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# **PROBLEM GAMBLING AMONG YOUNG WOMEN AND MEN IN SWEDEN**

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PROBLEM GAMBLING AMONG YOUNG WOMEN AND  
MEN IN SWEDEN  
THESIS FOR DOCTORAL DEGREE (Ph.D.)

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## SAMMANFATTNING

Spel om pengar bland ungdomar är ett betydande folkhälsoproblem. Trots att en förståelse av spelproblemets etiologi är avgörande för prevention finns en begränsad kunskap om uppkomsten av spelproblem och vilka riskfaktorerna för spelproblem hos ungdomar är. Föreliggande avhandling syftar till att estimerar incidensen av en första episod av spelproblem samt att undersöka några riskfaktorer för spelproblem bland svenska unga kvinnor och män.

I Studie I analyserade vi data bland de 16 till 24 år gamla studiedeltagarna (n=19016) i tvärsnittsstudien den Nationella Folkhälsoenkäten från åren 2004 till 2007. I Studie II och III använde vi de första två datainsamlingarna i Swedish Longitudinal Gambling Study (Swelogs), där studiedeltagarna var 16 till 44-åringarna (n=4364; Studie II) och 17 till 25-åringarna (n=2241; Studie III). I Studie IV använde vi en fall-kontroll studie från 2011, Swelogs kohorten, och analyserade data bland de 16 till 24-åriga fallen och kontrollerna (n=1116).

Incidensen av en första episod av spelproblem var högre bland svenska ungdomar, 16 till 24 år gamla, än bland 25 till 44-åringar, och tre gånger högre bland unga män (3,3; 2,2 - 5,0 %) än unga kvinnor (1,1; 0,4 - 3,1 %). Individuella förflyttningar under ett år, från spelproblem till återhämtning, och från återhämtning till återkommande spelproblem, var vanligt förekommande. Våra fynd antyder att den högre prevalensen av spelproblem bland svenska ungdomar i jämförelse med 25 till 44-åringar kan förklaras av en högre incidens av spelproblem för första gången samt en lägre proportion av återhämtning bland ungdomar jämfört med 25 till 44-åringar.

Det har föreslagits att livsstressorer kan leda till normbrytande beteenden bland ungdomar, samt att affektiva störningar och negativa livshändelser kan predisponera människor för spelproblem. Vi fann att en dålig psykisk hälsa var starkt associerad med spelproblem för kvinnor, medan en hög alkoholkonsumtion och utsatthet för våld var associerade med spelande och/eller spelproblem bland unga män, i tvärsnittsanalyser. Därutöver fann vi att lägre skolbetyg var associerade med en högre risk för spelproblem upp till åtta år senare för båda könen. Däremot föreföll en debut i affektiva störningar samt försummelse/misshandel i barndomen eller tonåren endast vara riskfaktorer för spelproblem för kvinnor (då särskilt ångeststörningar och känslomässig försummelse). För män föreföll dessa exponeringar inträffa samtidigt med, eller efter, spelproblemet (särskilt depression och fysisk misshandel).

Våra fynd vidgar den tidigare forskningen om spelproblemets etiologi. Incidensen av en första episod av spelproblem bland unga personer har inte estimerats i ett nationellt representativt urval förut. Därutöver har mycket få studier om riskfaktorer för spelproblem undersökt könen separat, trots att forskning har påvisat stora könsskillnader när det gäller prevalensen av spelproblem bland ungdomar. Våra fynd visar att svenska unga män har en högre risk för spelproblem i jämförelse med unga kvinnor, men att flera av de undersökta riskfaktorerna enbart var associerade med spelproblem bland unga kvinnor. Det är möjligt att vägen till spelproblem är olika för unga kvinnor och män, åtminstone delvis.

## ABSTRACT

Gambling among young people is a significant public health concern. While an understanding of the aetiology of gambling problems is crucial for prevention, there is limited knowledge about the onset of and the risk factors for problem gambling among youth. This thesis aims to estimate the incidence of a first episode of problem gambling and to examine some potential risk factors for problem gambling among Swedish young women and men.

In Study I, we analysed data among the 16 to 24 year-old study participants (n=19,016) in the cross-sectional Swedish National Public Health Survey in 2004 to 2007. In Study II and III, we used the first two waves of the Swedish Longitudinal Gambling Study (Swelogs), with the study participants being the 16 to 44 year-olds (n=4,364; Study II), and the 17 to 25 year-olds (n=2,241; Study III). In Study IV, we used a case-control study in 2011 nested in the Swelogs cohort, and analysed data among the 16 to 24 year-old cases and controls (n=1,116).

The incidence of first episode problem gambling was higher among Swedish youth, aged 16 to 24 years, than among 25 to 44 year-olds, and three times higher among young men (3.3; 2.2-5.0%) than young women (1.1; 0.4-3.1%). Individual transitions in problem gambling in one year, from problem gambling to recovery, and from recovery to recurrent problem gambling, were common. Our findings suggest that the higher prevalence of problem gambling among Swedish youth compared to 25 to 44 year-olds is explained by a higher incidence of first episode problem gambling, and a lower proportion of recovery, among youth compared to 25 to 44 year-olds.

It has been hypothesized that life stressors may lead to deviant behaviours among youth, and that affective disorders and adverse life events predispose people to problem gambling. We found that poor mental health was strongly associated with problem gambling for women, while high alcohol use and violence victimisation were associated with gambling and/or problem gambling for young men, in cross-sectional analyses. Further, lower compulsory school grades were associated with a higher risk of gambling problems up to eight years later for both sexes. However, an onset of affective disorders and child/youth maltreatment seemed to be risk factors for problem gambling only for females (in particular: anxiety disorders and emotional neglect). For males, these exposures seemed to occur simultaneously or after the gambling problem (in particular: depression and physical abuse).

Our findings extend previous research about the aetiology of gambling problems. The incidence of a first episode of problem gambling among young people has not been estimated in a nationally representative sample before. Moreover, while research has established large sex differences in the prevalence of problem gambling among youth, very few studies of risk factors for youth problem gambling have examined the sexes separately. Our findings show that Swedish young men have an increased risk of problem gambling compared to Swedish young women overall, but that several of the examined risk factors were only associated with problem gambling among young women. It is possible that the path to problem gambling is, at least in part, different for young women and men.

## LIST OF SCIENTIFIC STUDIES

- I. Fröberg, F., Hallqvist, J., Tengström, A. Psychosocial health and gambling problems among men and women aged 16-24 years in the Swedish National Public Health Survey. *European Journal of Public Health* (2013) 23 (3):427-433.
- II. Fröberg, F., Rosendahl, K. I., Abbott, M., Romild, U., Tengström, A., Hallqvist, J., The Incidence of Problem Gambling in a Representative Cohort of Swedish Female and Male 16–24 Year-Olds by Socio-demographic Characteristics, in Comparison with 25–44 Year-Olds. *Journal of Gambling Studies*. March 2014.[Epub ahead of print]
- III. Fröberg, F. Modin, B., Rosendahl, K.I., Tengström, A., Hallqvist, J. The Association Between Compulsory School Achievement and Problem Gambling Among Swedish Young People. *Journal of Adolescent Health* (2015) 56 (4):420-428.
- IV. Fröberg, F. Modin, B., Rosendahl, K.I., Tengström, A., Hallqvist, J. The association between child/youth maltreatment and affective disorders and problem gambling among Swedish young women and men. *Manuscript*.

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# 1 INTRODUCTION

Gambling is common among young people in Sweden. However, while gambling for most young people does not cause any harm, for some youth it has severe adverse consequences. Problem gambling among young people is associated with depression, suicidal ideation and attempts, substance use, delinquency, poor school achievement, and disrupted relations.(1, 2) Furthermore, an early initiation into gambling has been linked to an increased risk of developing gambling problems,(3, 4) and an early onset of gambling problems is associated with adverse social and health consequences that last well into adult life.(5) Hence, gambling among young people is a significant public health concern.(5)

However, while an understanding of how problem gambling emerges is important for prevention, there is limited knowledge about the incidence of a first episode of problem gambling and the risk factors for problem gambling among young people. Moreover, most of the research in this area has been carried out in North America and Britain, with fewer studies from Oceania and Europe.(1) It is uncertain whether findings from other cultures apply to Swedish youth.

Previous research has consistently shown that there are large differences between women and men with respect to gambling habits and the prevalence of problem gambling,(1, 6, 7) and that these differences are most pronounced in adolescence. Yet, few studies have examined sex differences in youth problem gambling.

The present thesis focuses on the emergence and occurrence of problem gambling among young people in Sweden. Another aspect in focus is potential risk factors for young people's problem gambling, specifically in the areas of mental health, substance use, social support, violence victimisation, school achievement, and child/youth maltreatment. A main focus throughout the thesis is differences between the sexes in the aetiology of problem gambling among young people.

## **2 BACKGROUND**

### **2.1 YOUNG PEOPLE**

In the present thesis, the samples that are analysed comprise people aged 16 to 25 years, and, hence, reflect two distinct developmental periods: the late adolescence (age 16 to 17 years) and the emerging adulthood (18 to 25 years). In the occidental world, adolescence is characterised by an initiation of growing autonomy and independence, while, the emerging adulthood is a period of identity formation, cognitive development, and preparation for the future adult life in terms of education, work and finances.(8) In the present thesis, young people or youth refer to both adolescents and emerging adults.

### **2.2 GAMBLING: DEFINITION AND THE SWEDISH CONTEXT**

In research and public health practice, gambling refers to an activity where something of a value (generally money) is put at risk for an uncertain outcome of an event or game determined by chance.(9) Examples of games in gambling are lotteries, horse-racing, bingo, poker, Casino games, and Electronic Gambling Machines (EGMs). Games where money is not put on stake, or where one pays for play but the intention is not to gain money (for example computer games, TV games, and amusement arcade games) are not defined as gambling in this thesis. It should also be noted that investment on the stock-market is not considered gambling, even though some features are similar to gambling.

Sweden has a very long history of gambling, with the first evidence being from the iron age.(10) Today, Sweden has a regulated gambling market, where only the state, the horse-racing organisations, some non-profit organisations, and small bingo halls or restaurant casinos can organise gambling. Young people, under the age of 18 years, are not permitted to gamble on most games in Sweden, with the main exception being lotteries.

In the 1980s, the gambling market in Sweden was commercialised by allowing gambling companies promote and market their games, as opposed to earlier.(10) As a consequence, the gambling market expanded with regard to games, gambling venues, and arenas and marketing. EGMs, which were withdrawn in the 1970s due to social problems, were re-introduced in 1996, and in the beginning of the 21<sup>st</sup> century, four international state-owned Casinos opened.(10) Moreover, gambling is now available online, which means that companies operating abroad are accessible from Sweden.(10)

### **2.3 PROBLEM GAMBLING: DEFINITIONS, PERSPECTIVES AND THEORIES**

#### **2.3.1 What is problem gambling?**

While there have been concerns about gambling for a long time, problem gambling was not recognized as a health issue until the 20<sup>th</sup> century. In 1980, pathological gambling was included as a diagnosis in the Diagnostic and Statistical Manual of Psychiatric Disorders.

Based on clinical experiences, pathological gambling was described as a chronic and progressive disorder where the individual was unable to resist urges to gamble, causing serious negative consequences for the individual, and the family, as well as the vocational, and financial situation.(11) Since then, the criteria for the diagnosis have been revised, and in the latest version of the Diagnostic and Statistical Manual of Psychiatric Disorders (DSM 5), a gambling disorder is considered a behavioural addiction with criteria similar to those of substance use disorders, such as: symptoms when abstinent, tolerance (a need to gamble for more money, or longer sessions) or a preoccupation with gambling.(12) In DSM 5, a gambling disorder is no longer necessarily viewed as a chronic and progressive disorder, and it is acknowledged that there are different levels of severity of the problem.(12)

The medical addiction view on gambling problems has received severe critique over the years. For example, several researchers have argued that by focusing on individual symptoms only, the addiction perspective fails to take into account the unequal distribution of problem gambling in society.(13-15) Further, according to Volberg and Wray,(16) the pathological gambling construct may lead socio-economically marginalised people to become stigmatised as pathological gamblers, and thus held responsible for their poverty “*because they ‘choose’ to gamble*”.(16)

Today the public health perspective is also very influential. Within this perspective gambling problems are seen as a continuum of gambling problems from low to high severity, with the focus being on harm caused by gambling.(17, 18) Abbott et al.,(19) defines harmful gambling as: “*any repetitive gambling that an individual engages in that leads to (or aggravates) recurring negative consequences such as significant financial problems, addiction, as well as physical and mental health issues. Negative consequences may also be experienced by the gambler’s family, social network, and community. The degree of harm can range from inconsequential, to transient, to significant, and finally to chronic.*”(19)

### **2.3.2 Dominating perspectives on problem gambling among youth in research**

Gambling problems among adolescents were first recognised in research in the late 1980s. In Britain, attention was brought to adolescents who gambled on “fruit machines” (EGMs),(20, 21) and in the US (22) and in Canada (23), prevalence studies among high school students showed that the prevalence of gambling and problem gambling were high. The perception of adolescent problem gambling in the 1980s was that of an addiction, following the view on pathological gambling among adults.

The criticism towards the addiction perspective, previously mentioned, has also been directed towards the conceptualisations of youth problem gambling.(13, 14) Moreover, it has been suggested that because young people do not have the same experiences as adults, the psychiatric criteria of pathological gambling, that are based on adults’ experiences, may not be valid for youth.(7) Further, the psychiatric criteria have never been studied, or validated,

among adolescents,(7) and there is no current agreed upon definition of adolescent problem gambling.(7, 24)

Among youth, problem gambling is often viewed as a *risk taking* or *problem behaviour*, similar to other risk taking behaviours such as delinquency or substance use.(25-28) Adolescence is a period in life in which risk-taking behaviours typically increase, although this peak can be viewed as part of a “normal” development. Risk taking behaviours in adolescence can be viewed as a way of regulating emotions and affects,(29, 30) to achieve peer-group identity and status,(31) and a consequence of less experience in adult habits (32) and of limiting and controlling one’s behaviour.(14)

My perspective on youth gambling is that gambling may cause severe harm and long term consequences for a young person, but nevertheless for most youth it is within the “normal” youth development. Further, in this thesis the focus is on gambling problems of mild to high level of severity, and not on problem gambling as an addiction.

#### 2.3.2.1 Terminology

A variety of terms for gambling problems exists in the literature. Among these are problem gambling, at risk gambling, compulsive gambling, irresponsible gambling, excessive gambling, gambling disorder, and pathological gambling. In general, a distinction is made according to severity of the problem, where a gambling disorder or pathological gambling often refers to the most severe form of problem gambling (as in the clinical diagnosis), while other terms, such as problem gambling, refer to less severe problems. There is no agreed upon definition of problem gambling, but in general it refers to an individual experiencing a loss of control over gambling (time, frequency or money spent) and adverse consequences of gambling (social, financial or vocational).(33) In practice in research, problem gambling includes both less and more severe gambling problems.

In the present thesis, when I refer to studies, I use the terms problem gambling, gambling problems, problems with gambling, or problematic gambling as encompassing both less and more severe problems with gambling.

#### 2.3.3 Theoretical models of the aetiology of problem gambling

There are several theoretical models that aim to explain how problem gambling emerges. However, according to a research review, relatively few studies about problem gambling among youth apply theories to explain the findings.(1) In this thesis, the following theories or models are used to formulate hypotheses and to interpret the findings: General Strain Theory, General Theory of Addictions, and the Pathways model of Problem and Pathological Gambling.

### 2.3.3.1 *General Strain Theory*

Initially, General Strain Theory aimed at explaining delinquency, but the theory has later been applied to other deviant behaviours, including a few studies about problem gambling.(34, 35) According to this theory, negative relationships in life cause strains in terms of emotional distress, anger or frustration. The strain may result from not meeting, or from losing expected and valuable goals in life, or from facing negative life events.(36) Young people with social support, a positive self-esteem, and problem solving skills are likely to manage such life strains well. However, some youth may turn to deviant behaviours as a way to deal or cope with life stressors, i.e. to achieve a relief, distraction, escape, or revenge.(36)

It is hypothesized that the risk of a young person engaging in deviant behaviour increases if there is an incentive for the behaviour in question.(37) Gambling may be perceived as an opportunity to become a winner,(38) and inspire dreams and fantasies of fast money.(39) A Swedish study shows that young problem gamblers often get a sense of “flow” when they immerse themselves into the game, and that gambling may give them renewed strength by serving as an outlet of pressure, stress and life problems.(14)

In this thesis, we examine if low achievement in compulsory school is associated with an increased risk of problem gambling, based on the hypothesis in the General Strain Theory that life strains may lead to deviant behaviours among youth.

### 2.3.3.2 *The General Theory of Addictions*

The General Theory of Addictions propose that the aetiology of addictive behaviours, including problem gambling, lies in physiological and psychological factors. According to the theory, two “sets of predisposing factors” lead to problem gambling: 1) A physiological resting state of arousal that is either chronically depressed, stressed or anxious, and 2) Negative experiences in childhood or adolescence, for example early rejection by parents, causing “deep feelings of inadequacy and rejection” and low self-esteem.(40) Moreover, according to Jacobs, both these factors are necessary and it is the combination of, or interaction between them that lead to an addiction.(40) Gambling or other addictive behaviours serve as a way to relieve the chronic stress condition, escape from a painful reality, and makes the gambler feel “alive”.(40) In this manner, gambling becomes a rewarding, positive experience, which in turn reinforces more gambling, but also something that eventually might lead to adverse consequences and desperation.(40)

While the General Theory of Addictions has been extensively cited in gambling research, I have only found two studies about problem gambling that have tested the theory. These studies, with samples comprised of adolescents (41) and adults (42), support the theory, but since the analyses were cross-sectional, no conclusions about the directions of the associations found can be drawn.(41, 42)

### 2.3.3.3 *The Pathways Model of Problem and Pathological Gambling*

In the Pathways model of Problem and Pathological Gambling, three distinct subgroups of problem gamblers are described.(43) In all three pathways, access and availability to gambling, and learning processes once gambling has been initiated, are important factors in the development of problem gambling. However, with the exception of the behaviourally conditioned pathway, there are also other predisposing factors. The antisocial impulsivist pathway refers to people who are high in impulsive, risk taking, and antisocial behaviours. Moreover, the problem gamblers in this pathway often have other problems, such as delinquency and substance abuse.(43)

The third pathway consists of emotionally vulnerable people who have a history of anxiety and depression, poor coping and problem-solving skills, and adverse life experiences. This pathway is similar to the General Theory of Addictions, with gambling being viewed as a way of regulating emotional states.(44) However, while in the General Theory of Addictions it is the interaction between emotional disorders and adverse life events that lead to problem gambling,(40) the Pathways Model of problem or pathological gambling states that in individuals with a certain vulnerability, predisposing risk factors lead to problem gambling in a “cumulative fashion”.(7) A predisposing risk factor generally refers to an earlier risk factor that interacts with later risk factors, which in the case of this model would imply an increased vulnerability. Further, a “cumulative fashion” could refer to mediation, interaction, or additive effects.

According to a research review,(45) a number of studies have, indeed, found three subtypes of problem gamblers similar to the pathways in the Pathways model of Problem and Pathological Gambling. However, because most studies have a cross-sectional design,(45) or include people with gambling problems at baseline,(46) no conclusions about factors leading to an increased risk of problem gambling can be drawn.(45)

In this thesis, based on the hypothesis in the General Theory of Addictions and the Pathways model of Problem and Pathological Gambling that adverse life events and affective disorders predispose people to problem gambling, we examine if maltreatment in childhood or youth and affective disorders are associated with an increased risk of problem gambling among youth.

## 2.4 RESEARCH ABOUT GAMBLING AND PROBLEM GAMBLING AMONG YOUTH

### 2.4.1 Gambling among young people

Research about the prevalence of gambling among young people has mainly been carried out in Canada, the US, and Britain, with fewer studies from Australia, New Zealand and Europe. These studies show that a large proportion of adolescents, between 30 and 90%, have gambled in the past year.(7, 47)

Studies consistently show that young women gambling less frequently, for lower amounts of money, and during shorter sessions than young men.(1, 2, 6, 7, 48) This pattern applies to Swedish youth too.(49) The prevalence of any gambling and regular/high frequent gambling (gambling in several forms of games and/or every week) in one year, by age group and sex, in the Swedish prevalence study Swelogs in 2008/2009 is shown in Table 1.

**Table 1.** *The prevalence of any gambling and regular/high frequent gambling in one year among Swedish youth in the past year, by age group and sex, measured in Swelogs in 2008/2009.*(49)

<i>Prevalence of gambling in the past year</i>	<b>Females</b>		<b>Males</b>	
	16 to 17 years	18 to 24 years	16 to 17 years	18 to 24 years
Any gambling	42%	59%	61%	74%
Regular/high frequent gambling	7%	11%	18%	41%

The most popular games among Swedish 16 to 24 year-olds, according to Swelogs in 2008/2009, are: lotteries, sports betting, poker, EGMs, and Casino games (Casino games mainly among 19 to 24 year-olds). Further, 3% of the 16 to 17 year-olds and 14% of the 19 to 24 year-olds reported that they had gambled online, with larger proportions among males than females.(49)

Compared to a previous Swedish prevalence study, where 60% of the 15 to 17 year-olds had gambled in one year, the gambling prevalence seems to have decreased among young people in Sweden between 1997/1998 and 2007/2008.(50) This is consistent with an overall gambling decrease in the Swedish population in this time period.(49, 50)

In 2014, a survey carried out in Swedish schools found that among 16 year-olds, about 8% of the females and 20% of the males had gambled in the past year. The corresponding numbers among 18 year-olds, were 32% for the males and 9% for the females.(51) Because the questions about gambling in the school-based survey are different from the questions in Swelogs, the results from these studies are not directly comparable.

## **2.4.2 The prevalence of problem gambling among young people**

### *2.4.2.1 Measuring problem gambling*

In research, problem gambling is generally measured through self-assessment instruments covering problematic gambling behaviours and adverse consequences of gambling. Most instruments assign scores to the respondent's answers on each question and add these to a sum-score. Based on the sum-score, respondents are assigned to different categories of gambling problems, such as problem gambling or at-risk gambling. In general, respondents who have not participated in gambling in the past year are not administered the problem gambling instrument. However, non-gamblers are often included in the analyses, either among non-problem gamblers or as a category of their own.

There are specific instruments to measure gambling problems among adolescents.(52, 53) These are derived from instruments for adults, but adapted to adolescents' reality. For example, instead of asking about "jeopardising relationships with spouse, child or other important person", the equivalent question directed to adolescents concerns problems in relation to family and friends. Some of the studies mentioned in this thesis about problem gambling among youth have used instruments developed for adults, and other studies have used the adolescent versions.

### *2.4.2.2 The prevalence of problem gambling among youth internationally and in Sweden*

Volberg et al.(7) show, in their review, that the prevalence of problem gambling among adolescents in North America, Europe, and Oceania varies between 0.8% and 13% in studies published between 2000 and 2009.(7) The large variation in prevalence estimates between studies may depend on the different definitions and measures of problem gambling in studies, as well as the age ranges of the samples. Studies from other parts of the world, such as Brazil (54) and Asia,(55) find similar prevalence estimates.

Research among youth in the age range of about 20 to 25 years has often been conducted in samples of college students. Two meta-analyses of international studies found that the prevalence of problem gambling among college students was 7.9%, in studies until 2005,(56) and 10.2% in studies until 2013.(57) Most of the included studies in these meta-analyses were carried out in North America.

In Sweden, the prevalence of problem gambling among young people is similar to other parts of the world. In Table 2, the prevalence of problem gambling in Sweden, by age group and sex, as measured in Swelogs in 2008/2009 is shown.

**Table 2.** *The prevalence of problem gambling in the past year in Sweden, by age group and sex, measured in Swelogs in 2008/2009.*(49) Problem gambling was measured by the Problem Gambling Severity Index, with a score of 3 or more being considered problem gambling.

<i>Prevalence of problem gambling by age group</i>	<b>Females</b>	<b>Males</b>
16 to 17 years	2.1%	5.0%
18 to 24 years	2.0%	8.7%
<i>Total: 16 to 84 years</i>	1.3%	3.2%

In a Swedish study from 1997/1998, 5.1% of the 15 to 17 year-olds, and 3.3% of the 18 to 24 year-olds had a gambling problem, compared to 2.0% in the overall population.(50) In 2003, a study of a small sample of 16 to 18 year-old males in Östersund, Sweden, reported a remarkably high prevalence of problem gambling: 22.4%.(58)

#### *2.4.2.3 Problem gambling among youth by socio-demographic groups*

Studies generally find a higher prevalence of problem gambling among youth than adults.(1, 47) For example, in a meta-analysis of North American prevalence studies until 2000, the prevalence of severe problem gambling in one year was 4.8% among adolescents, compared to 1.4% among adults.(59) These findings could be due a higher risk of developing problem gambling during adolescence and young years than later in life. Consistent with this, recent research in an Australian sample shows that initiating gambling before 18 years of age leads to a faster progression to problem gambling, compared to a later gambling onset.(3)

Alternatively, the prevalence of problem gambling in society could be increasing over time. In two reviews of studies in the US, the prevalence estimates of problem gambling is higher in studies conducted recently compared to studies from the 1970s.(59, 60) In Sweden, however, the prevalence of problem gambling remained stable between 1997/1998 (61) and 2008/2009 (49), with two exceptions: among 18 to 24 year-old men and people with a low level of education, the prevalence had increased in 2008/2009 compared to 1997/1998.(62)

Studies generally report a higher prevalence of problem gambling among young males compared to young women.(2, 7, 63) As shown in Table 2 above, this applies to Swedish youth too. However, some studies from the US show that the prevalence of problem gambling among adult women has increased over time, with the introduction of Casinos and EGMs, resulting in diminishing sex differences in problem gambling.(64, 65) A similar change does not seem to have occurred in Sweden however,(66) with the exception of Swedish adolescents aged 16 to 17 years among whom the sex differences has decreased slightly between 1997/1998 and 2008/2009.(62, 66)

### **2.4.3 The onset of problem gambling and course over time**

Relatively few studies have examined the onset in gambling and problem gambling among young people. Some studies based on the adult population show that while men typically start gambling in adolescence, women generally begin later in life,(3, 67, 68) thus making adolescence the period in life when sex differences in gambling are largest. However, a recent study examined gambling initiation in different birth cohorts in the US and found that the age of gambling onset has decreased over time, and that the largest change had taken place among women.(64)

Further, studies among help-seeking people have shown that the progression from gambling to problem gambling is faster for women than men.(67, 69) However, in a cohort of Australian adult twins, Slutske et al.(3) found that while men in general initiate gambling earlier in life than women, there were no sex differences in the speed of the progression from gambling to problem gambling.(3)

Longitudinal studies of the course of problem gambling over time in representative youth cohorts are scarce. Slutske et al.(70) followed up a cohort of students in Missouri, US, from the age of 18 to 29 years that was initially sampled to another study. The prevalence and incidence of problem gambling was similar at all four waves of data collection, but on an individual level, problem gambling was transitory and episodic.(70) Based on a representative cohort of youth from Minnesota, US, Winters et al.(71) show similar findings, with a stable prevalence of problem gambling in the three waves of data collection, but with large individual differences.(71) In line with these findings, some studies among youth and adults (72-76) show that recovery from problem gambling is common.

### **2.4.4 Risk factors for young people's problem gambling**

#### *2.4.4.1 Socio-demographic factors*

A handful of longitudinal studies have found an association between an early onset of gambling and a higher risk of gambling problems.(3, 4) Further, as previously mentioned, young men seem to have a higher risk of problem gambling compared to young women.(2, 7, 63) Some studies have found that ethnic minorities (77) and aboriginal (78) youth have a higher prevalence of problem gambling than other youth. Among aboriginal youth this association is closely tied to poverty.(78) However, according to a research review, few studies have examined the association between the socio-economic status of the family of origin and young people's problem gambling, with the existing ones pointing to a weak link between low family income and low level of parental education and problem gambling.(79)

#### *2.4.4.2 The gambling environment and the involvement in gambling*

According to Abbott et al.,(19) research shows that exposure to gambling in the community, in terms of geographic distribution, gambling density, characteristics of the gambling venues,

and types of gambling, is associated with harm of gambling. Further, the density of EGMs is higher in disadvantaged socio-economic areas than in other areas.(19)

Some studies show that youth who engage more frequently in gambling have a higher prevalence of problem gambling compared to youth who gamble less.(80) Further, studies among adults suggest that certain games are associated with a higher risk of problem gambling than other games.(49, 81, 82) These games (49) are characterised by a short time between betting and outcome (lose or win), and by offering the possibility to bet repeatedly in the same game. Other features of high risk potential games are, for example, that one can place several bets or gamble at several games simultaneously, and that the game is highly available.(83) However, other studies suggest that it is not the features of the game, but rather the overall involvement in gambling, in terms of a high frequency of participation several games, that lead to a higher risk of problem gambling.(84, 85)

#### *2.4.4.3 Family and peer relations*

According to a review of studies of family influence on youth gambling, there is a higher prevalence of gambling or problem gambling among youth who belong to families where the parents provide little social or emotional support, the parents approve of or are involved in the adolescent's gambling, the parents gamble, or a family member uses substances.(79) Some of these findings are confirmed in other research reviews, showing that youth with gambling problems more often have disrupted family relationships than other youth.(1, 2) In addition, some studies have found that child maltreatment, defined as physical or sexual abuse and/or neglect, is associated with problem gambling among youth (86) and adults.(87-92)

Moreover, a British study showed that youth who initiate gambling early in life often do so within the family, while a later gambling onset often occurs among friends or colleagues.(93) Finally, some studies suggest that youth who have friends who gamble, or who have gambling problems, gamble more than youth with non-gambling friends.(2)

Most of the above studies are limited by their cross-sectional design; it is unclear whether problem gambling leads to disrupted family relationships or a higher parental monitoring, or if the latter are rather risk factors for problem gambling.

#### *2.4.4.4 School related aspects*

Different school aspects have been associated with problem gambling. Truancy, conflicts, and other deviant behaviours displayed in school are more frequent among problem gamblers than other youth in North American cross-sectional studies (94, 95).

A few studies have examined the association between school achievement and problem gambling among North American youth, finding that youth with problem gambling often have poor school achievement.(96, 97) Further, in two longitudinal studies, poor school performance in adolescence increased the risk of problem gambling (4) or gambling (98) in

young adulthood. However, in another cohort, school achievement was only associated with problem gambling in unadjusted analyses; adjusted for a wide range of potential psychosocial risk and protective factors, this association did not remain.(99)

#### *2.4.4.5 Genetic factors*

Reviews of studies, mainly among adults, show that both genetic and environmental factors contribute to problem gambling.(100, 101) Similarly, a recent study found that both genetic and environmental factors influence adolescent gambling.(102) Further, examining sex differences in gambling among young adults, Beaver et al.(103) found that genetic factors have a larger influence on male gambling than on female gambling,(103) while, in the same sample, Slutske and Richmond-Rakerd (104) found that environmental factors explain all the variation in young adults' gambling.(104) In sum, the few existing studies are inconclusive regarding the genetic contribution to young people's gambling, while studies among adults suggest that both genetic and environmental factors contribute to problem gambling.(100, 101)

#### *2.4.4.6 Personality characteristics*

Several longitudinal studies have shown that impulsive and risk-taking behaviour early in life increases the risk of later problem gambling among youth. Some studies were conducted in a cohort of males in a low socio-economic area in Quebec, Canada, following up the boys from childhood through adolescence. These studies show that boys who displayed a high level of impulsive and risk taking behaviour in childhood and/or early adolescence, as rated by teachers and parents, had a higher risk of an early onset in gambling, higher frequency of gambling, and a higher prevalence of problem gambling. Moreover, high impulsive and risk taking behaviour were also associated with later co-occurring problem gambling, substance use, and delinquency.(105-107)

Consistent with the above findings, Slutske et al.(108) found that certain personality characteristics, such as negative emotionality and constraint, at the age of 18 years were associated with problem gambling and substance abuse at the age of 21 years, in a birth cohort from Dunedin, New Zealand.(108) In contrast, a cohort study of youth from Buffalo, US, Barnes et al.(109) found that gambling, substance abuse, and delinquency did not share risk factors; however, in this study gambling frequency, and not problem gambling, was studied.(109)

#### *2.4.4.7 Coping behaviours*

Some studies suggest that young people with gambling problems cope with life problems or stress differently than other youth. Young problem gamblers would be more likely to cope by distracting themselves or avoiding unpleasant feelings, while other young people more often actively try to resolve problems or handle stressful situations.(110) Further, some studies

suggest that gambling may serve as a coping behaviour for young people with gambling problems. While youth without gambling problems report to gamble for pleasure, to make money, or for the excitement according to one study,(111) young problem gamblers gambled to escape their problems, to reduce depressive feelings, to relax,(111) or, according to another study, as an outlet and to get renewed strength.(14) However, these studies are limited by their cross-sectional design; it is unclear whether gambling as a form of escape or distraction is a risk factor for problem gambling, or a consequence of the gambling problem.

#### 2.4.4.8 *Mental health including substance use*

Studies with a cross-sectional design consistently show that young people with gambling problems have psychosocial problems to a greater extent than other young people. According to the previously mentioned research review by Blinn-Pike et al.,(1) it is well established that adolescents with problem gambling use substances, and have depression or suicide ideation/attempts more frequently than other adolescents.(1) Another review, from the same year, by Shead et al.(2) confirms these findings. Moreover, reviews of studies including both youth and adults show that people with gambling problems more often than other people have substance abuse, depression, and anxiety disorders.(19, 112)

To my knowledge, only two studies have examined sex differences in the association between psychosocial problems and problem gambling among youth, showing that substance use and depression co-occur with *problem gambling* for both sexes,(113) but that alcohol use and depression is only associated with *gambling* for females.(6)

Once again, most of the above findings are limited by the cross-sectional design. However, results from three longitudinal studies provide additional support for the assumption that substance use/abuse is associated with an increase of problem gambling.(4, 99) or gambling.(98) Regarding the association between depression and problem gambling, a weak link was found in a cohort of youth in Maryland, US, but only for men who were low in impulsivity (not for women).(114) In a cohort of boys in a low socio-economic area of Quebec, Canada, impulsivity explained the initial association between depression and problem gambling in adolescence, but once established, the association between depression and problem gambling was direct and mutual.(115)

## **2.5 SUMMARY OF RESEARCH AND RELEVANCE FOR THE PRESENT THESIS**

Previous research has shown that problem gambling is more prevalent among young people than among adults. Further, while understanding how problem gambling emerges is important for prevention, there is limited knowledge about the onset and risk factors for problem gambling among youth.

To my knowledge, the incidence of a first episode of problem gambling has not been examined in a representative youth sample, and few studies have examined recovery and recurrent problem gambling among young people. Moreover, while research has established an association between psychosocial problems and problem gambling among young people, most of the research has been conducted in North America and Britain, and it is unclear whether the findings will translate to other cultures. Only two studies have examined the association between psychosocial risk factors and problem gambling among Swedish youth.

Previous research shows that there are large sex differences in the gambling habits and the prevalence of problem gambling among youth. However, I have only found two studies that have examined sex differences in the association between risk factors and gambling or problem gambling among youth previously. It has been suggested that women and men should be analysed separately in gambling research, thereby minimising the risk of omitting differences between the sexes.(13, 116)

A goal of this thesis is to extend the research area of problem gambling among young people by estimating the incidence of first episode of problem gambling, and analysing the association between some psychosocial potential risk factors and problem gambling, among young Swedish women and men separately, in two large nationally representative samples.

### **3 AIMS**

The overall aim of this thesis is to estimate the incidence of a first episode of problem gambling, and to examine some potential risk factors for problem gambling among young women and men in Sweden.

#### **3.1 SPECIFIC AIMS**

The specific aims are to:

- Explore the association between psychosocial aspects, gambling and problem gambling among 16 to 24 year-old Swedish youth, and to study whether any such associations differ according to the sex of the youth (Study I).
- Estimate the incidence of a first episode of problem gambling among 16 to 24 year-olds in Sweden, by demographic and socio-economic characteristics and gambling frequency, and to compare the incidence of a first episode of problem gambling between 16 to 24 year-olds and 25 to 44 year-olds, and between young women and young men (Study II).
- Estimate the prevalence of problem gambling, the incidence of recurrent gambling problems, and the recovery from gambling problems in one year among 16 to 44 year-olds in Sweden (Study II).
- Examine the association between final grades in compulsory school and mild and moderate/severe problem gambling in a cohort of Swedish 17 to 25 year-olds, controlling for socio-demographic circumstances, psychological distress, and alcohol use (Study III).
- Examine whether there were any sex differences in the association between school grades and problem gambling (Study III).
- To examine whether child/youth maltreatment and affective disorders are associated with problem gambling among 17 to 25 year-old Swedish women and men (Study IV).
- Study whether there is an interaction between maltreatment and affective disorders in the association with problem gambling (Study IV).

## 4 METHODS

### 4.1 DATA SOURCES

The four studies in this thesis are based on two national studies carried out by the Public Health Agency of Sweden (previously the Swedish National Institute of Public Health). Study I is based on Swedish National Public Health Survey and Study II-IV are based on the Swedish Longitudinal Gambling Study (Swelogs). Official national registers stored at Statistics Sweden are an additional data source used in all studies in the thesis. The Swedish National Public Health Survey and Swelogs are described in the following text.

#### 4.1.1 The Swedish National Public Health Survey

In Study I, we analysed data among the 16 to 24 year-old participants in the Swedish National Public Health Survey in 2004 to 2007. It is a representative cross-sectional survey carried out annually since 2004 by the Public Health Agency of Sweden in cooperation with Swedish county councils/regions and Statistics Sweden.

##### *4.1.1.1 Sampling and data collection of the Swedish National Public Health Survey*

The frame population of the Swedish National Public Health Survey is the 16 to 84 year-old residents in Sweden in the respective year according to the Register of the Total Population. The annual sample comprises 10,000 individuals (20,000 18-84 year-olds in 2004). In addition to this nationally representative sample, samples in county councils or regions in Sweden (of the same ages) are sampled each year. Different county councils or regions participate each year, with some participating several years and others only once or never, as shown in Table 3 on the following page.

Statistics Sweden sends out a self-administered postal questionnaire to the respondents each year. Since 2007, the participants are given the opportunity to answer the survey on the web. The postal/web questionnaire covers a broad range of health related, socio-economic and demographic issues, and includes some questions about gambling and problem gambling. Additional information about socio-demographic circumstances from official registers was linked to the datasets each year by Statistics Sweden.

Unfortunately, we had no information about the response-rate of 16-24 year-olds. However, among 16 to 29 year-olds the average response rate was 51.0% during 2004 to 2007, with a lower response rate among males than females.

**Table 3.** The county councils and regions that participated with additional samples in the Swedish National Public Health Survey between 2004 and 2007.

County councils and regions:	Year			
	2004	2005	2006	2007
Västra Götaland	Yes	Yes	Yes	Yes
Kronoberg	Yes			
Halland	Yes			
Dalarna	Yes	Yes		
Gävleborg	Yes			Yes
Gotland	Yes		Yes	
Jönköping		Yes		
Kalmar		Yes		
Blekinge		Yes		
Västernorrland			Yes	
Jämtland			Yes	
Västerbotten			Yes	
Norrbottn			Yes	
Östergötland			Yes	

#### 4.1.2 The Swedish Longitudinal Gambling Study (Swelogs)

In Study II, III and IV, we analysed data from Swelogs. Swelogs is a large representative longitudinal study about gambling and problem gambling in Sweden managed by the Public Health Agency of Sweden and carried out in cooperation with Statistics Sweden. The main focus of Swelogs is gambling, hence, the study contains a wide range of information related to gambling and gambling problems. Moreover, a broad range of other socio-demographic aspects, health issues and social aspects are also included. Further, socio-demographic variables from official registers have also been linked to the Swelogs data. The data in Swelogs is collected in three data collections “tracks”, and in the present thesis data from two tracks is used. The data collection of Swelogs Epidemiological and In-Depth track is shown in Figure 1 on page 21.

*The Epidemiological track* is a longitudinal representative cohort (the Swelogs cohort), initiated in 2008, and in which four waves of data collection have been carried out until 2015. The main purpose of the Epidemiological track is to estimate the prevalence and incidence of problem gambling in the Swedish population. Study II, III and IV of the thesis uses data from Wave I (in 2008/2009) and Wave II (in 2009/2010) of the Epidemiological track. Sampling to the Swelogs cohort, and data collection in Wave I and II is further described below.

*The In-Depth track* is a case-control study within the Swelogs cohort, initiated in 2011 with the purpose of retrieving detailed information about the mental health of the study participants in a lifetime perspective, life events, such as maltreatment in childhood or youth, and additional gambling aspects. In the In-Depth track, two waves of data collection have

been conducted until 2015. In Study IV, data from the first interview of cases and controls in 2011 are analysed. Sampling to the case-control study and the data collection in 2011 is further described below.

#### *4.1.2.1 Sampling and data collection of the Epidemiological track: the Swelogs cohort*

The frame population of the Swelogs cohort were residents in Sweden aged 16 to 84 years in 2008, according to the Register of the Total Population. A disproportionate sampling design was used, where young people (in particular 16 to 17 year-olds) and people assumed to have a higher probability of having gambling problems had a higher likelihood of being sampled. The oversampling of these groups was supposed to allow for In-Depth studies of young people and enable examinations of transitions over time in problem gambling. The sampling design was based on the variables sex, age, and a variable intended to predict the probability of having gambling problems. The variable, “probability of having gambling problems”, was derived from demographic and socio-economic variables in official registers assumed to indicate the risk of gambling problems. Based on previous research, male sex, low income, unemployment, and benefitting from social welfare indicated a higher risk of problem gambling, while the reversed association was assumed for people with an origin in the Nordic countries, who were married, and who had been on sick leave for more than a month. The number selected from each sex was equal. The final sample comprised 15,000 residents in Sweden aged 16 to 84 years in the Register of the Total population in 2008 in 24 strata, constructed by cross-classifying three levels of probability of gambling problems, four age groups (16-24, 25-34, 35-64, and 65-84) and sex. The methods and design of the Swelogs study are described in detail in a recent article.(117)

Between October 2008 and April 2009, the Wave I data collection in the Swelogs cohort was carried out through telephone interviews by Statistics Sweden. In addition, postal questionnaires were sent to respondents who could not be reached by telephone, or who preferred the postal survey, until August 2009. The questions in the interview and the postal questionnaire mainly focused on gambling related issues and problem gambling, but also covered a broad range of other health issues, such as alcohol use, psychological distress, as well as demographic and socio-economic circumstances. Additional information about demographic and socio-economic circumstances was gathered from official registers linked to the data by Statistics Sweden. In Wave II, all participants in Wave I who had consented to this were approached again. A telephone interview/postal questionnaire covering the same aspects as in Wave I (slightly shorter), was conducted between December 2009 and May 2010 (postal questionnaires until August 2010). The procedures were the same as in Wave I. Statistics Sweden updated the register variables. The response rates in Wave I & II of the Swelogs cohort, and in the two age groups analysed in the thesis, are shown in Table 4.

**Table 4.** Response rates in Wave I (in 2008/2009) and Wave II (in 2009/2010) of the Swelogs cohort among 16 to 24, and 25 to 44 year-olds, and 16 to 84 year-olds.

Age in 2008:	Wave I			Wave II		
	Sampled	Respondents	Response rate	Respondents	Lost to follow-up	Response rate
	N	N	%	N	N	%
16 to 24 years	5,926	3,592	60.6%*	2,597	995	72.3%*
25 to 44 years	**	2,388	(48%)**	1,708	680	71.5%*
<i>Total: 16 to 84 years</i>	15,000	8,165	54.4%	6,021	2,144***	73.7%

Note: In Study II, our sample consisted of participants aged 16 to 44 years at Wave I, in 2008 or 2009. Here the response rates are presented by age in 2008.

Note\*\*: No information about the response-rate for 25 to 44 year-olds was available at Wave I. Response rate for 25-34 year-olds is provided at Wave I.

Note\*\*\*: Lost to follow-up includes item non-response and partial interviews

#### 4.1.2.2 Sampling and data collection of the In-Depth track: the case-control study

The In-Depth track within Swelogs was initiated in 2011 as a case-control study. The cases were defined as participants in the Swelogs cohort who had ever had problem gambling. Identification of cases was based on information collected in Wave I and II of the Swelogs cohort in two self-assessment instruments of problem gambling: The South Oaks Gambling Screen-Revised Life time measure, used to identify cases with problem gambling occurring ever in life in Wave I. The Problem Gambling Severity Index, used to identify cases with problem gambling occurring in the past twelve months in Wave I and/or II. These instruments are described in detail on pages 26-27. The controls were sampled from Wave II of the Swelogs cohort. The controls were frequency-matched to the cases based on sex and age, with approximately three controls for each case.

The first data collection in the In-Depth track was conducted in 2011. A second data collection has been carried out (until 2015), but the present thesis only uses data from the first interview (in Study IV). Data was collected through telephone interviews among cases and controls between January and June 2011, conducted by the Centre for Psychiatry Research at Karolinska Institutet, and through postal questionnaires among nonrespondents until October 2011. The interviews covered a wide range of gambling related issues, a psychiatric diagnostic assessment, life stressors and adverse events, family and participant socio-demographic aspects. Additional socio-demographic information from official registers was linked to the data set.

In Table 5, the number of cases and controls aged 16 to 24 years in 2008 who participated in the interview in 2011 is shown, among females and males separately. Further, the number of cases that were identified by the SOGS-R Life (problem gambling at any time in life) and the PGSI (problem gambling in the past twelve months) is also shown.

**Table 5.** *The interview of cases and controls in 2011. The response rates among female and male cases and controls, and how the cases were identified; among female and male cases and controls aged 16 to 24 in 2008. The counts are numbers (N), and proportions (%).*

<i>Response rates and identification of cases</i>	<b>Females</b>		<b>Males</b>	
	Cases N=74	Controls N=311	Cases N=157	Controls N=574
Response rate:	64.1%	86.9%	71.0%	84.8%
Identification of cases:				
Problem gambling in the 12 months before Wave I and/or II*	N=37	-	N=98	-
Problem gambling at any time in life except Wave I or II**	N=37	-	N=59	-

Note \*= A score of at least 3 on the PGSI at Wave I and /or II, and a score of 0-20 on the SOGS-R Life time at Wave I.

Note \*\*= A score of at least 3 on the SOGS-R Life time at Wave I, and a score of 0-2 on the PGSI at Wave I and II.



## 4.2 STUDY PARTICIPANTS AND STUDY DESIGN

### 4.2.1 Study I

For Study I, we merged all the samples (national and additional) from the years 2004 to 2007 and restricted the analyses to the 19,016 respondents aged 16 to 24 years (10,569 were females).

Study I had a cross-sectional design, aiming at exploring the association between psychosocial aspects, gambling and problem gambling among young women and men in Sweden. Information about psychosocial aspects - substance use, mental health, social support and violence victimisation - and gambling and problem gambling was retrieved from the postal questionnaire. Additional socio-demographic information was gathered from official register variables that were linked to the data set.

### 4.2.2 Study II

Study II had a cohort design and aimed at estimating the incidence of a first episode of problem gambling among 16 to 24 year-olds in Sweden, by demographic and socio-economic characteristics and gambling frequency, and to compare the incidence of a first episode of problem gambling between 16 to 24 year-olds and 25 to 44 year-olds, and between young women and young men. Secondary aims were to estimate the prevalence of problem gambling, the incidence of recurrent gambling problems, and the recovery from gambling problems in one year among 16 to 44 year-olds in Sweden.

We analysed data from two samples of the Swelogs cohort in the first two waves of data collection, considering Wave I the baseline, and Wave II the follow-up of our analyses. The outcomes were analysed in a *follow-up sample* comprised of the 4,364 participants in both waves, who were 16 to 44 years old in Wave I. Attrition to follow-up was analysed in a *baseline sample* consisting of the 6,060 participants in Wave I aged between 16 to 44 years. Six participants were excluded from analyses: five were omitted because they reported no gambling participation but gave affirmative responses to problem gambling questions during the same twelve month period, and one participant was excluded because of a missing population weight in the data file.

Information about the outcomes was gathered from the interviews in Wave I of Swelogs, and information about socio-demographic characteristics and gambling frequency was gathered from the interviews in Wave II. Additional information about demographic and socio-economic circumstances was retrieved from official registers linked to the data by Statistics Sweden.

### 4.2.3 Study III

In Study III, the aim is to examine the association between final grades in compulsory school and mild and moderate/severe problem gambling among Swedish 17 to 25 year-old women and men.

In a cohort design, we analysed data among the 16 to 24 year-old participants in the first two waves of the Swelogs cohort. Official register information about the exposure, final grades in compulsory school, was linked to the Swelogs data and was considered as Time at Exposure (TE) in our analyses. We followed up the participants for two years, with Time at Follow-up 1 (TF1) being Wave I in 2008/2009, and with Time at Follow-up 2 (TF2) being Wave II in 2009/2010. Consequently, each participant generated two person-years of follow-up time, with two exceptions: 1) Participants aged 16 years in 2008 were not followed at TF1, because TF1 coincided with their final school year; 2) Participants with moderate/severe problem gambling at TF1 were not followed at TF2. The outcome was mild and moderate/severe problem gambling, measured in telephone interviews in the first two waves of the Swelogs cohort. The study design is illustrated in Figure 2 below.

**Figure 2:** Design of Study III. The figure describes how register information about grades in the final school year was linked to the Swelogs data.

Number of study participants (n), follow-up time in person-years (FT) by final school year (TE: Time at Exposure), and by Swelogs data collections with Time at follow-up 1 (TF1) in 2008/2009, and Time at follow-up 2 (TF2) in 2009/2010.										FT:
Age (years): 16	17	18	19	20	21	22	23	24	25	
TE: Final school year 2000 (n=150)								TF1 FT: 150	TF2 FT: 144*	294
TE: Final school year 2001 (n=172)							TF1 FT: 172	TF2 FT: 165*		337
TE: Final school year 2002 (n=136)						TF1 FT: 136	TF2 FT: 130*			266
TE: Final school year 2003 (n=133)					TF1 FT: 133	TF2 FT: 129*				262
TE: Final school year 2004 (n=99)				TF1 FT: 99	TF2 FT: 91*					190
TE: Final school year 2005 (n=103)			TF1 FT: 103	TF2 FT: 90*						193
TE: Final school year 2006 (n=109)		TF1 FT: 109	TF2 FT: 105*							214
TE: Final school year 2007 (n=765)	TF1 FT: 765	TF2 FT: 739*								1,504**
TE: Final school year 2008 (n=574)	TF2 FT: 556*									556**
<b>Total:</b>										<b>3,816</b>

Note \* Participants with moderate/severe problem gambling at TF1 were not included at TF2.

Note \*\*: There was an oversampling of participants aged 16-17 in 2008.

Information about gambling, health behaviours, and socio-demographic circumstances was collected in the telephone interviews of the first two waves of Swelogs. Additional information about socio-demographic circumstances was gathered from official registers linked to the Swelogs data set.

In total, 356 participants were excluded from analyses. First, we omitted five participants who reported no gambling participation, but still reported gambling problems during the same year. Second, we excluded participants who could have attended school abroad because of immigration to Sweden after the age of 15 (n=118) and/or emigration before the age of 16 (n=28). Third, we omitted participants who, according to register information, had received activity (n=174) and/or disability (n=4) benefits because of a disability or health problem. Finally, we excluded participants who had no registered grade score, but still were registered as having at least a secondary school level of education according to official register information (n=31). In total, we analysed data among 2,241 young participants, generating 3,816 person-years of follow-up time (of which females accounted for 1,642 person-years).

#### **4.2.4 Study IV**

The aim of Study IV is to examine whether child/youth maltreatment and affective disorders were associated with problem gambling among 16 to 25 year-old Swedish women and men. A second aim was to study whether there was an interaction between maltreatment and affective disorders in the association with problem gambling.

We analysed data among the 1,116 cases and controls aged 16 to 24 years in the case-control study in 2011 within Swelogs In-Depth track. The number of cases and controls, and the response rates, by females and males in Study IV is shown in Table 5 on page 20. Cases and controls were defined based on information about problem gambling collected in the telephone interviews in the first two waves of the Swelogs cohort (as described previously). We retrieved information about exposures from telephone interviews (postal questionnaires) conducted among cases and controls in 2011. Information about socio-demographic characteristics, and parental mental health was gathered from the interview at Wave I of the cohort, and the interview of cases and controls in 2011, and official registers linked to the data set.

### **4.3 MEASURES**

#### **4.3.1 Outcomes**

The outcomes in the four studies all focused on gambling and/or problem gambling, using information from self-assessment questions or instruments used in the interviews/questionnaires in the Swedish National Public Health Survey and Swelogs. Below follows a description of the questions and instruments used in the Swedish National Public Health Survey and Swelogs, and a definition of the outcomes of each of the four studies.

##### *4.3.1.1 Gambling and problem gambling questions in the Swedish National Public Health Survey*

The Swedish National Public Health Survey covers a wide range of public health issues; therefore, information on each health issue, including gambling, is limited to a few questions.

*Gambling* was measured by one question about any participation in the previous past twelve months that was directed to all respondents and had a dichotomous response alternative (Yes/No).

*Problem gambling* was measured by three questions about problematic gambling behaviour or consequences of gambling: Loss of control, symptoms of abstinence (restlessness or irritability) and lying about gambling. The three questions were administered only to respondents who had affirmed any gambling in the past twelve months. The questions were derived from two established self-assessment instruments of problem gambling, the SOGS (118, 119) and the DSM-IV,(120) that were used in a national survey about problem gambling in Sweden in 1997/1998.(61) Based on analyses from that survey, the Swedish National Institute of Public Health (now: the Public Health Agency of Sweden) selected these questions, assuming they would discriminate well between those with and without problem gambling. The response format in the original questions in the SOGS and DSM-IV was changed in order to resemble the format of other questions in the Swedish National Public Health Survey. Outcome of Study I

In Study I, the outcome was gambling and problem gambling. Following recommendations by the Swedish National Institute of Public Health (now: The Public Health Agency of Sweden), we scored each of the three problem gambling questions in the Swedish National Public Health Survey as “0”, “1” or “2”, and added the scores to a sum-score of 0-6, where a sum-score of 1-6 is supposed to indicate potentially problematic gambling behaviour.(122) We examined the internal consistency (if the questions seem to measure the same concept) by calculating Cronbach’s alpha, which resulted in a value of 0.65. This value is fairly low, given that values over 0.8 are recommended.(121)

Based on the questions about gambling and problem gambling, we defined the outcome in Study I as: *Gambling* in the past twelve months (a sum-score of 0) and *Problem gambling* occurring in the past twelve months (a sum-score of 1-6). We compared these categories with a third category of *Non-gambling*, defined as a negative answer to the gambling question.

#### 4.3.1.2 *Gambling and problem gambling questions or instruments in Swelogs*

The main objective of Swelogs was to study gambling and problem gambling. Therefore, the study contains numerous questions on these topics, including two well established self-assessment instruments of problem gambling: The South Oaks Gambling Screen-Revised Life Time measure (SOGS-R Life) and the Problem Gambling Severity Index (PGSI).

Information about *gambling* was retrieved from a number of questions directed to all respondents in Wave I & II about participation in nine different categories of games: bingo, lotteries, number games, horse racing, poker, sports betting, slot machines, casino games, and TV games. The questions concerned both gambling at any time in life and in the past twelve months. Each category included sub-categories of games in different venues or online. For

example, the category *bingo* included bingo in bingo halls, online and car bingo. The interviewer gave examples of games in each category and clarified that the questions only concerned gambling for money. In Study II-IV, *gambling in the past twelve months* was defined as any participation in any of the nine categories of game in the past twelve months. In Study II and III, information about gambling participation and initiation was used in describing the gambling behaviour of the study participants and in sensitivity analyses.

*Gambling initiation*: Based on information about when the participants first wagered money of their own, from the first interview of the Swelogs cohort, age at gambling initiation was defined as: *16 years or younger* and *at least 17 years (or never)*. For those who did not remember, the information was considered missing. This information was used for a sensitivity analysis in Study III.

To measure *problem gambling at any time in life* the SOGS-R Life was used. The SOGS instrument was originally developed to diagnose pathological gambling in clinical settings among adults.(118, 119) For many years, the instrument was the most used assessment instrument in problem gambling research. In Swelogs, the SOGS-R was included to enable comparisons with the large amount of other studies that have used the instrument, and because it includes questions about gambling problems occurring at any time in life, which other instruments often do not. The psychometric properties of the instrument have been evaluated with satisfactory results in a sample consisting of members of Gamblers Anonymous,(119) and in a representative sample;(123) however, no psychometric evaluations of the SOGS-R are published in Swedish samples.

The SOGS-R comprises 20 questions about symptoms and consequences of problem gambling, derived from clinical criteria of pathological gambling in DSM,(124) perceiving pathological gambling as an addiction. In addition, there are several questions about how the gambling is paid for, for example if it is covered through theft or by borrowing money. Each question is asked twice with two time frames: at any time in life and in the previous twelve months. It is recommended that the questions are scored with “0” or “1”, and adding the scores to a sum-score of 0-20, with a score of at least 5 being considered “probable pathological gambling”, and those with a score of 3-4 as having a gambling problem of lower severity, often labelled “problem gambling”. The last two categories are often collapsed to one to increase statistical power. Study II-IV use information about problem gambling at any time in life based on the SOGS-R Life from Wave I.

To measure *problem gambling in the past twelve months* the PGSI was used in Wave I & II. The PGSI was administered to respondents who had reported any gambling in the past twelve months. The PGSI was developed to measure problem gambling among adults in the general population, and aims to measure problem gambling from a public health perspective, focusing on harm and consequences, including the social and environmental aspects of

gambling problems.(18) The psychometric properties of the PGSI have not been examined in the Swedish population. Studies in other populations find a high internal reliability.(125, 126)

The PGSI consists of four questions about problematic gambling behaviour (for example: betting more than one can afford, borrowing money in order to gamble) and five questions about adverse consequences of gambling (for example: feeling that one has a gambling problem, health problems caused by gambling). In the Wave I data collection, one question about having experienced problems due to gambling in the past year was dropped from the interview by mistake. The Swelogs research team imputed the value of the missing variable using responses from another item, based on an analysis of data from British and Canadian gambling studies.(117) Study II-IV use information from the PGSI at Wave I & II to define the outcomes. Each of the nine questions has four response options scored as: “0”, “1”, “2” or “3”, and the scores are added to a sum-score of 0-27. It is recommended that, based on the sum-score, respondents are categorised into: score of 8 or more = problem gambling; 3–7 = moderate risk gambling; 1-2 = low-risk gambling; and 0 = non-problem gambling. Respondents who have not gambled in the past year are categorised as “non-gambling”.(18). In practice, the categories problem gambling and moderate risk gambling are often collapsed to one, to increase statistical power. In Study II-IV, we collapsed the categories with a score of 3-7 and 8-27 to one category, Problem gambling or Moderate/severe problem gambling, because there were too few study participants with a score of 8-27. The questions and response alternatives of the PGSI are shown in Table 6 below:

**Table 6.** *The questions and response alternatives in the Problem Gambling Severity Index.*(18)

<b>1</b>	How often have you played for more than you can actually afford to lose in the past twelve months?
<b>2</b>	How often have you needed to increase the amount you gamble with in order to get the same feeling of excitement in the past twelve months?
<b>3</b>	How often have you returned another day to attempt to win back what you lost, in the past twelve months?
<b>4</b>	How often have you borrowed money or sold something in order to have gambling money in the past twelve months?
<b>5</b>	How often have you experienced problems due to your gambling in the past twelve months?
<b>6</b>	How often has gambling caused you problems with your health, including stress and anxiety, in the past twelve months?
<b>7</b>	How often has someone criticized your gambling or said that you have problems with gambling in the past twelve months, irrespective of whether or not you felt this was true?
<b>8</b>	How often has your gambling caused financial problems for you or your household in the past twelve months?
<b>9</b>	How often have you had feelings of guilt over having gambled, or what happens when you gamble, in the past twelve months?

*Response alternatives and scoring for each question:* Never = score 0 Sometimes = score 1; Often = score 2; Always = score 3

#### 4.3.1.3 Outcome of Study II

Study II had several outcomes: incidence of first episode of problem gambling, incidence of recurrent problem gambling, recovery from problem gambling and prevalence of problem gambling. We measured the outcomes with the PGSI at Wave II, which was considered follow-up in the analyses. An episode of problem gambling occurring in the past twelve months before the follow-up was defined as a score of 3-27 on the PGSI, and no problem gambling (including non-gamblers) was defined as a score of 0-2.

We considered Wave I baseline in our analyses. The respondents were categorised into the following baseline categories: *Baseline never problem gamblers* (had a score of 0-2 on the SOGS-R Life and 0-2 on the PGSI at baseline, including non-gamblers), *Baseline previous problem gamblers* (had a score of 3-20 on the SOGS-R Life and 0-2 on the PGSI, including non-gamblers in the past year) and *Baseline problem gamblers* (had a score of 3-27 on the PGSI at baseline).

The outcomes of Study II were defined as follows:

*An incidence of first episode of problem gambling* was defined as an episode of problem gambling occurring in the twelve months before the follow-up among Baseline never problem gamblers.

*An incidence of recurrent problem gambling* was defined as an episode of problem gambling occurring in the twelve months before the follow-up among Baseline previous problem gamblers.

*Recovery from problem gambling* was defined as no episode of problem gambling occurring in the twelve months before the follow-up among Baseline problem gamblers.

*Prevalence of problem gambling at the follow-up* was defined as an episode of problem gambling occurring in the twelve months before the follow-up among all participants.

#### 4.3.1.4 Outcome of Study III

In Study III, the outcome was an episode of *Mild* or *Moderate/severe problem gambling* occurring in the past twelve months at Wave I or II. Based on information from the PGSI in Wave I & II, we categorised the participants into three problem gambling categories: *Mild* (score 1-2), *Moderate* (score 3-7) and *Severe* (score 8-27). We compared these categories with a fourth group consisting of participants with no such problems (score 0 and non-gamblers). Because only 14 participants had severe gambling problems, we collapsed the last two categories to: Moderate/severe gambling problems.

#### 4.3.1.5 Outcome of Study IV

In Study IV, the cases were defined as participants in Wave II of the Swelogs cohort who had ever had problem gambling. The cases were identified based on information collected through the SOGS-R Life at Wave I, and the PGSI at Wave I & II. A score of 3 or more on the SOGS-R Life or the PGSI was considered problem gambling, and a score of 0-2 no problem gambling, including in the last category non-gamblers.

### 4.3.2 Exposures

#### 4.3.2.1 Substance use

In Study I, we considered two aspects of *Substance use*, alcohol and cannabis use, gathering this information from the postal survey. *Cannabis use* was defined by one question about cannabis use at any time in life that had a three response alternatives: “Never/More than a year ago/Within the past year”. *Alcohol use* in the past year was assessed by AUDIT-C, a short version of the Alcohol Use Disorders Identification Test that consists of three alcohol consumption questions and that is validated in different samples.(127) Each question is scored 0-4, resulting in a sum-score of 0-12, with higher scores indicating more use. Dawson et al(128) found that among 18-29-year-olds, cut-off scores of 5 for risk drinking, and 5 or 6 for dependency performed well, however they did not differentiate between the sexes. In general, lower cut-off scores are used for women than men.(128) We categorized AUDIT-C into: None to average use (score 0-4 for males, 0-3 for females), high use (5-6 for males, 4-5 for females) and very high use (7-12 for males, 6-12 for females).

Information about alcohol use was also used in Study III, for the purpose of adjusting for confounding. For Study III we retrieved this information from the interviews/postal surveys in the Wave I & II data collection of Swelogs, assessing alcohol use by the AUDIT-C in the same way as in Study I.

#### 4.3.2.2 Mental health

In Study I, we explored the association between mental health and problem gambling. We considered two aspects of mental health, retrieving this information from the Swedish National Public Health Survey: Psychological distress and suicidal ideation/attempts. *Psychological distress* in the past weeks was measured by the short version of the General Health Questionnaire (GHQ-12), that is validated in different cultural settings.(129) The instrument includes 12 questions about symptoms of distress in the past weeks, for example: being able to concentrate on what one is doing, losing much sleep over worry, or feeling capable of making decisions about things. Each question in the GHQ-12 is given a score of 0 or 1, resulting in an index-score of 0-12, with lower scores indicating more psychological distress. We categorized the GHQ-12 score in accordance with recommendations from the Swedish National Institute of Public Health (now: the Public Health Agency of Sweden):(122) High psychological distress (0-2); and Low psychological distress (3-12). To

measure *suicidal ideation/attempts*, we collapsed two questions: 1) “Have you ever been in a situation where you seriously considered committing suicide”; and 2) “Did you ever make a suicidal attempt”. The response alternatives for these questions were “yes/no”, and we considered an affirmative response to one or both of the questions as suicidal ideation/attempts at any time in life.

In Study IV, one exposure was *Affective disorders* and we gathered information about this from the 6<sup>th</sup> Swedish version of the Mini-International Neuropsychiatric Interview (M.I.N.I. 6.0) (130) used in the interview of cases and controls in 2011. In addition, the research team phrased some questions and added these to the interview. M.I.N.I. 6.0 is a structured diagnostic interview of mental health disorders, according to the Psychiatric Diagnostic and Statistical Manual (DSM-IV), and the interview has been validated in several countries.(131) The interview starts with 1-3 screening questions concerning each disorder, continuing to further questions if the first responses are affirmative. We considered the following *affective disorders*: Generalised anxiety disorder, Panic disorder, Social phobia, Post-traumatic stress disorder, and Major depression. Regarding Major depression, the M.I.N.I. covers symptoms previously in life and in the past weeks. For the other disorders, the M.I.N.I. only covers recent symptoms; therefore the research team added questions about symptoms previously in life, following the interview structure of Major depression. We combined the above information about diagnoses into three dichotomous variables (never/ever): *Anxiety disorders* (Generalised anxiety disorder, Panic disorder, Social phobia and/or Post-traumatic stress disorder), *Depressive disorders* (Major depression), and *Affective disorders* (Anxiety and/or depressive disorders). For each disorder we then added information about the respondent’s age at onset of the disorder, and if applicable, the age at first suicidal attempt or ideation, panic attack, and/or symptoms of agoraphobia; upon which two measures were constructed: *Age at onset of affective disorders* (never/age 4-12 years/13-17 years/18-26 years); and *Time at onset of affective disorders*, with the following three categories: 1) *Never*; 2) *Same year or after gambling problem or after 2008* (Same year= 2007/2008 or 2008/2009 for cases, and 2008 for controls); 3) *Before the gambling problem or before 2008*. If the respondent fulfilled the criteria for more than one affective disorder, we defined the age of onset as the youngest age.

In Study III, analyses were adjusted for psychological distress as a potential confounder, retrieving this information from the interviews/postal surveys in the Wave I & II data collection of Swelogs. We defined *Psychological distress* based on the Kessler-6 scale, with six questions assessing non-specific psychological distress in the past four weeks with a sum-score of 0-24. Among adults, many studies classify respondents with scores of 13-24 as having probable serious mental illness and those with scores of 0-12 as not having serious mental illness,(132) and in one study, a cut-off of 5 performed well in assessing moderate mental distress.(133) We defined *no/low psychological distress* as a score of 0-4, *moderate distress* as score 5-12, and *serious distress* as score 13-24.

#### 4.3.2.3 *Final grades from compulsory school*

In Study III, the exposure was school achievement defined as *final grades from compulsory school*. We retrieved this information from official national registers at the Swedish National Agency for Education. During the years 2000 to 2008, when the participants in Study III graduated, each subject in compulsory school was graded as: Not passed=0, Passed =10, Passed with distinction =15, and Passed with special distinction=20, with a total grade score of 0-320. We divided the total grade score into tertiles, including in the lowest tertile nine participants with a grade score of “0” (equivalent to no grade in any subject), and 30 participants with no registered grade.

#### 4.3.2.4 *Violence victimisation, social support, and child/youth maltreatment*

In Study I, we defined *being the victim of violence* in the past year by collapsing two questions in the postal survey in Swedish National Public Health Survey: Subjected to physical violence and subjected to threats. Each question had a dichotomous response alternative, “yes/no”, and an affirmative response to at least one of the questions was considered as having been victimised of violence in the past year.

*Social support* was defined by two questions from the postal survey in the Swedish National Public Health Survey in Study I: 1) *Is there anyone that you can share your private feelings with and confide in?*; and 2) *Can you get help from someone if you have practical problems or fall ill? E.g. get advice, borrow things, help with grocery shopping, repairs, etc.* The response alternatives for the first question were “Yes/no”, and for the second: “Yes, always/Yes, most of the time/No, mostly not/No, never”. We considered the response “yes” to the first question, and/or the response “Yes, always/Yes, most of the time” to the second question as having social support.

In Study IV, one exposure was child/youth maltreatment. We considered four aspects of maltreatment and retrieved this information from the interview of cases and controls in 2011. *Physical neglect* was defined by the two statements: *As a child or teenager: I never lacked what I needed (food, clothing et cetera); I felt safe.* Then, *Emotional neglect* was defined by the following two statements: *As a child or teenager: I felt that people close to me cared for each other; There was always an adult nearby when I needed help or support.* For each of the statements about physical or emotional neglect the response alternatives were “True/In part true/Not true”, and the response “Not true” to one or both questions was considered as physical or emotional neglect, respectively. *Physical abuse* was defined based on the statement: *As a child or teenager: I was at least once physically abused (beaten, held, locked in, et cetera),* and *Sexual abuse* was defined by the statement: *As a child or teenager: I was at least once sexually abused (harassed, forced into sexual acts, et cetera).* The questions about physical and sexual abuse had the response alternatives “True/Not true”, and an affirmative response was considered physical or sexual abuse, respectively. We also combined the information about the four aspects to one variable, *maltreatment*, and considered the response

“Not true” to at least one of the questions about physical or emotional neglect, and/or the response “True” to one or both of the questions about physical and sexual abuse as having experienced child/youth maltreatment. In the combined variable, we used information about the other aspects when information was missing concerning one aspect of maltreatment.

### 4.3.3 Other variables

#### 4.3.3.1 Socio-demographic and economic characteristics of the youth and the family/parents

*Place of Birth/Ethnic Origin:* From the Register of the Total Population, we retrieved information about the participant’s place of birth, the mother’s, and the father’s place of birth. In Study I & II this information was used for the variable *Place of birth* (Sweden/Europe /Elsewhere). In Study II we also considered the *Parent’s place of Birth:* Information about the mother’s and the father’s place of birth from the Register of the Total Population was combined into the categories: At least one in Sweden/Both immigrants. When one parent’s origin was unknown, the category for the known parent was used, and if both were unknown the information was considered missing. In Study III & IV, we combined all three variables into *Ethnic origin* with the categories: Born in Sweden with Swedish parents/Born in Sweden with one or two immigrated parents/Not born in Sweden. When one parent’s origin was unknown, the category for the known parent was used. If both parents were unknown, the participant’s origin was used.

*Occupation/Labour market status:* This information was retrieved from the Longitudinal integrated database for studies on health insurance and labour markets. In Study I, the variable *Occupation* was used with the following categories: Unemployed, pensioner, sick-leave/ Student /Employed, and in Study II we had the following categories of the variable *Occupation:* Student/Employed/Unemployed/Sick leave or disability (includes long term sick leave, rehabilitation, and disability pension). For Study III & IV, information from several variables was combined into one variable, *Labour Market Status*, with the following categories: Student/ Working /Unemployed. In Study III & IV, the category of participants on sick leave, rehabilitation or parental leave were omitted from analyses because of the low number of participants in that category.

*Living situation/Living with parents:* In Study I, information about *Living situation* (living with parents /on one’s own /with partner) was gathered from the Longitudinal integrated database for studies on health insurance and labour markets. In Study II, III & IV, information about whether the participant *lived with parent(s)* or not was from the first interview/postal survey of the Swelogs cohort.

*The Household disposable income:* Information about the household disposable income from the Longitudinal integrated database for studies on health insurance and labour markets from year 2006 was used in Study I, and from year 2008 in Study II, III & IV. The variable

includes all sources of income (employment, social welfare, unemployment benefits, and other subsidies) and was categorised according to quartiles: Low = lowest quartile; average = second and third quartile; and high = the highest quartile. In Study III & IV, we present the income measure for households with or without parents separately, retrieving this last information from Wave I of the cohort.

*Household Financial Problems:* In Study II, information about how the household managed financially in the past 12 months from Wave I of the Swelogs cohort was categorised into: Manages well (makes all payments/has no financial obligations)/Financial problems (sometimes or often financially troubled/behind with payments).

*Parents' level of Education:* In Study IV, based on information from the interview of cases and controls in 2011 where the respondents were asked about number of years of education the parents had, we defined the parents' level of education as: Primary school or less (0-9 years)/At least one secondary school (10-12 years)/One parent university (13 years or more)/Both university. If one parent's level of education was unknown, we used the information from the other parent. If both parents' level of education was unknown, the information was considered missing.

#### 4.3.3.2 *Gambling frequency*

In Study II, we were interested in gambling frequency. Respondents who reported that they had participated in any gambling activity were asked about their gambling frequency in Swelogs; how often and on how many gambling activities the participants had gambled in the previous 12 months. Gambling frequency was defined as *non- or infrequent gamblers* (no gambling/few games/monthly but on one game only) or *high frequency gamblers* (at least weekly and/or on several games).

#### 4.3.3.3 *Mental health of parent(s)*

In Study IV, we were interested in the *parents' mental health*. Based on information from the interview of cases and controls in 2011 of whether someone in the respondent's family had a mental health problem (including substance abuse), we constructed a dichotomous variable of *Parental mental health problem*: No/Yes, one or both parents.

## 4.4 STATISTICAL ANALYSES

### 4.4.1 Measures of occurrence (Study II)

The outcome analyses in Study II were performed among the 4,364 participants aged 16-44 years who participated in the first two waves of the Swelogs cohort.

First, incidence proportions of a first episode of problem gambling and of recurrent problem gambling, and proportions of recovery, and prevalence of problem gambling were calculated; in the two age groups of interest (16-24 and 25-44 year-olds), by socio-demographic

characteristics, and gambling frequency. Second, sex-stratified incidence proportions of a first episode of problem gambling were calculated among 16-24 year-olds only.

Then we analysed attrition to follow-up and differences in follow-up time among all 6,060 participants aged 16 to 44 years in Wave I of the Swelogs cohort.

In order to examine if attrition was selective, socio-demographic characteristics of the participants in Wave I & II, and among those lost to follow-up, were compared in three groups based on information about problem gambling at baseline (baseline problem gamblers, baseline previous problem gamblers, and baseline never problem gamblers).

Incidence proportions of first episode problem gambling between participants with different lengths of follow-up time were compared, because a shorter follow-up time than twelve months could lead to underestimations of this association.

We calculated standard errors with Taylor series linearization and probability values with Pearson's Chi square.

#### **4.4.2 Analyses of associations between potential risk factors and gambling and/or problem gambling (Study I, III and IV)**

In Study I and III, we analysed the association between exposures and gambling and/or problem gambling in multinomial logistic regressions, a variant of logistic regression that handles dependent variables with more than two levels. In Study IV, we applied a logistic regression for dichotomous dependent variables.

In Study I, the association between psychosocial aspects and gambling and problem gambling was analysed in two models. First, we performed univariate analyses served to select psychosocial variables that were significantly associated with gambling or problem gambling at a probability level of 0.10. In model 2, the selected variables were then further analysed multivariately. Three of the considered confounders influenced the associations of interest (changed the estimates by 10% or more) and were included in the model: Age, place of birth and occupation. Standard errors were calculated with Taylor series linearization.

In Study III, the association between school grades and mild and moderate/severe problem gambling was estimated in five models adjusting for potential confounders (age, ethnic origin, household income, alcohol use and psychological distress). We also conducted an age-stratified analysis (17-19 or 20-25 years in 2009) of the same association. Confidence intervals are based on the standard maximum-likelihood variance estimator (MLE). Using a clustered sandwich estimator, allowing for intragroup correlation, we controlled for whether the MLE estimator was appropriate for the analyses. Small differences were found between the two estimates, indicating that the residuals were uncorrelated with the independent variables in the model; therefore, the MLE was retained.

In Study IV, the associations between maltreatment and affective disorders and problem gambling were adjusted for design variables and potential confounders in three models (age, family socio-economic circumstances, parental mental health, and maltreatment or affective disorders). We also estimated the associations between time of onset of affective disorders and problem gambling in a subsample where cases who only had gambling problems prior to the first wave of Swelogs were excluded.

#### *4.4.2.1 Interaction*

In Study IV, interaction between the two exposures in the association with problem gambling was assessed by the Synergy Index. Interaction was defined as departure from additivity of effects, and the Synergy Index was calculated as the ratio between the combined effect and the sum of the separate effects of the exposures. The Synergy Index is equal to 1.0 when there is additivity of effects, while scores over or less than 1.0 indicates interaction.(134, 135)

#### *4.4.2.2 Attributable fraction*

In Study IV, we calculated the attributable fraction for each exposure, that is the proportion of cases in the population that can be attributed to each exposure, as: The proportion of cases that is exposed\*  $(RR - 1)/RR$ .(136)

#### *4.4.2.3 Sensitivity analyses*

In Study III, we performed a sensitivity analysis in a subsample without history of gambling problems, using a first episode of problem gambling as outcome. This analysis was assumed to further establish the temporal order between school grades and gambling problems.

In Study IV, we conducted a sensitivity analysis in a subsample where cases 19 years old or younger and cases that only had gambling problems prior to the first wave of Swelogs were excluded, estimating the association between maltreatment until the age of 19 years and problem gambling from age 20 to 25 years. This analysis was assumed to establish the temporal order between maltreatment and gambling problems.

### **4.4.3 Potential confounders**

In all four studies, the main analyses were stratified by the study participants' sex (male/female). Further, all main analyses were adjusted for, or stratified by the study participants' age, because several of the covariates/exposures and problem gambling can be assumed to be associated with the participant's age.

In Study III & IV, the potential influence of school achievement and child/youth maltreatment on problem gambling could vary depending on both the participants' age and on time passed since the time of the exposure. Adjustment for age was also important because young people were initially oversampled in Swelogs, and in the case of Study IV, the controls were frequency matched to the cases based on age (and sex).

In Study I, III and IV, the analyses were adjusted for ethnic origin and socio-economic situation (labour market status, living situation, household financial situation, and parents' level of education), since these factors can be assumed to be associated with several of the exposures (137-142) and with problem gambling.(13, 143)

In Study III, the analyses were adjusted for the participants' alcohol use and psychological distress, because these behaviours have been associated with gambling problems,(1) and school achievement previously.(144)

Finally, in Study IV, the parents' mental health was taken into account, given that parents' mental health has previously been found to be associated with the exposures of interest, child maltreatment,(145) and affective disorders,(142) as well as problem gambling.(143)

#### **4.4.4 Calibrated population weights**

In Study I-III, calibrated population weights were used in analyses. These weights were calculated by Statistics Sweden as a product of a design weight and a non-response weight, multiplied by an adjustment factor. The adjustment factor accounts for auxiliary socio-demographic information about the population found in national official registers, such as sex, age, place of birth, civil status, income, residential area, employment status, level of education, profession, social welfare, sickness benefit, unemployment, and employment branch. The weights correct the sample to the known population, and minimize bias due to non-response.(146) In the case of Study I, the weights take into account the fact that we pooled several samples. Concerning Study II and III, that use Swelogs data, the weights also account for the stratified sampling procedure in Swelogs.

#### **4.5 ETHICAL CONSIDERATIONS**

Both in the Swedish National Public Health Survey and Swelogs respondents are informed of the data linkage of official registers and how data will be used and stored through letters attached to postal questionnaires or delivered to respondents' postal address attached to the postal survey or prior to a telephone interview. Participation in the surveys is considered informed consent to these procedures.

The Ethical Committee at Karolinska Institutet approved Study I (2010/5:10), and the Ethical Committee at Umeå University approved Study II-IV (Dnr 08-078 Ö and Dnr 2010-350-32Ö).

## 5 RESULTS

### 5.1 INCIDENCE OF FIRST EPISODE PROBLEM GAMBLING, RECOVERY, RECURRENT PROBLEM GAMBLING AND PREVALENCE OF PROBLEM GAMBLING (STUDY II)

We found that the incidence proportion of a first episode of problem gambling in one year was 2.3% (95% confidence interval: 1.5-3.4) among youth aged 16 to 24 years. The incidence was three times higher among young men (3.3; 2.2-5.0%) than women (1.1; 0.4-3.1%). Further, among female adolescents, 16 to 18 years, the incidence was quite high (2.2; 0.7-6.8%) compared to females 19 to 24 years (0.3; 0.1-1.1%), while among young men, the incidence proportion was similar in the two age groups (3.4; 2.1-5.5% and 3.3; 1.7-6.1%). Further, among 25 to 44 year-olds, the incidence of a first episode of problem gambling was 0.8 (0.4-1.6) %, and the estimates were similar between the sexes.

A first episode of problem gambling was associated with high frequency gambling, in particular among youth. However, most new problem gamblers at follow-up were none or low frequency gamblers at baseline, regardless of age. For young women, young age and household financial problems were associated with first episode problem gambling.

Young male new problem gamblers were more likely to have gambled monthly on poker (at a Casino or privately), bingo (in a bingo hall or car bingo), or at the Casino at baseline, compared to other young men. Among young women, high frequency gambling, in particular on Electronic Gambling Machines (EGMs), poker, or sports betting, was associated with first episode problem gambling.

A high proportion (76.2; 64.9 to 84.7%), of the 16 to 44 year-olds who had problem gambling at baseline had recovered at the follow-up. Recovery proportions were particularly high among women and adults aged 25 to 44 years. Further, the incidence of recurrent problem gambling at the follow-up was also high (13.9; 7.5-24.3%) among 16 to 44 year-olds, in particular among men. The prevalence of problem gambling at the follow-up was three times higher among men (3.9; 2.9-5.2%) than women (1.1; 0.6-2.1%), and twice as high among youth (4.1; 3.1-5.5%) than adults (1.8; 1.2-2.8%).

## **5.2 POTENTIAL RISK FACTORS FOR PROBLEM GAMBLING AMONG YOUNG WOMEN AND MEN (STUDY I, III & IV)**

### *5.2.1.1 The association between psychosocial aspects and gambling and problem gambling among young Swedish women and men (Study I)*

In Study I, we found that several of the examined psychosocial aspects were associated with gambling and/or problem gambling, when adjusted for the study participants' age, place of birth, and occupation, but with notable sex differences.

For men, the higher the past-year alcohol use, the higher was the likelihood of gambling and problem gambling in the past year (odds ratio: 3.9, 95% confidence interval: 2.2-7.1). Furthermore, violence victimisation in the past year was associated with problem gambling among men, but not women (OR 2.3, 1.4-4.0).

For women, a high alcohol use was associated with a lower probability of problem gambling (OR: 0.1, 0.1-0.4), compared to no alcohol use. A poor mental health, in terms of psychological distress in the past weeks (OR 6.2, 2.1-17.6) and suicidal attempts/ideation at any time in life (OR 2.9, 1.2-7.2), was strongly associated with problem gambling among women.

### *5.2.1.2 The association between compulsory school grades and problem gambling among young women and men (Study III)*

The main analysis showed that final grades in school at the age of 16 were associated with an increase in mild and moderate/severe problem gambling at 17 to 25 years of age, adjusted for socio-demographic characteristics, psychological distress and alcohol use. Young women with low grades had eight times the odds of moderate/severe problem gambling (OR 8.6, 1.7-42.5), compared to women with high grades. The corresponding estimate for men was 2.0 (0.9-4.6).

In females, adjustment for socio-demographic characteristics and psychological distress decreased the estimates of the association between school grades and moderate/severe problem gambling, and adjustment for alcohol use increased the estimates. This change in estimates was not seen for men. Further, females with low and average grades had high levels of psychological distress.

Age-stratified analyses showed that in adolescent females aged 17 to 19 years, both low and average school grades, compared to high grades, were associated with moderate/severe problem gambling. In females aged 20 to 25 years, only low grades increased moderate/severe problem gambling. It should be noted, however, that few women had moderate/severe problem gambling, which is reflected in wide confidence intervals for these estimates.

Among men, there were large differences between the age groups. In adolescent males, low school grades were associated with an increase of mild gambling problems. In 20 to 25 year-old men with low grades, incidence proportions of moderate/severe problem gambling were high, as were proportions of unemployment. Among adolescent men with low and average grades, high proportions had initiated gambling before the age of 16 years.

A sensitivity analysis of the association between final grades and a first episode of problem gambling showed that the overall associations as reported remained, with minor differences in point estimates, but with wider confidence intervals.

#### 5.2.1.3 *The association between child/youth maltreatment, affective disorders and problem gambling among young women and men (Study IV)*

The main analysis showed that child/youth maltreatment and affective disorders were associated with problem gambling in females (OR 2.2, 1.1-4.3, and OR 2.3, 1.2-4.4) and males (OR 1.5, 0.9-2.6, and OR 1.5, 0.9-2.5), adjusted for socio-demographic circumstances, parental mental health, and maltreatment/affective disorders. However, the confidence intervals for the estimates among males are wide and include “1”. In total, 27.6% of female cases could be attributed to maltreatment, and 34.4% to affective disorders. The corresponding attributable fractions for males were lower: 9.8% and 9.1%.

The specific aspects of maltreatment and affective disorders that were associated with problem gambling differed between the sexes, with emotional neglect and anxiety disorders for females, and physical abuse and depression for males.

A sub sample analysis showed that for women, the risk of problem gambling was high if the affective disorder had started *before* the episode of problem gambling occurred. For men, a strong association with problem gambling was seen when the affective disorders had started *the same year or later than* the gambling problem, compared to no affective disorder or that the affective disorder started before the gambling problem.

A sensitivity analysis of the association between maltreatment until the age of 19 years and problem gambling between 20 and 25 years showed that the above reported association of maltreatment and problem gambling remained for females, but not for males.

Further, the risk of problem gambling was increased among females who had experienced both child/youth maltreatment and had had an affective disorder (Synergy index 1.9; 0.5-7.3), adjusted for socio-demographic variables and parental mental health. This increase was not seen in males. Among males, a combined exposure seemed to be associated with a slightly lower risk of problem gambling in the adjusted model (Synergy index 0.4; 0.1-2.5). However, these estimates are imprecise, with wide confidence intervals, for both females and males.

## 6. REVIEW OF STUDY I-IV

Study	Aims	Study population	Design	Outcomes	Exposures, confounders, stratification	Main findings
I	To explore the associations between psychosocial health, gambling and gambling problems among Swedish 16-24 year-olds. Second, to study whether there were any sex differences in these associations.	A representative sample of 19,016 Swedish 16-24 year-olds from the Swedish National Public Health Survey in 2004 to 2007.	Cross-sectional study	Gambling and problem gambling	Exposures: Substance use, poor mental health, victim of violence, social support. <b>Confounders:</b> Age, gender, occupation, living situation, household disposable income. <b>Stratification</b> by sex.	For males, <b>high alcohol use</b> and being the <b>victim of violence</b> were associated with gambling and/or problem gambling. For females, <b>a poor mental health</b> was associated with problem gambling.
II	To estimate the incidence of first episode problem gambling among Swedish 16-24 year-olds, by demographic and socioeconomic characteristics and gambling frequency. Second, to compare the incidence of a first episode of problem gambling between 16-24 and 25-44 year-olds and between young women and men. Third, to estimate the proportions of recovery and incidence in recurrent problem gambling, and prevalence of problem gambling among 16-44 year-olds	The 16-44 year-olds (n=4,358) in Wave I & II in the representative Swelogs cohort.	Cohort study	Incidence of a first episode of problem gambling Recovery from problem gambling Incidence of recurrent problem gambling Prevalence of problem gambling	<b>Outcome presented by:</b> Gambling frequency, gambling initiation, place of birth, parents' place of birth, occupation, lives with parents; household disposable income, household financial problems. <b>Stratification</b> by sex and age group.	<b>Incidence of first episode problem gambling</b> was higher among 16-24 than 25 44 year-olds, and higher among young men than women. <b>Individual transitions in one year</b> , from problem gambling to recovery, and from recovery to recurrent problem gambling, were common among 16-24 and 25 44 year-olds.
III	To examine the association between school grades at the age of 16 years and problem gambling at the age of 17-25 years among Swedish females and males.	The 16-25 year-olds in Wave I & II in the representative Swelogs cohort (3,816 person-years of follow-up time).	Cohort study	Mild and moderate/severe problem gambling	<b>Exposure:</b> Register linked final grades from compulsory school. <b>Confounders:</b> Age, ethnic origin, labour market status, living with parents, household disposable income, psychological distress, alcohol use. <b>Stratification</b> by sex and age group.	<b>Low and average grades in compulsory school</b> at age 16 years, compared to high grades, were associated with higher risk of mild and moderate/severe problem gambling at ages 17-25 years.
IV	To examine whether child/youth maltreatment and affective disorders were associated with problem gambling among 17 to 25 year-old women and men in Sweden.	231 cases and 885 controls aged 16-24 years selected from Wave I & II of the representative Swelogs cohort.	Case-control study nested in cohort	Problem gambling	<b>Exposures:</b> Affective disorders and child/youth maltreatment. <b>Confounders:</b> Age, ethnic origin, labour market status, living with parents, household disposable income, parents' level of education, parents' mental health, maltreatment/affective disorders. <b>Stratification</b> by sex.	Maltreatment and affective disorders were associated with problem gambling for both sexes. Specifically, problem gambling was associated with <b>emotional neglect and anxiety disorders</b> for females, and <b>physical abuse</b> and <b>depression</b> for males. While the exposures seemed to precede problem gambling for females, maltreatment and affective disorders seemed to occur in the same year as, or after, the gambling problem for males.

## 7 DISCUSSION

The thesis focuses on problem gambling among young people in Sweden. The occurrence of problem gambling – incidence of a first, and a recurrent, episode of problem gambling, recovery, and prevalence of problem gambling – is one of the main aspects in focus. Another issue in focus is potential risk factors for young people’s problem gambling. Moreover, differences between the sexes are a main focus throughout the thesis.

The main findings can be summarised as follows:

The incidence of a first episode of problem gambling was higher among 16 to 24 year-olds than 25 to 44 year-olds, and higher among young men than young women. Individual transitions in problem gambling in one year, from problem gambling to recovery, and from recovery to recurrent problem gambling, were common both among 16 to 24 and 25 to 44 year-olds. Recovery proportions were higher among 25 to 44 year-olds than 16 to 24 year-olds, and higher among females than males.

Several potential risk factors were associated with gambling and/or problem gambling among Swedish youth, but with notable sex differences.

For females, a poor mental health, in terms of psychological distress in the past weeks and suicidal ideation/attempts ever in life, was strongly associated with problem gambling in the cross-sectional Study I. For males, there were strong associations between a high alcohol use and violence victimisation in the past year, and gambling and/or problem gambling.

There was a strong and graded association between final grades in compulsory school at the age of 16 years and moderate/severe problem gambling at 17 to 25 years of age among women. Among men, low and average final grades in compulsory school were associated with a higher risk of mild gambling problems for adolescents, and with moderate/severe problem gambling for 20 to 25 year-olds.

Child/youth maltreatment and affective disorders were associated with problem gambling for both sexes. Specifically, emotional neglect and anxiety disorders were associated with problem gambling for females, while the corresponding associations for males concerned physical abuse and depression. However, while the exposures seemed to precede the gambling problem in time for the females, for the males, the maltreatment and the onset of affective disorders seemed to occur in the same year as or after the problem gambling.

## 7.2 INTERPRETATIONS OF MAIN FINDINGS

### 7.2.1 The occurrence of problem gambling among young people in Sweden

We found that the incidence of first episode problem gambling was higher among youth, aged 16 to 24 years, than among adults 25 to 44 years, and higher among young men than young women. To our knowledge, the incidence of a first episode of problem gambling has not been estimated in a nationally representative sample before. However, our estimates are consistent with numerous studies showing similar sex and age differences in the *prevalence* of problem gambling.(1, 47, 59, 68)

#### 7.2.1.1 *A comparison between youth and adults*

One potential interpretation of the difference between age groups in the incidence of first episode problem gambling is that it reflects a change over time. Recent generations could have a higher risk of gambling problems than previous generations due to changes in society that influence gambling activities, such as an increasing online gambling in the 21<sup>st</sup> century. Consistent with this interpretation, two reviews of prevalence studies in the US find higher prevalence estimates of problem gambling in studies conducted in recent years compared to studies from the 1970s.(59, 60)

Alternatively, the risk of developing problem gambling could be higher in young years than in adulthood, reflecting a general peak in risk-taking or deviant behaviours in adolescence as compared to other periods in life.(147, 148) Consistent with this interpretation, a recent study in an Australian sample shows that initiating gambling before 18 years of age leads to a faster progression to problem gambling, compared to a later gambling onset.(3)

Further, the higher *prevalence* of problem gambling among youth than adults reported in numerous studies,(1, 47, 59, 68) including Study II of this thesis, could be explained by a higher incidence of first time problem gambling among young people than adults, and by the fact that many young people “mature out of”, or recover from, their gambling problems when they enter adulthood. According to Moffitt,(148) only a small group of adolescents persist with deviant behaviours throughout adulthood.(148) However, few studies have examined the course of problem gambling over time in young people and findings are inconclusive regarding whether maturing out of gambling problems occurs or not.(70, 71, 149). Our findings suggest that the higher prevalence of problem gambling among Swedish youth than adults is explained by a higher incidence of a first episode of problem gambling and a lower recovery from problem gambling among youth than adults.

#### 7.2.1.2 *A comparison between young women and men*

Our finding that the incidence of first time problem gambling was more than twice as high among young men than young women is in agreement with several studies showing similar sex differences in the prevalence of problem gambling.(1, 47) One possible explanation for

this sex difference could be that the young men gamble more frequently than young women, as observed in Study I & III. In agreement with this interpretation, a recent study in the Swelogs cohort showed that Swedish women and men aged 16 to 84 years were as likely to have a gambling problem – if they gambled regularly – but that the prevalence of regular gambling was almost twice as high among men as among women.(150)

However, we found that monthly gambling was only associated with first episode problem gambling for young women, not for young men. While this finding suggests that regular gambling is not associated with new gambling problems for young men, it is also possible that the progression from low to high frequent gambling and further to problem gambling occurs fast, and that the follow-up period of twelve months was too long in order for us to capture these changes. Our observation that most youth with first time gambling were non/low frequency gamblers at baseline suggests that the progression from low gambling to problem gambling may be fast for some youth.

An alternative interpretation is that it is gambling on games with a “high risk potential”(83) that leads to an increased risk of problem gambling, and further that young men gamble more on such “high risk games” than young women. Some of our findings indicate that gambling on games with a high risk potential may be associated with problem gambling among youth. In Study II, youth with first time problem gambling had a higher gambling on games with a fairly high/high risk potential: Poker, bingo, and Casino games for men, and EGMs, poker, or sports betting for women. Further, in Study III, young men had an overall high participation on such games, in particular EGMs, poker, sports betting and Casino games. Young women in Study III only had a high participation in on such game, EGMs, and that was only among young women with low or average school grades. Accordingly, it seems possible that the higher gambling activity on games with a high risk potential among young men than women, may be associated with a correspondingly higher incidence of problem gambling. However, this potential interpretation does not explain why young men participate in “high risk” gambling to a higher extent than young women.

Another sex difference was that having financial problems in the household was associated with a first episode of problem gambling for young women, but not for young men. This finding is similar to the association between problem gambling and unemployment seen among women in Study I, and suggests that problem gambling may be associated with social problems for young women.

As mentioned, we found a high incidence proportion of first time problem gambling among adolescent females aged 16 to 18 years; almost as high as the corresponding proportion among adolescent men, which is in contrast to studies showing that the onset of gambling and problem gambling generally occurs later in life for women than men, and after adolescence.(3, 151)

However, some studies in US samples show that the prevalence of problem gambling among women has increased over time, which is related to an introduction of Casinos and EGMs.(64, 65) As mentioned, we found that young women with new gambling problems had a relatively high participation in games with a high risk potential:(83) EGMs, poker and sports betting. This gambling preference is in contrast with findings from a previous study showing that Swedish women in general gamble on chance games, such as lottery or scratch tickets, and that EGM:s, poker and sports betting generally are preferred by men.(66)

Our findings suggest that if a similar increase in problem gambling occurs among women aged 16 to 44 years in Sweden; this increase is mainly among the adolescent women. These findings should be taken with caution, however, given that the number of adolescent female problem gamblers in our study was very low; the estimates of the incidence proportions among adolescent females were hence imprecise.

### *7.2.1.3 Recovery and recurrent problem gambling*

In agreement with previous studies among youth and adults,(70-76) we found that individual transitions in problem gambling in one year, from problem gambling to recovery, and from recovery to recurrent problem gambling, were common among youth and 25 to 44 year-olds. However, most previous studies have focused on recovery; fewer studies in representative samples have examined recurrent problem gambling (relapse). Our findings show that not only is recovery common, but so is recurrent problem gambling.

## **7.2.2 Potential risk factors for problem gambling among Swedish young women and men**

Several of the potential risk factors examined in Study I, III and IV were indeed associated with problem gambling among Swedish youth. However, there were also notable differences between young women and men, with respect to which specific aspects that were associated with problem gambling, and the time order between exposures and outcome.

### *7.2.2.1 A poor mental health and alcohol use*

Most previous studies regarding the association between mental health, substance use and problem gambling among youth show that depression, suicidal ideation/attempts, and substance use co-occur with problem gambling among youth of both sexes.(1, 2) The few studies that have examined sex differences in this association in representative samples, find that substance use and depression co-occur with *problem gambling* among adolescents of both sexes,(113) but that alcohol use and depression is only associated with *gambling* for females.(6) These studies contrast our findings, that alcohol use and depression are associated with problem gambling for men, and that psychological distress, suicidal ideation/attempts and anxiety disorders are associated with problem gambling for females. It is possible, however, that some of the differences are due to differences in measurement. For example, the measure for problem gambling that we used in Study I was based on three questions and

it is uncertain to what extent these questions captures problem gambling, or what aspect of problem gambling they may capture. Further, our samples comprised 16 to 24 year-olds, while the previous studies mentioned had samples with only adolescents. Further, in Study I, the analyses were cross-sectional and no conclusions about the time order between exposures and outcome can be drawn.

In Study IV, we performed a sensitivity analysis of the time order between the onset of the affective disorder and problem gambling. This analysis showed that an onset of an affective disorder was associated with an increased risk of later problem gambling for females. For males, however, the association between affective disorders and problem gambling seemed to be such that the events occurred in the same year, or that the affective disorder had its onset after the gambling problem. Further, we saw that a relatively high number of men with problem gambling reported that they had an onset of depression between 18 to 26 years of age, compared to men without gambling problems. This suggests that it is possible that depression is a consequence of the gambling problem, rather than a risk factor for problem gambling, for young men.

Longitudinal studies in representative youth cohorts examining the association between depression and problem gambling are scarce. In one cohort, a weak link between depression and problem gambling was found for men who were also low in impulsivity,(114) and in a cohort that comprised boys in a low socio-economic area, impulsivity explained the emergence of an association between depression and problem gambling in adolescence, but later, the association between depression and problem gambling was direct and mutual.(115) These studies suggest that the association between depression and problem gambling among young men that we observed may be due to shared risk factors, among these possibly impulsivity.

Moreover, a handful of longitudinal studies in representative youth samples show that substance use/abuse predict problem gambling for both sexes.(4, 99) and that impulsive and risk-taking behaviour increase the risk of co-occurring problem gambling and substance abuse (and delinquency) among men,(107) suggesting that the association between alcohol use, gambling and problem gambling that we found among men could be explained by impulsivity as a mutual risk factor.

An alternative interpretation of the association between alcohol use, gambling and problem gambling among men is that it could reflect that gambling frequently takes place in restaurants, night clubs, bars, and casinos, where alcohol is consumed. Moreover, the games in these establishments are in general such that they are considered to have a high risk potential,(83) for example EGMs or Casino games, which could in part explain the association between alcohol use and problem gambling. Moreover, some experimental studies suggest that drinking alcohol while gambling may lead to a higher betting,(152, 153) more rapid losses,(152) and an increased time spent gambling.(153)

Our findings among young women, that a poor mental health was strongly associated with problem gambling and further that an onset of affective disorders seemed to be associated with a higher risk of later problem gambling, are consistent with the General Theory of Addictions and the Pathways model of Problem and Pathological Gambling. These theories/models hypothesize that emotional problems predispose people to problem gambling.(40, 43) Gambling is viewed as an attempt to relieve a chronic stress condition or to escape from reality,(40) or to regulate unpleasant emotions.(43) However, some studies among adults show that problem gambling predicts an onset of affective disorders for both sexes,(154, 155) and it is suggested that impulsivity and poor emotional regulation may be shared risk factors for psychiatric problems, including gambling problems.(155)

#### *7.2.2.2 Final grades in compulsory school*

In Study III, we found that lower final grades in compulsory school were associated with an increased risk of mild and moderate/severe problem gambling at age 17 to 25 years for both women and men. The association between school achievement and gambling has only been examined in three longitudinal studies before. In two cohorts, low school grades were associated with problem gambling,(4) or gambling (98) in young adulthood, while in another cohort an association between academic failure and problem gambling was only present when the analyses were adjusted for age and sex, not when adjusted for a wide range of risk and protective factors.(99) One explanation for the differences between studies may be differences in the outcome measures, as well as the exposure. Moreover, in contrast with the other two mentioned studies; we examined the sexes separately, finding a stronger association between school grades and problem gambling for females than males.

The hypothesis in the General Strain Theory, that life stressors that cause emotional distress, or frustration may lead to deviant behaviours as a way of coping with the strain,(36) is verified by our findings of an association between lower school grades and problem gambling. According to the General Strain Theory, life events that are perceived as unjust, or are associated with circumscribed opportunities or a sense that one has failed, are particularly likely to cause strain.(37) Neglect or abuse by parents, unemployment, and poor school achievement are examples of such life stressors that may lead to emotional distress and to subsequent coping through deviant behaviours.(37) Hence, also consistent with the hypothesis in the General Strain Theory, are our findings in Study II that household financial problems were associated with first episode of problem gambling among females, and in Study IV, where we found that emotional neglect was associated with problem gambling among females.

However, an alternative interpretation of the association between lower school grades and problem gambling is that there is a reciprocal process, where low socio-economic circumstances and emotional problems lead to lower school achievement, causing further social problems and emotional distress, and gambling as a way to cope with the distress. In

continuation, intense gambling may lead to a lack of context and meaning in life, and contribute to more stress and emotional problems, and gambling may become problematic.(14)

### 7.2.2.3 *Child/youth maltreatment*

In Study IV, we found an overall association between child/youth maltreatment and problem gambling for both sexes, but the specific aspects of maltreatment associated with problem gambling differed between the sexes, with emotional neglect for females and physical abuse for males. While emotional neglect has not been found to correlate with problem gambling among youth before, some studies have associated physical abuse with problem gambling. However, in contrast with our findings, these studies show that physical abuse is associated with problem gambling among women only,(156) or that intimate partner or family violence is associated with problem gambling for both sexes.(116) Our findings are consistent, however, with Study I, where violence victimisation was associated with problem gambling only among men.

Our sensitivity analysis concerning the time order between maltreatment and problem gambling suggested that these events may occur close in time among the 16 to 24 year-old men. An alternative explanation for this link among young men is that it reflects the higher risk of violence that young men have of being exposed to violence in public places,(157) which may also include gambling venues. This interpretation is in line with the previous interpretation of alcohol and gambling occurring together in night clubs, bars and Casinos.

For women, however, maltreatment before the age of 20 years seemed associated with a higher risk of gambling problems at age 20 to 25 years. This finding is consistent with the General Theory of Addictions and the Pathways model of Problem and Pathological Gambling, hypothesizing that adverse life events may lead to problem gambling, and that gambling is a way of coping with emotional distress.(40, 43) A slightly different explanation for this finding is proposed by the hypothesis in the General Strain Theory, i.e. that rejection by parents may cause serious strain because it threatens a child's needs and identity.(37) While we did not examine parental rejection, emotional neglect could include rejection by parents. Further, according to the General Theory of Addictions, it is the combined effect, or interaction between, adverse life events and affective disorders that lead to problem gambling. Consistent with this, we found that a combined exposure of maltreatment and affective disorders was associated with an increase in problem gambling, compared to the sum of the effects of the two exposures, for females.

Unexpectedly, however, we found an antagonistic interaction between maltreatment and affective disorders in the association with problem gambling for males. However, a relatively small number of male cases reported an onset of affective disorders before 13 years of age. If

the potential underreporting occurred among male cases that also had experienced maltreatment, it could explain the unexpected antagonistic interaction among the males.

### **7.2.3 Further interpretations of the sex differences**

One focus throughout this thesis has been potential sex differences in the occurrence of problem gambling and in risk factors for problem gambling. We have found notable differences between young women and men in all four studies, however, the interpretations of the associations between potential risk factors and problem gambling have discussed in previous sections, have not broadened the understanding of these sex differences, for example, why young men gamble on “high risk games”, or why certain risk factors are only associated with female problem gambling.

One potential explanation for these sex differences is that genetic factors have a different impact on gambling in young women and men. However, as previously mentioned in the review of risk factors in Chapter 2, while studies among adults suggest that both genetic and environmental factors contribute to problem gambling,(100, 101) the few existing studies in youth samples are inconclusive regarding the genetic contribution to young people’s gambling.(103, 104)

Another potential explanation for the sex differences is that while gambling can be viewed as a “normative” behaviour for young men, as a part of a developmentally accepted pattern of risk-taking behaviours in young years, for young women, gambling can be viewed as a deviant behaviour, that may lead onto a developmental path with severe social and psychological problems.(6) This is in agreement with our findings that while young men participated in more gambling on games with a high risk potential overall, among young women, a relatively small proportion gambled on such games, and only if they had low and average school grades. It is also consistent with our finding that young women with household financial problems had a particularly high incidence of first episode of problem gambling.

Hence, conforming to social norms of engaging in risk-taking behaviours could lead to young men having an overall higher risk of developing gambling problems. This interpretation seems to coincide with the previous suggestion that the association between alcohol use, violence victimisation/physical abuse, gambling and/or problem gambling among young men may be due to gambling in environments where alcohol is consumed and where there is a high risk for young men to be victims of violence (bars, night clubs, and Casinos).

Further, one potential explanation for how young women would engage in gambling, in particular, is found in research about substance use. It is suggested that poor childhood relationships, including parental neglect or low parental monitoring, may lead to a lower ability in children to adapt to different social contexts. This in turn causes difficulties in relations and may link adolescents with emotional problems to deviant peers who may offer

opportunities to engage in substance use, and model substance use as a way to cope with emotional distress.(158, 159) Applying this model to our findings suggests that parental neglect (maybe reflected in emotional neglect) links females with anxiety disorders to deviant peers, who offer gambling opportunities and promote gambling as a way to cope with distress. This explanatory model seems to fit in well with our finding that emotional neglect and anxiety disorders were associated with problem gambling for females, and suggests that the way to gambling for young women would be through the peer group.

Other potential explanations for the observed sex differences found in research about substance use focuses on gendered coping behaviours. According to two research reviews, adolescent substance abuse is predicted by maltreatment in childhood for females, and by maltreatment in adolescence for males,(160, 161) similar to our findings with sex differences in the time order between maltreatment and problem gambling. An explanation for this sex difference regarding maltreatment and adolescent substance abuse is that in childhood, coping behaviours are developed in accordance with socially acceptable behaviours: internalising behaviours for girls and externalising for boys. When maltreatment occurs in childhood, girls cope with the emotional distress through internalising behaviours, such as substance use, while boys cope with their distress through externalising behaviours.(160) Further, according to a recent study, the coping behaviours used by boys may lead to a diminishing impact of maltreatment over time, while the coping behaviours used by girls may lead to an increasing impact.(162) Consequently, it is possible that the impact of child maltreatment has diminished by adolescence in males, but not in females, due to different coping behaviours.

Moreover, an explanation for the association between maltreatment in adolescence and adolescent substance abuse for males (160, 161) focuses on the process of maturing out of risk-taking behaviours. Maturing out of risk-taking behaviours is expected to occur in young adult years in order to comply with society's expectancies of becoming more responsible.(148) It is hypothesized that maltreatment in adolescence may lead to a delay in maturing out of substance abuse for men.(160) If this applies to problem gambling, it means that maltreatment in adolescence, possibly physical abuse/victimisation of violence, leads to young men continuing with a problematic gambling behaviour rather than maturing out of it. However, while this hypothesis is parallel with the notion of gambling as a normative risk-taking behaviour, longitudinal studies in the gambling area show inconclusive findings with respect to whether maturing out of gambling problems occurs or not.(70, 71, 149)

## 7.3 METHODOLOGICAL CONSIDERATIONS

### 7.3.1 Epidemiological methods

In this thesis, one ambition has been to study problem gambling among youth in nationally representative samples, using epidemiological methods in the study design and in the analyses. However, Swelogs was designed as a multi-purpose study with an interdisciplinary approach, rather than an epidemiological study. While this is one of the advantages of Swelogs, it has also carried some limitations when applying epidemiological methods to the material. In the following paragraphs, I will discuss how the ambition to apply epidemiological methods, based on data from a multi-purpose study, fell out in Study III and IV.

#### 7.3.1.1 *Study III: A cohort design*

In Study III, we were interested in examining whether school achievement was associated with later problem gambling. Register-based compulsory school grades for all participants in Wave II of the Swelogs cohort were available to us, and we decided to base Study III on the Swelogs cohort, applying a cohort design to our analyses. In a cohort study, a group of people with certain exposure characteristics but without the outcome in question are followed up to identify the occurrence of one or more outcomes. In the case of Study III, the study population was the 16 to 24 year-olds in the representative Swelogs cohort, and the outcome was mild and moderate/severe problem gambling.

The exposure in a prospective cohort study is generally ascertained at baseline (and sometimes also at follow-ups), and the outcome is measured continuously or at subsequent follow-ups. However, in Study III, the exposure (register-linked school grades at age 16 years) was measured before Swelogs was initiated in 2008/2009, since the final year in school for our study participants occurred from year 2000. Therefore, we were able to follow-up the study participants concerning the outcome at Wave I of Swelogs (not only in Wave II). The exposure was considered Time at Exposure (TE), with Time at follow-up 1 (TF1) being Wave I of Swelogs in 2008/2009, and Time at follow-up 2 (TF2) being Wave II in 2009/2010.

Having two follow-ups, rather than one, allowed us to base our analyses on follow-up time instead of number of study participants. As a consequence, each study participant contributed with two person-years in the analysis, with some exceptions. The 556 participants who were 16 years old in 2008 could contribute with one year in the analyses (TF2). If we had based the analyses on number of study participants, these participants would have been excluded completely, because exposure and outcome coincided at TF1.

A consequence of linking school grades to this cohort, in which the age ranged from 16 to 24 years at Wave I of Swelogs, was that for the older participants several years had passed since TE at TF1. For example, a participant who was 24 years old at TF1 had graduated from

school in year 2000, which means that we lacked information about the outcome for seven years. Ideally, all study participants would have been followed up from graduation and onwards, thereby all incidences of problem gambling could have been ascertained. We addressed this problem, in part, by stratifying our analysis by age group.

Another consequence of the design is that we could not separate time from age; a potential association between school grades and problem gambling could depend on time elapsed since graduation and/or on the age of the study participants.

Further, the fact that we used Wave I of Swelogs as our first follow-up resulted in a limitation related to how problem gambling was measured at TF1. Our outcome was measured by the PGSI, which asks questions about events in the past twelve months. However, the PGSI does not define the onset of these potential events; therefore we did not know whether the study participants had gambling problems at initiation of the follow-up. Accordingly, a study participant considered to have a gambling problem at TF1 could have had a gambling problem already when attending compulsory school, in which case the temporal order between exposure and outcome could not be separated. One way of avoiding this potential problem would be to examine the onset of problem gambling at TF2, as we did in Study II when estimating the incidence of a first episode of problem gambling. However, that design had other undesirable consequences. First, we would only have one follow-up (TF2), losing the advantages previously mentioned with two follow-ups. Second, given our observation in Study II that a high proportion of problem gamblers recovered in one year, it is unlikely that many study participants would have an ongoing gambling problem for several years. Restricting the analyses to first episode problem gambling at TF2 could lead to an underestimation of gambling problems, in particular among the older study participants. Rather than using the restricted analysis as main analysis we opted for using it as a sensitivity analysis, allowing us to confirm the time order between exposure and outcome, but at the same time using more of the available information in our main analyses.

#### *7.3.1.2 Study IV: A case-control study in the Swelogs cohort*

In Study IV, we were interested in examining the hypothesis that adverse life events and emotional disorders predispose people to problem gambling. The case-control interview in 2011 contained information about maltreatment in childhood and young years, and affective disorders (including the age of onset), therefore we decided to base Study IV on the case-control study in Swelogs.

The case-control study is sometimes nested within a well-defined cohort study, but even if not, the cases should always be seen as identified within a cohort, which in turn is defined as a group of people without the outcome at the start, who are followed up with regard to the occurrence of the outcome. The cases can be either prevalent or incident cases. Prevalent cases are existing cases at a certain time point, with an unknown onset of the outcome, while

incident cases are new cases occurring within the follow-up period. Incident cases are generally preferred in etiologic studies, for several reasons. One is that among prevalent cases, those that have had the outcome for a long time may be overrepresented, since those who have recovered or did not survive are not prevalent cases anymore; thereby the exposure could be associated with survival or with long duration of the outcome. With incident cases, the association between exposure and the development of the outcome can be examined specifically.

In Swelogs, the outcome was primarily measured with the PGSI that asks questions about consequences of gambling and problematic gambling behaviour occurring in the past twelve months. However, in the case-control study, cases were also identified based on the scores of the SOGS-R Life, which concerns consequences and behaviours occurring at any time in life. Hence, both instruments that were used to define the cases in Study IV measure gambling problems in retrospect; in the past twelve months or at any time in (the past) life.

The cases that were identified based on the PGSI are incident when the episode of gambling problem started within the follow-up period or prevalent when the gambling problem was already present when the follow-up period started. Unfortunately, the distribution of incident and prevalent cases based on the PGSI is not known in Wave I.

The cases that were identified based on the SOGS-R Life at Wave I, did not have any problem gambling in previous twelve months, but at some time previously in life. In total, 50% of the female cases, and 38% of the male cases in Study IV were identified based on the SOGS-R Life. For these cases, we cannot know if the exposure occurred before or after the gambling problem.

In Study IV, we considered restricting our analyses to: 1) Cases with an episode of problem gambling occurring in the twelve months before Wave I or II - prevalent or incident cases; 2) Cases with an incidence of a first episode of problem gambling at Wave II. However, both options resulted in low statistical power, due to the low number of cases, so we decided to stay with the case-control study design as it was originally planned when the Swelogs data collection was organised. Consequently, our analyses in Study IV are partly cross-sectional. We addressed the problem with the case definition in a sensitivity analysis in the first restricted sample above.

The controls in a case-control study should be sampled from the same population as the cases, and still be at risk of developing the outcome. Moreover, the controls should be representative of the source population. If this is achieved, the distribution of exposures among the controls reflects the distribution in the source population, resulting in similar estimates of the association between exposure and outcome as if it had been a cohort study. In a case-control study nested in a cohort, as in Swelogs, the controls can be sampled at the end of the study period or at the same time as the cases. A consequence of the latter procedure,

with simultaneous or incidence-density sampling, is that a control at one follow-up could become a case at another follow-up, and that time at risk can be taken into account in the analyses.

In the case-control study in Swelogs, the controls were sampled from respondents still at risk at the end of Wave II, and frequency matched based on sex and age (3:1), a so called prevalent control sampling design. Some of the disadvantages of sampling prevalent controls are related to follow-up. First, loss to follow-up may result in the controls no longer being representative of the study population. Second, if certain factors have affected loss to follow-up, these factors have also influenced the selection of controls. Moreover, if those factors would also be associated with exposure and outcome, the estimate of the association between exposure and outcome could be biased. Further, in Study IV, the sampling of controls for the cases that only had a history of gambling problems took place after the gambling problem occurred in time, which means that the controls may not be representative of the source population.

### **7.3.2 The outcome measures**

#### *7.3.2.1 Measuring problem gambling among youth with measures developed for adults*

An important issue concerning the outcome measures used in this thesis, is that the instruments/questions were not developed to measure gambling problems among young people. It has been suggested that instruments for adults should not be used for youth.(7, 163) The instruments designed to specifically measure problem gambling among adolescents, often use other definitions/thresholds for problem gambling than instruments for adults.(52, 53) For example, in a “broad definition” of adolescent problem gambling suggested by Winters et al.,(164) daily gambling in the past year, regardless of the score on the adolescent version of the SOGS-R, is sufficient in order for an adolescent to be considered a problem gambler.(164) However, it should also be noted that because there is no agreed upon definition of adolescent problem gambling,(7, 24) it is not possible to determine whether one classification of adolescent problem gambling is better than another.

#### *7.3.2.2 A comment on terminology*

The categories that we call Mild and Moderate Problem gambling in Study III, are originally called Low and Moderate *risk* gambling.(18) I have deliberately omitted the word “risk” in the definition of the outcomes in this thesis, because in my opinion it is conceptually confusing to use the word “risk” for an outcome. In epidemiology, the risk of a health problem is equivalent to the incidence, and refers to the probability of a health problem in a specified period of time.(134) The word risk is also used as in “risk factor”, referring to a factor associated with an increase in the outcome. Hence, risk is conceptually distinct from an outcome.

### 7.3.2.3 *General concerns about the instruments/questions*

While the psychometric properties of the PGSI have been evaluated in representative samples with satisfactory results,(125, 126) according to Svetieva and Walkers,(165) these evaluations are based on circular reasoning; the PGSI is compared with the same instruments from which eight of the nine questions were derived. Therefore, a high correlation between these instruments is expected, but it is not indicative of classification accuracy.(165) This limitation does not only apply to the PGSI, but also to other problem gambling instruments, such as the SOGS, according to Shaffer and Korn.(166)

The instruments/questions that are used in this thesis retrieve information retrospectively; concerning the past twelve months (the PGSI and the questions in the Swedish National Public Health Survey) or any time in life (the SOGS-R Life), which may lead to recall bias. For example, in Study II, poor recall of gambling problems previously in life at Wave I, could have caused a misclassification: some participants considered to have a *first* episode of problem gambling at Wave II should have been classified as having a *recurrent* episode of problem gambling. As a consequence, the incidence proportion of a first episode of problem gambling may have been overestimated.

Further, the twelve month time frame of the PGSI and the questions in the Swedish National Public Health Survey, does not clarify when the episode of gambling problem occurred; in the beginning of the twelve months, at the end, or if there were several episodes during the same twelve month period. Accordingly, while the proportion of problem gambling measured by the PGSI generally is considered a measure of the prevalence of problem gambling (for example in Study II in this thesis), this proportion does not really meet the definition of the prevalence as an “existing state” of problem gambling.(134)

The PGSI and the questions in the Swedish National Public Health Survey were only administered to study participants who had gambled in the past year, following common practice in gambling research. However, it is possible that some people experience consequences of earlier gambling episodes for some time after having stopped gambling, in which case they should maybe be considered to have a gambling problem. In fact, this may already be the case, considering that it is possible to affirm to both gambling and problem gambling in the same interview without referring to gambling and problem gambling occurring simultaneously within the twelve month period.

In Study II-IV, we categorised a score of 3-27 as Problem gambling or Moderate/severe problem gambling. Because there were too few study participants with a score of 8-27 we could analyse that category separately. While this is common practice in research,(60) a recent study by Currie et al.(167) has shown that while the PGSI differentiates well between a score of 0 and a higher score, and between a score of 8-27 and a lower score; the instrument is less successful in discriminating between a score of 1-2 and 3-7.(167) Consequently, a cut-off 3 for problem gambling may not be optimal.

In Study III, we analysed Mild problem gambling with a score of 1-2 on the PGSI as outcome, which is consistent with the lower “thresholds” for adolescents’ gambling problems, than for adults’ gambling problems often applied in research.(52, 53) However, in Study II and IV, analysing it was not feasible to have Mild gambling problems as an outcome. In Study II, when calculating the incidence proportion of a first episode of problem gambling, the baseline sample could have no history of gambling problems. Accordingly, a low threshold for the outcome (a score of 1 instead of 3) would result in a lower threshold for a history of gambling problems; and consequently in a too small baseline sample. In Study IV, the controls and cases were originally sampled as Non-problem gamblers (score 0-2) and Problem gamblers (score 3-27). Had we re-classified the controls with a score of 1-2 to cases, we would have lost controls (and thereby statistical power). Further, many study participants with a score of 1-2 in the Swelogs cohort had not been selected as controls. For these reasons, we decided to use the original case definition in Study IV. This means however, that among the Non-problem gamblers in Study II and IV, there may be some study participants that have Mild gambling problems.

### **7.3.3 Strengths & limitations**

While there is a growing body of research about problem gambling among young people, the research field has been dominated by cross-sectional studies mainly conducted in school or treatment seeking samples from the US, Canada or Britain.(1) This thesis broadens the research area by studying problem gambling in two large representative Swedish samples, allowing us to generalize the findings to the youth population in Sweden.

While research consistently report large sex differences in the prevalence of gambling and problem gambling, in particular among youth, few studies have examined sex differences in the associations between risk factors and problem gambling among youth. Our large sample sizes allowed for stratified analyses of the sexes, which is normally not possible due to the low number of young women who gamble or have gambling problems. These analyses have added to previous research by showing that several of the examined risk factors are differently associated with problem gambling for young women and men.

There is a general lack of studies concerning the first episode of problem gambling in representative sample. The longitudinal design of Swelogs made it possible to estimate the incidence of first episode problem gambling in a nationally representative youth sample for the first time.

The data sources that we have used, the Swedish National Public Health Survey, Swelogs, and official registers, have provided us with a large amount of data of high quality. The official register variables that were linked to the data sets had no recall bias, self-selection and little missing.

However, there are also some limitations to consider with respect to the methodology.

### 7.3.3.1 Attrition

Both the Swedish National Public Health Survey and Swelogs had quite low response rates, and in Swelogs there was considerable loss to follow-up. One problem with attrition is that generalizability may decrease. However, in Study I, II and III, we used population weights in our analyses that to some extent reduce bias due to non-response.(146)

In Swelogs, loss to follow-up at Wave II was higher in groups in which problem gambling is generally most prevalent in the population: men,(68) youth,(1) and individuals with a low socio-economic status.(13) Similarly, in the Swedish National Public Health Survey, young men had a lower response rate than young women, and in Study IV, the cases had a lower response rate than controls. This selective attrition could lead to underestimations of the prevalence/incidence of gambling and/or problem gambling, which in turn would affect the estimates of recovery, recurrent problem gambling, and first episode problem gambling in Study II.

If the exposures were associated with attrition equally as the outcome, the associations between exposures and outcomes could be diluted. For example, in Study III there was a higher attrition among men and individuals with a low socio-economic status, among whom, generally, school grades are lower (137) and the prevalence of problem gambling is higher.(13, 68) However, if attrition is differently associated with the exposure and the outcome, the associations could be biased.

### 7.3.3.2 Retrospective and self-reported retrieval of information

With the exception of the register variables, information used in this thesis was self-reported in telephone interviews or postal surveys in retrospect. As a consequence, the information may be biased, for example due to social desirability, comprehension of the questions, or poor recall. Again, if information is biased equally in exposure and outcome, this could lead to diluted associations. For example, previous studies show that retrospective retrieval of information about adverse experiences in childhood (49) and of problem gambling ever in life (51) may lead to underestimations of the prevalence, which could influence the associations between maltreatment and problem gambling in Study IV.

Further, if information is biased differently in exposures and outcomes, it may lead to biased associations. For example in Study IV, we observed that very small number of male cases reported an onset of affective disorders before 13 years of age. If this potential underreporting occurred among male cases that also had experienced maltreatment it could explain the unexpected antagonistic interaction between maltreatment and affective disorders that we observed among the males.

In Study III & IV, we used the SOGS-R life time to define our subsamples for sensitivity analyses. The intention was to exclude study participants considered to have a gambling problem ever in life according to the SOGS-R life time from analyses, thereby limiting the

risk of reversed causation. If there was an underestimation of “life time problem gambling”, possibly due to recall bias, the risk of reversed causation remains to some extent, in particular among the older study participants.

#### 7.3.3.3 *Cross-sectional analyses*

Study I had a cross-sectional design; as a consequence, we cannot draw any conclusions about the direction of the observed associations between the examined exposures and the outcome. Further, as previously discussed, due to how cases and controls were sampled in Study IV, Study IV can also be considered partly cross-sectional in its analyses. However, we were able to perform a sensitivity analysis of the age of onset of affective disorders and a first episode problem gambling as outcome, and between maltreatment before the age of 20 years and problem gambling occurring after the age of 20 years, showing that the exposures seemed to precede the outcome in females but not in males.

#### 7.3.3.4 *Confounding*

We adjusted for several possible confounders in our analyses. We had access to socio-demographic information from official registers, and we also had interview/questionnaire information about factors from different time points in life.

Register-based information has certain advantages, such as no recall bias, self-selection and little missing. However, information from official registers is limited to some extent, among young study participants. For example, some variables only include information about residents in Sweden from 18 years of age. Further, it is often unclear whether the information reflects the family of origin or the young person. Because young people are often registered at their parents’ home, even though they may be living somewhere else, we were in some instances not able to separate information about the family of origin from information about the young person. We addressed this problem by adjusting for if the youth lived with their parents or not (self-reported information). Moreover, in Study IV, we had information about the parents’ level of education from an interview.

One problem with some of the confounders that we adjusted for is that we cannot establish the temporal order between the possible confounder and exposure and outcome. This concerns for example psychological distress and alcohol use in Study III, where we observed that the associations between school grades and problem gambling changed slightly after adjustment for psychological distress and alcohol use, in females. In Study III, we suggested that it is possible that the association between psychological distress, alcohol use, school achievement, social problems and gambling problems is reciprocal.

In Study I, we adjusted for all the exposures in the adjusted model. Such a mutual adjustment has been suggested to lead to misinterpretations of the associations of interest.(168) While the choice of exposures and potential confounders for the adjusted model in Study I was

conventional (based on p-values and the discrepancy between unadjusted and adjusted estimates of the associations of interest), it would perhaps have been better to have selected fewer covariates and identified potential confounders based on prior assumptions of causal relations.

In Study IV, we did not consider alcohol a potential confounder in the associations of interest, given that the exposures could be assumed to increase the risk of both problem gambling and substance use, according to the General Theory of Addictions (40) and according to previous studies.(160, 161) However, considering the previously mentioned interpretation that gambling, physical abuse and alcohol may be linked among young men, it is possible that alcohol use is an unmeasured confounder in the association between physical abuse and problem gambling in Study IV.

## **7.4 CONCLUSIONS**

While previous research shows that the prevalence of problem gambling is higher among young people than adults, there is limited knowledge about the onset of and the risk factors for youth problem gambling. Moreover, studies consistently show large sex differences with respect to gambling and problem gambling,(1, 6, 7) in particular among adolescents. Yet, few studies have examined sex differences in youth problem gambling.

This thesis contributes to the research field as summarized:

1. The incidence of a first episode of problem gambling has not been estimated in a representative youth sample before. We found that the incidence of a first episode of problem gambling was three times higher among young men (3.3; 2.2-5.0%) than young women (1.1; 0.4-3.1%).
2. Our findings suggest that the higher prevalence of problem gambling among Swedish youth aged 16 to 24 years than adults aged 25 to 44 years is explained by a higher incidence of a first episode of problem gambling, and lower proportions of recovery among youth than adults.
3. Young men had a higher gambling participation than young women overall, and in particular in games associated with a higher risk of problem gambling.
4. For young women, frequent gambling and household financial problems were associated with first episode problem gambling.

5. Several of the examined risk factors were differently associated with problem gambling for young women and men:
  - For young women, affective disorders (anxiety), lower compulsory school grades, and child/youth maltreatment (emotional neglect) were associated with an increased risk of later gambling problems, and hence, seemed to be risk factors for problem gambling.
  - For young men, lower compulsory school grades were associated with an increased risk of later problem gambling, and seemed to be a risk factor for problem gambling.
  - However, alcohol use, maltreatment (physical abuse/violence victimisation), and affective disorders (depression) seemed to occur simultaneously with, or after the gambling problem for young men, and consequently, do not seem to be risk factors for problem gambling for young men. It is possible that the observed associations are due to mutual risk factors, or that they are consequences of a gambling problem; however, this is unclear.
6. Our findings, with large sex differences in the aetiology of problem gambling among Swedish youth, indicate that it is relevant to separate between the sexes in analyses of young people's problem gambling.

In sum, young men in Sweden seem to have an overall increased risk of problem gambling compared to young women, which could be associated with a higher gambling participation among young men than women, in particular in "high risk games". Moreover, our findings suggest that the path to problem gambling may be, at least in part, different for young women and men. While for both sexes, lower school achievement was a risk factor for problem gambling, for young women, so were affective disorders and child/youth maltreatment (in particular emotional neglect).

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