social and economic consequences of problem gambling.
(5) Identify risk and protective factors for gambling behaviors/habits.

The Swelogs study design comprises three tracks of data collection: the epidemiological track (EP-track), an in-depth track (ID-track) where a sub-sample from the EP-track is followed more frequently focusing on risk and protective factors and consequences and a follow-up track with a sub-sample from the 1997/1998 study. The entire data-collection plan is presented in Table 1. This paper describes the EP-track.

Methods

A disproportional sampling design was chosen to obtain more problem gamblers than would have been obtained using a straightforward random sample which was important in order to have adequate numbers of risky gamblers in subsequent waves of the study to follow transitions over time and enable selection of cases for the in-depth study. The issue of youth problem gambling was deemed particularly important and this is why persons below 25 were over-sampled.

Pilot study

A pilot study was carried out during spring 2008. One important aim was to test the stratified sampling design chosen for the EP-track. The frame population, consisting of all persons aged 16–84 years in the Register of the Total Population (RTB), was cross-classified by age group and postcode area clusters. A stratified random sample of 2000 was included in the pilot study. Age groups of 16–24 and 25–34 were over-sampled as were postcode area clusters in suburbs and city centers with high rates of rental housing where higher rates of problem gambling were expected.

Data collection was carried out by Statistics Sweden (SCB) using telephone interviews as the primary method. Postal questionnaires were sent to those not reached by telephone. Therefore, 1015 persons (50.7%) from the selected sample were interviewed by telephone and 94 (4.7%) responded via the postal questionnaire yielding a total response rate of 55.4%.

Sample

An important finding from the pilot study was the need for a different stratification approach. For the main study, a stratified random sampling procedure based on a derived variable (i.e. the probability of a person having gambling problems) was estimated in a regression model with data from the pilot study and calculated from official register information. Male gender, low income, unemployment and receiving social welfare were associated with a higher

Table 1. Data collection plan for Swelogs

	2008/2009	2009/2010	2011	2012	2013	2014	2015
Epidemiological track	EP I n = 15,000 Age 16-84	EP II n = 8,165 Age 17-85		EP III n = 7,064 Age 19-87		EP IV n ~ 7 000 Age 21-89	
In-depth track			ID I n = 2,400 Age 18-86		ID II n ~ 2,000 Age 20-89		ID III n ~ 2,000 Age 22-91
Follow-up track		n = 578 Age 27-85					

probability for gambling problems and a Nordic origin, being married and being on sick leave for more than a month were associated with a lower probability. Twenty-four strata were constructed by cross-classifying three levels of probability of gambling problems, four age groups (16–24, 25–34, 35–64, and 65–84) and gender. The sampling strategy involved assigning higher sampling probabilities for young people and people with higher probability of gambling problems but equal numbers of males and females. The frame population was again all persons aged 16–84 years in the RTB. A stratified random sample of 15,000 individuals was selected. Table 2 presents information about the sample size and composition.

Topics covered and instruments used

A bio-psycho-social model of problem gambling (Rönnberg *et al.*, 2007) was the starting point for the theoretical underpinning of Swelogs. The model was developed within a framework of applied behavior analysis and social learning theories.

The bio-psycho-social model was used to guide the development of Swelogs questionnaires. This was complemented by a public health perspective that takes account of broader gambling contexts and a wide spectrum of risk and problem gambling states. In addition, a dynamic approach was adopted to capture transitions between different categories of gambling behavior and problem gambling. In other words, while there is interest in severe problem or probable pathological gambling and making comparisons with the previous Swedish prevalence survey and similar studies elsewhere, there is also an interest in examining transitions, prospectively, between a variety of forms and intensities of gambling participation.

Swelogs uses internationally recognized and validated instruments when available. The instruments were

Table 2. Sample size from each strata based on age, gender and estimated probability of gambling problems (p_k). Strata size within parentheses.

Estimated probability of gambling problems	Gender	Age groups				
		16–24	25–34	35–64	65–84	Total
Low probability: $p_k \leq 0.03$	Male	307 (2757)	203 (89,754)	742 (985,291)	749 (432,879)	2001 (1,510,681)
	Female	347 (375,622)	444 (516,388)	512 (1,789,951)	697 (756,867)	2000 (3,438,828)
Moderate probability: $0.03 < p_k \leq 0.1$	Male	582 (342,966)	632 (400,130)	422 (801,697)	364 (214,761)	2000 (1,759,554)
	Female	1477 (141,629)	243 (38,339)	242 (35,092)	38 (3625)	2000 (218,685)
High probability: $0.1 < p_k$	Male	2184 (200,786)	938 (92,634)	285 (84,338)	93 (8606)	3500 (386,364)
	Female	1029 (1323)	1231 (2638)	1231 (2283)	9 (11)	3500 (6255)
Totals		5926 (1, 065,083)	3691 (1,139,883)	3434 (3,698,652)	1950 (1,416,749	15,001 (7,320,367)

translated into Swedish and retranslated into English to secure validity before use. Table 3 presents information about the instruments used in each wave of the study.

Gambling participation

Gambling participation was measured in two steps. Initial screening questions on lifetime and past year gambling on horses, bingo, number games, sports and betting, lotteries, gaming machines, poker, casino games or television (TV)-contests were followed by more detailed questions on past year gambling based on the answers to the screening questions. For each main gambling form, follow-up questions concerning participation in specific types of activities during the past 12 months and time and money spent during the past 30 days were asked. Another format to assess participation was used in the postal questionnaire, with a general question on participation for each general gambling form followed by questions on participation in each specific type of activity. In later waves of data collection, the format for assessing gambling participation in the postal questionnaire was changed to be more similar to the interview format.

A screening question on Internet gambling was used in the interviews in the first wave 2008/2009. Respondents who did not endorse this question were not asked questions concerning Internet gambling as follow-up questions. This was changed for later data collections when the screening question about Internet gambling was dropped and all respondents were asked Internet gambling questions for those gambling forms in which they had been involved in the past 12 months. Internet gambling was then measured as participation through the Internet in any type of gambling included in the questionnaire. This more indirect method to measure Internet gambling, through participation in any type of Internet gambling, was used for postal questionnaire respondents in all waves.

Problem gambling

The South Oaks Gambling Screen Revised (SOGS-R) (Abbott and Volberg, 1996) was used to enable comparisons with the previous prevalence study from 1997/1998 while the Canadian Problem Gambling Severity Index (PGSI) (Ferris and Wynne, 2001) was used in all waves of the study to enable comparisons with other recent and future studies. The SOGS-R was administered to all Lifetime gamblers while the PGSI was administered to all Past Year gamblers.

There is some overlap between the two instruments. The third PGSI-item about going back another day to win back lost money equals the first past year item in SOGS-R and was only asked once during the interview, in conjunction with other SOGS questions.

Also the fifth PGSI-item on experiencing problems because of gambling equals a SOGS-item, namely the last past year item, but the response options differ between the instruments. The SOGS item is a Yes/No-question, while the PGSI has four different response options: Never/Seldom/Often/Always. The planned solution was to ask the question among the SOGS items, but to use a follow-up question for those answering yes to obtain the PGSI responses. Unfortunately the past year SOGS-question about having experienced problems due to gambling was dropped in the interviews because of a faulty skip rule following the lifetime question. As a consequence the follow-up question covering the PGSI response options was not administered. The postal questionnaire included the SOGS past year question on having experienced problems past year, but the follow-up question with PGSI-options was again left out. As a result, the full SOGS past year was assessed only among respondents answering the postal questionnaire, and no respondent was asked the fifth PGSI item. Results from other studies show that the SOGS classification based on 19 items is equivalent to the classification based on 20 items. The SOGS index was thus used with only 19 items for the past year instrument. The loss of the PGSI-item was more crucial, and an imputation strategy was created based on an analysis of data from British and Canadian gambling studies. Based on this analysis, answers to PGSI-item 8 on economic problems due to gambling were imputed for those who answered "Yes" to the SOGS lifetime question about having experienced problems due to gambling.

The imputation was later evaluated with wave 2 data. The difference between using response data and imputed data for item 5 affected the rate of low risk gamblers to a minor extent. The observed bias was 0.1 percent-units, which is less than the random error. A few individuals also changed between moderate risk and problem gambling, but with the same number ($n = 2$) in both directions. This is also of relatively low concern, since most analyses were completed with the two most serious categories merged into one category of problem gamblers.

The FORS is a short three-item instrument intended to assess risk of gambling problems rather than gambling problems as such. It was developed for use in the Swedish National Public Health Survey and included in Swelogs to test its performance against the two full problem gambling screens. The FORS is comprised of three questions on attempts to reduce gambling, feeling restless or irritated when not able to gamble and lying about how much one gambles. The FORS was administered in the first wave of data collection among other health related questions

Table 3. Topics covered and instruments used in Swelogs

Topic		Instrument/measures/ target groups	Register data	Swelogs epidemiological track			
				EP1	EP2	EP3	EP4
I	*Gambling participation*						
	Screening questions on gambling participation in nine main gambling forms: horses, bingo, number games, sports and betting, lotteries, gambling machines, poker, casino games, TV-contests	Lifetime gambling; the nine gambling forms + gambling via Internet		X			
		Past 12 months gambling		X	X	X	X
		Past 12 months gambling via Internet		X			
	Detailed questions on gambling participation; frequency in time past 12 months for subtypes within each gambling form, time and money spent past 30 days for each main gambling form	Questions asked according to answers to the screening questions on past 12 months gambling		X	X	X	X
	Favorite type of game, additional gambling in other forms	Only asked to respondents identified as gamblers in any form the past		X			
	Largest winning past 12 months	12 months through the screening questions		X	X	X	X
	Questions of age and type of game for the first time gambling ever	Asked to respondents that ever gambled during their lifetime		X			
II	*Problem gambling measurements*						
	Gambling problems during lifetime and the past 12 months	The SOGS-R; Asked to all respondents that ever gambled		X	X		
	Gambling problems the past 12 months	The PGSI; Asked to past 12 months gamblers		X	X	X	X
		The FORS; A short instrument used in the Swedish Public Health Survey		X			
	Gambling problems the past 12 months						
III	*Gambling related issues*						
	Gambling among family and friends in the childhood	Asked to past 12 months gamblers		X			
		Asked to all respondents			X		
	Gambling among family and friends presently	Asked to past 12 months gamblers		X			
	Gambling together with family and friends	Asked to all respondents			X	X	X
		Asked to past 12 months gamblers				X	X

(*Continues*)

Table 3. (Continued)

Topic		Instrument/measures/ target groups	Register data	Swelogs epidemiological track			
				EP1	EP2	EP3	EP4
	Criminal activities due to gambling					X	X
	Thoughts on gambling	Questionnaire constructed by Abbott and Jonsson: the JAS; asked to past 12 months gamblers		X		X	
	Gambling at work/during school time	Asked to past 12 months gamblers		X	X	X	X
	Drinking alcohol while gambling on horses, live poker, casino games, gambling machines or poker, gambling machines or bingo via the Internet	Administered according to previous answers on gambling and alcohol use				X	X
	Gambling problems among nearby persons			X	X	X	
	Negative influence from others gambling					X	
	Help seeking on the behalf of others or for own sake			X		X	
	Ever lent money to someone for gambling purposes			X			
IV	*TV and computer gaming*						
	General participation past 12 months			X	X	X	X
	Detailed questions concerning more recent time periods and money spent	Asked to past year participants		X		X	
V	*Health issues*						
	General health			X	X	X	X
	Happy past 30 days					X	X
	Mental health	The Kessler 6		X	X	X	X
	Smoking			X	X	X	X
	Alcohol use past 12 months	Short AUDIT; Same questions used in the Swedish Public Health Survey		X	X	X	X
VI	*Social issues*						
	Help and support			X		X	X
	Having someone close			X		X	X

(*Continues*)

Table 3. (Continued)

Topic		Instrument/measures/ target groups	Register data	Swelogs epidemiological track			
				EP1	EP2	EP3	EP4
	Violence; been subject to violence or threat of violence			X		X	X
	Trust in others					X	
	Trust in institutions/ organizations in society					X	
	Leisure activities					X	
VII	*Demographics*						
	Sources of income			X	X	X	X
	Satisfaction with work	Asked to those having income from work according to previous question		X			
	Fears of losing employment within the next 12 months			X	X	X	X
	Personal income			X			
	Household economy			X		X	
	Type of household			X		X	
	Life events past 12 months	Questionnaire adopted from the Victoria Longitudinal Gambling Study			X	X	X
	Age, gender, origin, area of residence, education, disposal income (personal/ household), capital, debts, education, school results, source of income, profession, family consumption weight, type of occupation, branch, marriages, divorces, domestic moves, migration, parental leave, unemployment, sick allowance, study allowances, early retirement/sickness pension, income from capital, age related pension, social allowance	Personal information available from Statistics Sweden	X				

adopted from the Public Health Survey to enable comparison with the results from that survey.

Other gambling related issues

Questions concerning gambling among family and friends during childhood and presently were included but only administered to Past Year gamblers. These questions were also included in the questionnaire for the one-year follow-up when they were administered to all respondents.

A block of questions on thoughts about gambling constructed by Abbott and Jonsson (the JAS) was administered to all Past Year gamblers. The main idea behind the instrument is to identify early signs of forthcoming

problems. The items of the instrument are of Likert type with a seven-step response scale ranging from "Not at all" to "Completely". Two questions regarding drinking alcohol while gambling and smoking while gambling were included in the block with a similar format but not intended to be included in the instrument.

Other items in this section of the questionnaire covered gambling during work hours, gambling among family or friends and help-seeking for one's own gambling problems or on behalf of others. Questions on alcohol use together with gambling were included in the third wave of data collection.

Television and computer gaming

A screening question on TV and computer gaming was included and followed by more detailed questions on frequency and money spent on computer gaming.

Health issues

General health was measured through one general question and additional questions concerning the number of sick days taken in the past month. There were also questions on possible longtime illness or reduced functioning for the respondent or for someone in the household.

The Kessler-6 (Furukawa *et al.*, 2003) was used to assess mental health in combination with the number of days of reduced health due to psychiatric factors during the past 30 days.

Risky alcohol habits were assessed through a short version of Alcohol Use Disorders Identification Test (AUDIT; Reinert and Allen, 2002) adopted from the Swedish National Public Health Survey.

Tobacco use was measured through one question on smoking with three options: daily smoking, smoking occasionally and no smoking.

Social issues

Social support was measured with questions about having someone who would provide help and support when needed and a question about having someone to share one's innermost feelings with.

Experienced violence or threat of violence was measured for lifetime as well as the past 12 months.

Demographics

A large number of demographic variables were added to the response data set from official statistics gathered by SCB, with informed consent from the respondents. The option to add already collected information and link it to

each informant reduces participant response burden and leaves room for more specialized questions in the questionnaire. A partial list of added information includes age, gender, place of residence, origin of the person him/herself and both parents, migration, education, income, employment status, children, household size, wealth and debts, with some of these variables acquired for several years back. The most recent information available after the first data collection was from 2006 except for information in the RTB, which is updated annually or more often.

The questionnaire included questions on sources of income (where income from gambling was of special interest), disposable income and possible problems with the household economy. Data on disposable income could not be used in the analysis due to a high rate of nonresponse among the interviewed respondents and noncomparable information from the postal questionnaires where the question was formulated in terms of income before taxes.

Ethical approval

The study plan was approved by the Regional Ethical Review Board in Umeå before data collection began in 2008. Additional ethical applications have been submitted in subsequent years due to changes in questionnaires for consecutive data collections. All of the submitted applications have been approved.

Fieldwork

Data collection was carried out by SCB's central telephone group with specially trained interviewers using computer-supported telephone interviews in the WinDati system, developed by SCB, as the primary method. Postal questionnaires were used to follow-up those not reached by telephone. The primary fieldwork for the initial study was divided into three phases and lasted from October 2008 to April 2009. Postal questionnaires were collected from April until August 2009. A pre-notification letter was sent to the residential address of the selected individuals a few days ahead of the start of each phase. The letter explained the purpose of the study and included information of the intention to combine response data with data from official registers. Participation in the study was then regarded as informed consent to include register data. The letter was available in 16 different languages as well as Swedish. Incentives to motivate the subjects were not used.

Information about the selected sample was sent to a telecom operator for manual and machine-assisted matching of numbers, yielding land-line subscriptions

and/or mobile phone numbers for 78% of the sample. Special letters asking for telephone numbers were then sent to those for which no known number was identified in the initial process. In addition, further tracking in the event of returned mail and for individuals not reached after five attempts was conducted.

Land-line and mobile phone numbers were used. Up to 10 attempts were made to reach all known numbers for each selected individual. The average length of the interviews was 24 minutes (standard deviation [SD] = 10.2). Forty-two interviews were conducted through an interpreter in pre-booked three-part telephone conferences. The postal questionnaire covered 31 pages. A reminder was sent eight days after the questionnaire to those who had not yet replied. A new questionnaire was sent as a second reminder after additional nine days. Information from the postal questionnaires was scanned.

Quality assurance measures

The primary data collection with telephone interviews was carried out in the WinDati system which contains controls for valid values. The project was coordinated at SCB through a project manager responsible for quality issues.

The interviewers were given a special four hour training on gambling by representatives from the SNIPH. During the course of the fieldwork, the experiences and viewpoints of the interviewers regarding the survey were collected through supervisors and considered in cooperation between the data collector and the SNIPH.

An extra step in the planning process was added in wave 2 to assure that no items were lost due to faulty skip-rules or other technical problems. The principal investigator at the SNIPH received the programed interview guide on a CD and tested all possible paths. Additionally, data from the first 100 interviews were sent to the SNIPH and evaluated in relation to response and non-response.

Imputations

Imputations were used in questions belonging to either of the problem gambling instruments where item-non-responses were set as equal to "No". The estimated prevalence of gambling problems is therefore a conservative measure and is possibly somewhat lower than the actual prevalence in the population.

Imputations were also used for missing information on sums spent on gambling in the past 30 days. Item-non-responses were replaced with the mean value for gamblers with equal amount of time spent gambling in a specific gambling form and the imputed variables were then categorized into four different classes.

Calibration weights

Calibration weights based on population register information compensating for sample bias and non-response bias were used in all analysis of data (Särndal and Lundström, 2005, 2008). Gender, age, born in a Nordic country, income, civil status, living in a larger city, employment status, family type education, profession, social well fare, leave on sick pay, unemployment and branch affected the value of the weights. The variables used in the weighting procedure were either correlated with the response rate or belonged to the variables used to calculate the probability of gambling problems used for sampling.

The weights were created to adjust estimates at a population level. Before analysis, they were transformed to permit analysis based on the number of respondents in each wave. The range for the transformed weights was 0.00143–10.813 in wave 1 and 0.00140–12.260 in wave 2. The unequal weighting effect (UWE) was 2.95 in wave 1 and 2.73 in wave 2.

Results

Response wave 1

Table 4 shows the results of data collection in wave 1 of the study. One hundred and fifty-three individuals were identified as not belonging to the target population due to emigration or death. The actual sample was thus decreased from 15,000 to 14,847 individuals. Of these, 591 individuals (4.0%) were not able to participate due to health or language issues. Some 2510 (16.9%) refused to participate when reached and 3567 (24.0%) were not

Table 4. Response and non-response in Swelogs, wave 1

	Number	Percentage
Initial sample	15,000	
Over coverage	153	
Net sample	14,847	100
Refusal	2510	16.9
Unable to participate[a]	591	4.0
No contact	3567	24.0
Telephone interviewed	7504	50.5
Answer through mail questionnaire	675	4.5
Unweighted total response	8179	
Incomplete responses	14	
Unweighted net response	8165	55.0
Weighted net response		63.0

[a]Illness (temporal), physical/psychological disability, institutionalized or due to language problems.

reached by telephone and did not answer through the postal questionnaire, which was sent to all people not reached by telephone.

The response rate was 55%. When the calibration weights compensating for varying sampling probabilities and non-response were used, the estimated response rate was 63%.

Lower response rates were expected in strata with high probability for gambling problems. Therefore, 50% of the total sample was allocated within these categories in order to reach a sufficient number of problem gamblers. Strata specific response rates and proportions of lifetime problem gamblers are presented in Table 5.

The overall response rate was lower in the high probability risk strata but it also varied by gender and age. One example of the latter is males aged 16–24 with a response rate of 45% in the low probability risk strata but 63% in the high probability risk strata.

The proportion of lifetime problem gamblers was overall 2.5% in the low probability strata, 7.6% in the middle category and 10.8% in the high probability strata, all within the estimated range of expected risk in the different strata. The proportions among males were mostly higher within cross-categories of age and estimated risk of gambling problems.

Item-non-response, including "don't know" and "refused", was negligible since most of the data were collected through computer-assisted telephone interviews. The highest non-response was observed for questions concerning age when gambling for the first time (20.5%), favorite game (9.4%) and net income (8.8%). Furthermore, 91.9% of the questions had a partial non-response below 1% while 6.3% of the questions had a partial non-response between 1% and 5%. These questions were typically about household economy, about alcohol use or questions demanding a detailed answer such as the largest winning amount in the past year or the number of sick days past month.

Design effect

The effect of the disproportional sampling is demonstrated in Table 6 where PGSI estimates in waves 1 and 2 are compared with and without adjustment through calibration weights. The difference between estimated proportions ranges from 18% to 55%. Non-gamblers and at-risk/problem gamblers are over-represented in the achieved sample.

Differences between people interviewed and responding via postal questionnaire

Eight percent of the respondents answered via postal questionnaires. Compared to respondents reached by telephone the postal questionnaire respondents were to a

larger extent female (58.4% versus 46.8%). A considerably higher proportion was aged between 25 and 44 (44.0% versus 29.6%) and few were below 18 (4.7% versus 22.9%). The proportion of single persons living with children was also higher among the postal questionnaire respondents (9.0% versus 5.5%) and more of them were born outside Sweden (47.3% versus 26.3%). A larger proportion was living in one of the three largest cities in Sweden (29.8% versus 18.0%). The proportion that gambled during the past year was almost equal, but the postal questionnaire respondents gambled more on bingo (6.7% versus 3.3%) and less on lotteries (38.2% versus 45.1%), poker (8.0% versus 16.3%) and casino table games (6.8% versus 9.1%). Internet gamblers were more common among postal questionnaire respondents (13% versus 8.4%) and the proportion of problem gamblers (PGSI 8+) was considerably larger (2.4% versus 0.6%).

Response wave 2

The second wave of data collection was undertaken from December 2009 to August 2010 with the same procedures as used in wave 1, but with a shorter questionnaire. The average interview duration was now 16 minutes (SD = 6.6) and the questionnaire was shortened from 31 to 26 pages. The main aim of the second wave was to estimate the incidence of gambling problems over a year.

The 8165 respondents from wave 1 were re-contacted in wave 2 and 74% of those participated in the second wave. The weighted response rate was 80%. The participation was somewhat higher for men than for women. Response rates were generally lower in strata with a higher probability of gambling problems, except for the young males (16–24), where the opposite was observed as in the first wave. The response rate was 68% among the young males with a low probability of gambling problems, 70% among those with a moderate probability and 73% among those with a high probability of gambling problems.

When comparing respondents in only wave 1 with those participating in both waves, we found that attrition was significantly higher among single people, with or without children, people born outside Sweden, people living in one of the three largest cities in Sweden, people without academic education, those with low economic status, with reduced mental health, daily smokers and people with risky alcohol habits. Table 7 presents information about the characteristics of respondents participating only in wave 1 and those participating in both waves 1 and 2 of the study.

Attrition was significantly lower among non-problem gamblers, especially those gambling monthly or more

Table 5. Response rates and proportions of lifetime problem gamblers according to SOGS (3+) in different strata and categories. Information given as percent (*n*)

Estimated probability of gambling problems	Gender		Age groups				Total per gender	Total proportion of problem gamblers
			16–24	25–34	35–64	65–84		
Low probability: $p_k \leq 0.03$	Male	Response rate	45% (138)	67% (135)	66% (487)	64% (476)	62% (1236)	2.5% (61)
		Problem gamblers	8.0% (11)	8.1% (11)	3.9% (19)	1.3% (6)	2.5% (47)	
	Female	Response rate	63% (220)	66% (291)	70% (359)	54% (378)	62% (1248)	
		Problem gamblers	3.2% (7)	0.7% (2)	0.3% (1)	1.1% (4)	1.1% (14)	
Moderate probability: $0.03 < p_k \leq 0.1$	Male	Response rate	66% (382)	62% (391)	57% (239)	52% (190)	60% (1202)	7.6% (188)
		Problem gamblers	14.9% (57)	13.0% (51)	6.3% (15)	1.6% (3)	10.5% (126)	
	Female	Response rate	70% (1037)	49% (118)	42% (102)	32% (12)	63% (1269)	
		Problem gamblers	4.9% (51)	1.7% (2)	8.8% (9)	0	4.9% (62)	
High probability: $0.1 < p_k$	Male	Response rate	63% (1373)	37% (347)	29% (83)	30% (28)	52% (1831)	10.8% (346)
		Problem gamblers	11.4% (157)	16.4% (57)	12.0% (10)	3.6% (1)	12.3% (225)	
	Female	Response rate	43% (442)	40% (489)	36% (443)	56% (5)	39% (1379)	
		Problem gamblers	11.3% (50)	9.6% (47)	5.4% (24)	0	8.8% (121)	
Totals		Response rate	61% (3592)	48% (1771)	50% (1713)	56% (1089)	54% (8165)	
		Problem gamblers	9.3% (333)	9.6% (170)	4.6% (78)	1.3% (14)	7.3% (595)	

Table 6. Unweighted and weighted estimates of risk of problem gambling (PGSI) in waves 1 and 2

Gambling/ gambling problems	Wave 1 (2008/2009)			Wave 2 (2009/2010)		
	Unweighted	Weighted	Difference weighted/ unweighted	Unweighted	Weighted	Difference weighted/ unweighted
Non-gamblers	37.4% (3050)	29.4% (2403)	−21.2%	32.7% (1968)	26.6% (1602)	−18.5%
No-problem gambler	50.4% (4118)	62.9% (5140)	+24.8%	56.7% (3416)	67.4% (4055)	+18.8%
Low risk	8.4% (689)	5.4% (440)	−36.1%	7.4% (445)	4.1% (244)	−45.1%
Moderate risk	3.0% (249)	1.9% (157)	−37.0%	2.7% (164)	1.6% (95)	−42.0%
Gambling problems	0.7% (59)	0.3% (26)	−55.9%	0.5% (28)	0.3% (21)	−25.0%

often, and higher among non-gamblers as well as people with gambling problems. Participation in horse gambling and gambling on number games or lotteries was significantly more common among continued participants than among those in the attrition category. No significant difference was observed for other gambling forms.

Response waves 3 and 4

The third wave of data collection started in February 2012. The last interviews were completed in May 2012 and the postal questionnaires were collected until August 2012. A fourth wave is planned another two years after wave 3.

In total 7064 respondents from wave 1 were recontacted in wave 3; 961 individuals had declined further participation in wave 2 and were thus excluded from the wave 3 sample. The response rate was 60% in wave 3. Furthermore, 47.7% of the wave 1-respondents ($n = 3898$) have participated in all three waves. An additional 29.6% have participated in either wave 2 or 3; 22.7% only participated in wave 1.

Discussion

Swelogs is a large and complex study. The data collected thus far together with added information from official registers constitutes a rich and comprehensive dataset that will be improved by further data collection in future waves of the study. An important and unique aspect of the study was the possibility of including information from official registers. This allowed for the creation of individual sampling probabilities for all citizens which is not possible in most other jurisdictions. This also meant that the burden on respondents could be minimized since we did not have to include many demographic questions of theoretical interest in the questionnaires. However, it affects the response rate in a negative way through those not willing

to consent to the linkage with register data which was required to participate in the study.

There were some difficulties implementing the study. For example, using a bio-psycho-social model to simultaneously develop the theoretical underpinnings of the study and to guide the development of the questionnaires was problematic. It would have been better to have a fully developed theory to guide the selection of items for the interviews and questionnaires. There was also a trade-off between including enough questions to assess all dimensions of the model and minimizing respondent burden.

Carrying out a large longitudinal study with many thousands of respondents and different data collection tracks is a complex process and we learned some valuable lessons in carrying it out. Perhaps most importantly, our experience underscores the need to have multiple investigators checking each step in the development process, with particular attention to the interview process to avoid the loss of questions due to faulty skip rules or other mistakes. Another lesson learned is the need to allow enough time for planning and evaluation before such a large-scale study is fully launched. One pilot study was completed and resulted in substantial changes to the questionnaire; a second pilot study would have been beneficial. However, as is often the case, this was deemed to be impossible due to the time schedule.

The sampling frame, the RTB, is up-dated five times a week and covers all individuals registered at a permanent address in Sweden. The over- and under-coverage in relation to the target population is small. Furthermore calibration weights based on individual register information were used to reduce bias from unequal sampling probabilities and varying non-response over the population. The bias between unweighted and weighted estimates of different problem gambling categories was between 21% and 56% in wave 1 and between 18% and 45% in wave 2. However, using weights also led to loss of precision with larger standard errors and lower power.

Table 7. A comparison of unweighted results in wave 1 between respondents in wave 1 only and respondents participating in wave 1 and wave 2

		Wave 1 only (*n* = 2144)	Wave 1 and wave 2 (*n* = 6021)	*p*-Value
Gender	Female	1098 (51%)	2798 (46%)	< 0.001
	Male	1046 (49%)	3223 (54%)	
Age	16–17	393 (18%)	1352 (22%)	< 0.001
	18–24	585 (27%)	1224 (20%)	
	25–44	725 (34%)	1788 (30%)	
	45–64	219 (10%)	787 (13%)	
	65–84	222 (10%)	870 (14%)	
Family situation	Single, without children	1197 (57%)	3178 (53%)	< 0.001
	Single with children	175 (8%)	297 (5%)	
	Married/cohabiting, without children	458 (22%)	1590 (26%)	
	Married/cohabiting, with children	281 (13%)	927 (16%)	
Living in one of the largest cities	Stockholm/Gothenburgh/Malmö	469 (21%)	1083 (18%)	< 0.001
Country of birth	Sweden	1305 (61%)	4573 (76%)	< 0.001
	Other country in Europe	338 (16%)	640 (11%)	
	Non-European country	497 (23%)	808 (13%)	
Highest education	Primary	936 (49%)	2432 (44%)	< 0.001
	Secondary	689 (36%)	1901 (34%)	
	University	287 (15%)	1219 (22%)	
Household economy	No problem	1290 (66%)	4290 (75%)	< 0.001
	Has to struggle now and then	424 (22%)	1048 (18%)	
	Has to struggle all the time	131 (7%)	238 (4%)	
	Behind with payments	114 (6%)	133 (2%)	
Socio-economic status	Low	440 (52%)	1136 (39%)	< 0.001
	Medium	275 (32%)	902 (31%)	
	High	137 (16%)	858 (30%)	
Health	Bad mental health	960 (48%)	2463 (42%)	< 0.001
	Daily smoking	428 (21%)	816 (14%)	< 0.001
	Risky alcohol habits	416 (20%)	1042 (18%)	0.009
Gambling	Gambled past year	1257 (59%)	3841 (64%)	< 0.001
	Horses	239 (11%)	844 (14%)	0.001
	Bingo	209 (4%)	83 (4%)	n.s.
	Number games	331 (15%)	1178 (20%)	< 0.001
	Sports	369 (17%)	1066 (18%)	n.s.
	Lotteries	846 (40%)	2791 (46%)	< 0.001
	Gambling machines	320 (15%)	826 (14%)	n.s.
	Poker	338 (16%)	936 (16%)	n.s. 0,810
	Casino games	212 (10%)	517 (9%)	n.s.
	TV-contests	208 (10%)	560 (9%)	n.s.
	Internet	194 (9%)	525 (9%)	n.s.
Gambling frequency	No gambling	887 (42%)	2190 (36%)	< 0.001
	Low frequency (1–3 gambling forms or monthly in one form)	710 (33%)	2134 (36%)	
	Medium frequency (monthly gambling in several forms or weekly in one form)	344 (16%)	1116 (18%)	

(*Continues*)

Table 7. (Continued)

		Wave 1 only (*n* = 2144)	Wave 1 and wave 2 (*n* = 6021)	*p*-Value
	High frequency (weekly gambling in several forms)	197 (9%)	577 (10%)	
PGSI	No gambling	881 (41%)	2169 (36%)	< 0.001
	No problem gambling	956 (45%)	3162 (52%)	
	Low risk	191 (9%)	498 (8%)	
	Moderate risk	84 (4%)	165 (3%)	
	Gambling problems	32 (1.5%)	27 (0.5%)	

Note: n.s., not significant.

Use of postal questionnaires complicated the study although their use was important since different demographic groups completed the postal questionnaires compared to those reached by telephone. However the use of different data collection modes poses difficulties, primarily when the data files are merged if the formats used are not identical but also because the different modes themselves are known to affect the responses (Williams and Volberg, 2009). It is therefore important to check response patterns for respondents reached with different data collection modes.

The sampling strategy, which included over-sampling in important target groups with expected high rates of problem gamblers and equally expected high rates of non-response, proved to be effective and guaranteed large enough groups of problem gamblers to yield well-founded estimates of prevalence and incidence in not only the population but also in sub-categories. Another effect was that a substantial sub-sample of approximately 600 people with ongoing or earlier gambling problems could be selected from the respondents for the in-depth study. The price we paid was a lower overall response rate, even though some over-sampled categories, such as young men with high probability of gambling problems, had an unexpectedly high response rate. Another downside of our sampling strategy was that we recruited too few middle-aged or older female problem gamblers, a group that has proved to be of interest in our study. Since around 80% of the Swedish problem gamblers are males, the strategy used to calculate estimated risk was affected and the sampling strategy thus less effective to target groups where female problem gamblers would have been more likely found. We see a need for other studies of these groups in the future to complement what was found in the Swelogs cohort.

The PGSI was included as the primary instrument measuring problem gambling given the public health profile of the study. It was considered more important to estimate the overall number of people moving along the continuum of risk and problems than actual rates of pathological gamblers. The SOGS was also included in waves 1 and 2 to enable comparisons backwards to the previous Swedish prevalence study.

Similar to other longitudinal studies Swelogs has been affected by non-response. The overall response rate, which does not correct for the effects of the complex sampling strategy, was 55% in wave 1. The weighted response rate, which can be seen as an estimate of the expected response rate for a simple random sample, was 63%. These rates are quite similar to the unweighted and weighted response rates achieved in a recent Dutch survey of mental health disorders (59% unweighted and 65% weighted) (de Graaf *et al.*, 2010).

As the study moves on we seem to lose non-gamblers and problem gamblers in particular while keeping non-problem gamblers to a higher extent. This still leaves us with a large and fairly representative sample to follow transitions over the entire study period as these categories were over-represented in the original sample.

The primary purpose of Swelogs was to develop evidence-based methods of problem gambling prevention based on a better understanding of the temporal sequence of changes in gambling and problem gambling and their relation to risk and protective factors in the environment. Over time, we will be able to distinguish between people with long-term gambling problems and others with more transitory types of problems and thus suggest different preventive efforts for different needs.

Now heading towards the final data collection in Swelogs we look forward to contributing to the field with new information concerning relationships that are impossible to discern in cross-sectional studies. Problems encountered during the study have been resolved for the most part and we have a large store of rich material to study and publish from for years to come.

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