



# Impulsivity, risk gambling, and heavy episodic drinking among adolescents: A moderator analysis of psychological health



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## ABSTRACT

**Introduction:** Adolescence is associated with an increased inclination for risk behaviors, like gambling and heavy episodic drinking (HED). While impulsivity is a well-documented risk factor, the purpose of this study is to explore if there are variables modulating this association. The study examined the effects of impulsivity and psychological health on risk gambling and HED, and whether psychological health functions as a moderator, i.e., protective factor.

**Methods:** Data was extracted from the Stockholm School Survey, collected in 2014 and 2016 among students in the ninth grade of primary school (15–16 years) and second grade of upper secondary school (17–18 years) in Stockholm ( $n = 21,886$ ). Impulsivity, psychological problems, risk gambling, HED, and a number of socio-demographic control variables were measured using self-report data. The statistical method was binary logistic regression.

**Results:** Results showed that risk gambling (3.4%) and HED (22.8%) were prevalent among Swedish pupils. Impulsivity and—to a weaker extent—psychological problems as well as several sociodemographic variables were risk factors for risk gambling and HED. Furthermore, psychological problems negatively moderated the association between impulsivity and HED among girls.

**Conclusions:** This study supports evidence that impulsivity represents a risk factor for risk behaviors, and—contrary to the a priori hypothesis—indicates that the association between impulsivity and HED in female students might be attenuated by the presence of psychological problems. Prevention measures should particularly address adolescents exhibiting the mentioned risk factors and aim at reducing psychological problems, but not necessarily target the adolescents showing impulsivity and psychological problems simultaneously.

## 1. Introduction

Mental and behavioral health problems among adolescents are a growing concern in Europe (WHO, 2017, 2018). Internalizing disorders, such as depression and anxiety, represent the most common mental disorders among 15–19-year-olds, followed by behavioral disorders and substance use disorders (SUDs) (WHO, 2018). Globally, mental disorders and SUDs are the primary cause of disability in children and adolescents (Erskine et al., 2015). Childhood and adolescence are critical phases in the life course of individuals for mental health, affecting not only the mental health at later stages of life, but arguably also the mental health of the next generation (WHO, 2017, 2018). Against this background, it is important to promote the mental health of young people, and prevent mental health problems from an early stage on.

In comparison to children and adults, adolescents are more inclined to engage in risk taking behaviors (Duell & Steinberg, 2019), such as heavy episodic drinking (HED) and gambling. The prevalence of alcohol use by youth has decreased in numerous countries since the turn of the millennium, but there are indications that heavier drinking groups are not included in this downward trend (Pape, Rossow, & Brunborg, 2018, for a review). Worldwide around 16.0% of alcohol drinking adolescents aged 15 years or older engage in HED, which can be defined as consumption of six or more alcoholic beverages on at least one occasion at least monthly (WHO, 2014). HED is associated with short term consequences, such as acute intoxication, injuries or violence, but also with long term health problems (Oesterle et al., 2004; WHO, 2014).

Despite of age restrictions in most jurisdictions, gambling is a common activity among young people and problem gambling is

**Abbreviations:** SUD(s), substance use disorder(s); HED, heavy episodic drinking; SSS, Stockholm School Survey

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considered as an increasing public health issue in adolescents (Messerlian, Derevensky, & Gupta, 2005; Wardle, 2019). According to a recent systematic review of international studies since 2000, the prevalence of problem gambling among youth amounts to 0.2–12.3% (Calado, Alexandre, & Griffiths, 2017). Gambling can be regarded as a continuum with the gradations “no gambling”, “social gambling”, “at-risk gambling”, and “problem gambling” (Turchi & Derevensky, 2006). (At-)risk gambling refers to gambling with some negative consequences, such as social, financial or health-related problems, and problem gambling can be defined as gambling with severe or more serious negative consequences and problems (Public Health Agency of Sweden, 2014). Gambling disorder—previously included in the section of Impulse-Control Disorders—was moved to the chapter Substance-Related and Addictive Disorders in the fifth revision of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, APA, 2013) due to comprehensive research on the relationship between gambling and SUDs indicating similarities in symptomatology, comorbidity, common genetic vulnerabilities, etc. (see Petry et al., 2014, for a review). In line with this step toward a more transdiagnostic and dimensional perspective on addiction, underlying transdiagnostic concepts have been examined (Brooks, Lochner, Shoptaw, & Stein, 2017). A well-known construct, which appears to play an integral role in the development and maintenance of addiction, is impulsivity (Brooks et al., 2017; Ouzir & Errami, 2016; Verdejo-García, Lawrence, & Clark, 2008). According to the International Society for Research on Impulsivity (n.d.), “impulsivity has been variously defined as behavior without adequate thought, the tendency to act with less forethought [...] or a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions”. Impulsive behaviors are heightened during adolescence (Argyriou, Um, Carron, & Cyders, 2018) probably due to imbalanced maturations of different brain regions (Crone & Dahl, 2012). Neural development over the life span is assumed to influence decision making processes, which in turn affect the susceptibility for substance use (Argyriou et al., 2018). An extensive body of literature shows an association between impulsivity and alcohol dependency (among other SUDs) as well as problem gambling, and moreover, suggests impulsivity to be a common risk factor for those disorders (Loree, Lundahl, & Ledgerwood, 2015; Verdejo-García et al., 2008). Since the potential to decrease impulsive personality traits through psychotherapeutic interventions appears to be limited (Hershberger, Um, & Cyders, 2017), it stands to reason to explore other psychological variables possibly involved in this association and easier to be changed.

According to the Health Behavior in School-aged Children study, 29% of 15-year-old girls and 13% of 15-year-old boys in Europe reported “feeling low more than once a week” (Inchley et al., 2016). A systematic review of international studies suggested an increase in internalizing problems among adolescent girls in the 21st century, whereas for boys the findings were mixed (Bor, Dean, Najman, & Hayatbakhsh, 2014). Scandinavian studies found a close link between various forms of psychological problems, like low life satisfaction, depressed mood or anxiety, and alcohol consumption among young people (Hagquist & Rydelius, 2013; Malmgren, Ljungdahl, & Bremberg, 2008; Strandheim, Holmen, Coombes, & Bentzen, 2009). As for gambling, Fröberg, Hallqvist, and Tengström (2013) showed that psychological distress and suicidality were associated with higher probabilities of problem gambling among young women. In turn, psychological health can function as a buffer to addiction, as was demonstrated for self-esteem and meaning in life in the relationship between impulsivity and internet addiction (Zhang et al., 2015). Furthermore, boys tend to engage more in externalizing behaviors, like drinking or fighting, and girls are more inclined to react in an internalizing way (Inchley et al., 2016), implying that gender—among other sociodemographic variables—has a strong effect on the occurrence and manifestation of mental health problems and addiction.

About half of all lifetime mental disorders have their onset in the

mid-teens (Kessler et al., 2007; WHO, 2018), indicating that adolescence is a sensitive and crucial episode in life. For the prevention of mental ill-health enhanced knowledge on risk factors is needed. The purpose of the present study is therefore to identify individual factors associated with risk behaviors among youth, in order to develop prevention and intervention measures targeting particularly those adolescents who are at risk. To the best of our knowledge there are no studies exploring the association between impulsivity, psychological health and risk gambling respectively alcohol consumption among youth at the same time. This study aims to investigate the effects of impulsivity and psychological health on risk gambling and HED in 15–18-year-old students while also taking account of sociodemographic factors. In particular, it was examined if adolescents' psychological health moderated the potential association between impulsivity and risk gambling/HED. It is hypothesized that (1) impulsivity and psychological problems both represent risk factors for risk gambling and HED, and (2) psychological health acts as a protective factor by attenuating the association between impulsivity and risk gambling/HED.

## 2. Methods

### 2.1. Data material

The data material was extracted from the Stockholm School Survey (SSS), a survey conducted biennially among students in the ninth and final grade of primary school (ages 15–16 years) and in the second grade of upper secondary school (in the following referred to as 11th grade; ages 17–18 years) in all public schools and several independent schools in Stockholm, Sweden. The survey consists of a standardized paper-pencil questionnaire with 101 questions including subquestions. It is carried out at one occasion in spring term in the classroom during lesson and handed over to the class teacher in sealed envelopes. Besides questions on sociodemographic factors, the questionnaire comprises various topics, such as risk behaviors including alcohol use, gambling, drug use, smoking, etc., but also questions on personality characteristics and psychological health. For this study the data of the surveys performed in 2014 and 2016 were merged. The response rate in 2014 was 76% and in 2016 78% (Stockholm Municipality, 2016), leading to a total sample size of  $N = 26,585$  (2014:  $n = 12,540$ ; 2016:  $n = 14,045$ ). Participants with missing values on the variables risk gambling, HED, impulsivity, psychological health, and/or on any of the control variables were excluded from the analyses, resulting in a final study sample of  $n = 21,886$  (corresponding to 82.3% of the original sample).

The SSS is conducted anonymously by the students and contains no information on personal identification. According to the decision of the Regional Ethical Review Board of Stockholm (Ref. No. 2010/241–31/5), analyses of data from the SSS are therefore not subject to consideration.

### 2.2. Measures

#### 2.2.1. Dependent variables

*Risk gambling* was assessed using three subquestions which were posed only to students who ticked “Yes” to a previous item addressing gambling in the past year (“Have you bought lottery tickets or gambled for money at any time during the last 12 months?”). Adolescents were asked: “How many times during the last 12 months have you...”: a) “...tried to reduce your gambling?” b) “...felt restless and irritated if you haven't been able to gamble?” c) “...lied about how much you've gambled?”, and requested to mark one of the response categories “Never”, “1–2 times” or “3 times or more” (Kjellström, von Saenger, Jarl, & Modin, 2018). Based on the three subquestions one dichotomous overall measure of risk gambling was constructed: Participants who responded at least “1–2 times” to any of the three subquestions were classified as engaging in risk gambling, while those who responded “Never” to all three subquestions (and those who stated that they had

not gambled at all in the last 12 months) were classified as not engaging in risk gambling. A previous study using this definition of risk gambling revealed a prevalence rate of 3.5% (Brolin Låftman, Alm, Olsson, Sundqvist, & Wennberg, 2019), which is in line with other studies on risk gambling in Sweden (Sundqvist, Rosendahl, & Wennberg, 2015). In order to validate the measure, internal consistency of the set of items (Cronbach's  $\alpha = 0.66$ ) was examined and exploratory factor analysis (EFA) was conducted. A principal component analysis was performed and based on the Kaiser-criterion and scree plot one factor was extracted. This factor explained 60.7% of the variance with factor loadings ranging from 0.68 to 0.83.

*Heavy episodic drinking* (HED) was captured by the item "How often do you drink the following amounts of alcohol at any one time: 18 cl spirits or a whole bottle of wine or four large bottles of strong cider/alcohol or four cans of class III beer or six cans of class II beer" (Kjellström et al., 2018). The response categories were "Do not drink alcohol", "Never", "Very seldom", "A few times each year", "A few times a month", "A couple of times a month", and "A few times a week". The item was dichotomized by classifying students who answered at least "A few times a month" as engaging in HED and those who answered at the most "A few times each year" as not engaging in HED. The content and dichotomization of the item refers to the definition of HED by the WHO (2014), and a previous study using a similar item (Olsson & Fritzell, 2015) revealed a comparable prevalence rate to data for Sweden provided by the WHO (2014), indicating content and construct validity of the item (cf. Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018).

### 2.2.2. Independent variables

*Impulsivity* was measured by asking participants to rate how well four statements describe them as a person on a four-point scale (1 = Describes very poorly, 2 = Describes rather poorly, 3 = Describes rather well, 4 = Describes very well). A sample item is "Sometimes I do things without thinking" (Kjellström et al., 2018). An average score was built, provided that at least 75% of the items (3 items) were answered. Three of the four items were similar to items in the impulsivity subscale of the Youth Psychopathic traits Inventory (YPI), for which good internal consistency is documented (Andershed, Kerr, Stattin, & Levander, 2012). Due to few items, the measure used in this study has shown just moderate internal consistency ( $\alpha = 0.52$ ; Hinton, 2004). EFA was used to examine the structure of the items. Principal component analysis revealed a one-factor-structure based on the Kaiser-criterion and scree plot. The factor explained 41.4% of the variance with factor loadings ranging from 0.56 to 0.78.

*Psychological problems* were assessed by seven items addressing different domains of mental health, such as depressed mood, anxiety, self-esteem, loss of energy, and life satisfaction. Students were asked to rate on five-point scales with different frequency (for example *Very often* to *Seldom*) and intensity specifications (*Very much* to *Not at all*) depending on the content of the question. A sample item is "How often do you feel you're not good enough?" (Kjellström et al., 2018). An average score was computed, given that there was valid information on at least 70% (5 items) of the items. High internal consistency was demonstrated for this scale ( $\alpha = 0.83$ ).

Additionally, psychosomatic problems and an overall measure for subjective health problems were captured. *Psychosomatic problems* were measured by five items addressing headache, bad appetite, gastrointestinal complaints, and sleep problems. There were five response categories indicating different frequencies (for example *Several times a week* to *Never*) of the mentioned problems. A sample item is "How often have you had a headache this school year?" (Kjellström et al., 2018). An average score was built based on valid information on at least 75% (4 items) of the items. The scale showed adequate internal consistency ( $\alpha = 0.73$ ). *Subjective health problems* comprised the two subscales psychological and psychosomatic problems, leading to 12 items. An average score based on the means on the two subscales was computed.

The overall measure had good internal consistency ( $\alpha = 0.86$ ). The structure of the items was checked beforehand by EFA. Principal component analysis with varimax rotation was performed, and according to Kaiser-criterion and scree plot two factors were extracted. Factor 1 "psychological problems" explained 39.1% of the variance with factor loadings ranging from 0.41 to 0.79 and factor 2 "psychosomatic problems" explained 10.7% of the variance with factor loadings from 0.60 to 0.70. Two items showed cross loadings; based on theoretical considerations they were assigned to factor 1.

### 2.2.3. Control variables

*Gender* was captured by the question "Are you a boy or a girl?" with the response categories "Boy" and "Girl".

*Grade* was assessed by the question "What year are you attending?" with the response categories "9" and "2 at upper secondary school".

*Family structure* was assessed by the question "Which people do you live with?" and a list of response categories to be marked. Participants who ticked both "Mother" and "Father" were coded as living with two parents in the same household (students who additionally marked one or more of the alternatives "Stepfather/stepmother", "Mother and father alternately", "Foster parents" or "I live alone" were classified as not living with two parents in one household).

*Parental university education* was constructed from the question "What is the highest education your parents have?". The response categories, to be marked separately for mother and father, were: "Old elementary school (folkskola) or compulsory school (max 9 years schooling)", "Upper secondary school", "University and university college" and "Don't know". Considering the fact that a large proportion of students ticked "Don't know" or skipped the question (25.1% for mother; 28.8% for father), a dichotomous variable was created differentiating between students having at least one parent with university education and all others.

*Migration background* was measured by the question "How long have you lived in Sweden?" with the response categories "All my life", "10 years or more", "5–9 years" and "Less than 5 years". The item was dichotomized by allocating students who had lived in Sweden at least ten years to one category and those who had lived in Sweden less than ten years to the other.

Also, the *year* of the survey (2014 vs. 2016) was used as a control variable.

### 2.3. Statistical analyses

The statistical method was binary logistic regression applying the "logistic regression" command in SPSS 25. Odds ratios (OR), *p*-values, 95% confidence intervals (CI), and Nagelkerke's  $R^2$  ( $R_N^2$ ) are reported. For each outcome variable five sets of binary logistic regressions were performed. First, crude analyses were conducted, comprising bivariate logistic regressions for each control and independent variable. Models 1–4 were fully adjusted, meaning they included all control variables simultaneously. By using the block by block command in SPSS, in addition to the control variables, the independent variables were included separately (Models 1 and 2), together (Model 3), and as interaction term, in order to examine possible moderator effects (Model 4). For the interpretation of main effects focus was put on the crude analyses and Model 3 and for the interpretation of interaction effects on Model 4. Analyses were conducted for impulsivity and psychological problems as independent variables. Besides, the set of regressions was run for the variables psychosomatic problems and overall subjective health problems ( $n = 21,716$ ), respectively. Moreover, stratifications by gender and grade as well as subgroup analyses were performed.

### 3. Results

Descriptive statistics of the study sample are shown in Table 1. With regard to the dependent variables, 3.4% of the students fulfilled the

**Table 1**  
Descriptives.  $n = 21,886$ .

	<i>n</i>	%		
<i>Dependent variables</i>				
Risk gambling	740	3.4		
Heavy episodic drinking	4990	22.8		
<i>Control variables</i>				
Gender				
Girl	11616	53.1		
Boy	10270	46.9		
Grade				
9	9909	45.3		
11	11977	54.7		
Year				
2014	9986	45.6		
2016	11900	54.4		
Family structure				
Two parents in the same household	13060	59.7		
Other	8826	40.3		
Parental university education				
No parent	8352	38.2		
At least one parent	13534	61.8		
Migration background				
≥ 10 years in Sweden	19931	91.1		
< 10 years in Sweden	1955	8.9		
<i>Independent variables</i>				
	Mean	SD	Min	Max
Impulsivity	2.31	0.56	1	4
Psychological problems	2.36	0.84	1	5
Psychosomatic problems <sup>a</sup>	2.74	0.91	1	5
Subjective health problems <sup>a</sup>	2.55	0.78	1	5

<sup>a</sup>  $n = 21,716$ .

criterion for risk gambling and 22.8% of the students for HED.

### 3.1. Risk gambling

In order to examine the effect of the independent variables on risk gambling, crude analyses and four additional binary logistic regression models were performed. Results are presented in Table 2. Impulsivity was associated with an increased likelihood for risk gambling both in the crude analysis ( $OR = 1.72, p < .001$ ) and in the fully adjusted model (Model 3:  $OR = 1.82, p < .001$ ). Students who reported psychological problems were less likely to have been engaged in risk gambling (crude:  $OR = 0.91, p = .030$ ), but when adjusting for the covariates and including impulsivity they had a higher likelihood for risk gambling (Model 3:  $OR = 1.18, p = .001$ ). There was no significant interaction between impulsivity and psychological problems (Model 4:  $OR = 0.92, p = .283$ ). The variance explained by the model with both predictors (Model 3) was  $R_N^2 = 0.13$ , and did not change when including the interaction term (Model 4). Adjusted analyses with psychosomatic problems respectively overall subjective health problems as independent variables revealed similar results (not presented in table). In the unadjusted analyses psychosomatic problems were positively linked to risk gambling (crude:  $OR = 1.14, p = .002$ ), whereas overall subjective health problems were not significantly associated with risk gambling (crude:  $OR = 1.03, p = .493$ ).

With regards to the control variables, results showed that boys clearly were more inclined than girls to have been engaged in risk gambling during the past 12 months (crude:  $OR = 8.33, p < .001$ ). Furthermore, students who did not live with two parents in the same household had a higher likelihood for risk gambling (crude:  $OR = 1.35, p < .001$ ). Students with a university educated parent were less likely to have been engaged in risk gambling in the last year (crude:  $OR = 0.58, p < .001$ ). Migration background was associated with an increased likelihood for risk gambling (crude:  $OR = 1.75, p < .001$ ). Concerning grade and year there were no statistically significant associations.

### 3.2. Heavy episodic drinking

Also for HED the crude analyses and the four sets of binary logistic regressions were performed. Results are presented in Table 3. There was a clear association between impulsivity and HED (crude:  $OR = 2.26, p < .001$ ; Model 3:  $OR = 2.32, p < .001$ ). Psychological problems were also associated with HED, but less strong and only when not adjusting for the control variables and for impulsivity (crude:  $OR = 1.16, p < .001$ ). Furthermore, there was a significant negative interaction between impulsivity and psychological problems (Model 4:  $OR = 0.92, p = .013$ ). This result suggests that psychological problems negatively moderated the positive association between impulsivity and HED. The variance explained by Model 3 was  $R_N^2 = 0.15$ , but did not increase in Model 4.

In order to disentangle and corroborate this interaction, data was stratified by gender and grade (not presented in table). After the stratification by gender, the interaction term remained significant only for female students (Model 4:  $OR = 0.85, p < .001$ ), albeit it was close to significant for male students, too (Model 4:  $OR = 0.89, p = .056$ ). For girls, both impulsivity (Model 3:  $OR = 2.48, p < .001$ ) and psychological problems (Model 3:  $OR = 1.09, p = .003$ ) were associated with an increased likelihood for HED. For boys, there was a clear association between impulsivity and HED (Model 3:  $OR = 2.14, p < .001$ ), whereas the association between psychological problems and HED was negative in the adjusted model (Model 3:  $OR = 0.92, p = .016$ ). The stratification by grade revealed a similar pattern of results like the analysis of the whole sample (not presented in table). For students in the ninth grade the effect of impulsivity (Model 3:  $OR = 2.97, p < .001$ ) was stronger than for students in the 11th grade (Model 3:  $OR = 2.08, p < .001$ ). The significant effects of psychological problems in the crude analyses differed only slightly between the two grades (ninth grade:  $OR = 1.31, p < .001$ ; 11th grade:  $OR = 1.08, p = .001$ ). The interaction was significant in both grades, but was stronger for the younger students (Models 4: ninth grade:  $OR = 0.87, p = .024$ ; 11th grade:  $OR = 0.92, p = .050$ ).

In order to further investigate this interaction, the group of students with elevated scores on impulsivity and psychological problems was extracted and compared to the rest of the participants (not presented in table). Thus, the sample was split based on the median on the scales for impulsivity ( $Mdn = 2.25$ ) and psychological problems ( $Mdn = 2.29$ ). In students scoring high both on impulsivity and psychological problems, impulsivity was associated with an increased likelihood for HED (Model 3:  $OR = 2.05, p < .001$ ), whereas psychological problems were negatively associated with HED in the adjusted model (Model 3:  $OR = 0.89, p = .028$ ). For this group there was no significant interaction between the independent variables (Model 4:  $OR = 1.05, p = .687$ ).

As for psychosomatic and overall subjective health problems, the crude analyses revealed similar results like for psychological problems (not presented in table). In contrast, the adjusted models showed significant main effects of psychosomatic problems (Model 3:  $OR = 1.18, p < .001$ ) and subjective health problems (Model 3:  $OR = 1.14, p < .001$ ), but no significant interactions (Models 4:  $OR = 0.98, p = .526$ ;  $OR = 0.94, p = .079$ ).

With regards to the control variables, results from the crude analysis indicated that boys were less likely than girls to have been engaged in HED ( $OR = 0.94, p = .043$ ), whereas this association disappeared in the fully adjusted models. Students in the 11th grade were at greater risk for HED than students in the ninth grade (crude:  $OR = 3.20, p < .001$ ). Moreover, students assessed in the year 2016 had a decreased likelihood for HED than the students two years before (crude:  $OR = 0.81, p < .001$ ). Participants, who did not live with their parents as well as participants with at least one university educated parent were more inclined to have been engaged in HED (crude:  $OR = 1.32, p < .001$ ;  $OR = 1.21, p < .001$ ). Migration background was associated with a lower risk for HED (crude:  $OR = 0.37, p < .001$ ).

**Table 2**

Binary logistic regressions of risk gambling. Odds ratios (OR) with 95% confidence intervals (CI) and Nagelkerke's  $R^2$  ( $R_N^2$ ).  $n = 21,886$ .

	Crude <sup>a</sup>		Model 1 <sup>b</sup>		Model 2 <sup>c</sup>		Model 3 <sup>d</sup>		Model 4 <sup>e</sup>	
	OR	95% CI	OR	95% CI	OR	95 % CI	OR	95% CI	OR	95% CI
Gender										
Girl (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Boy	8.33***	6.69-10.37	8.71***	6.99-10.86	9.47***	7.55-11.87	9.52***	7.59-11.94	9.49***	7.57-11.90
Grade										
9 (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
11	1.02	0.88-1.18	1.09	0.94-1.27	1.08	0.93-1.25	1.08	0.93-1.26	1.08	0.93-1.25
Year										
2014 (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
2016	1.02	0.88-1.18	1.08	0.93-1.25	1.04	0.89-1.21	1.07	0.92-1.24	1.07	0.92-1.24
Family structure										
Two parents in the same household (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Other	1.35***	1.17-1.56	1.18*	1.01-1.37	1.20*	1.03-1.39	1.15	0.99-1.35	1.15	0.99-1.34
Parental university education										
No parent (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
At least one parent	0.58***	0.50-0.67	0.64***	0.55-0.75	0.63***	0.54-0.73	0.65***	0.55-0.75	0.65***	0.56-0.75
Migration background										
≥ 10 years in Sweden (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
< 10 years in Sweden	1.75***	1.41-2.16	1.64***	1.32-2.04	1.52***	1.23-1.89	1.62***	1.30-2.02	1.61***	1.30-2.01
Impulsivity	1.72***	1.51-1.95	1.90***	1.66-2.17	-	-	1.82***	1.59-2.08	2.21***	1.51-3.22
Psychological problems	0.91*	0.83-0.99	-	-	1.27***	1.16-1.40	1.18**	1.07-1.29	1.45	0.98-2.16
Impulsivity *psychological problems	-	-	-	-	-	-	-	-	0.92	0.79-1.07
$R_N^2$	-	-	.13	-	.12	-	.13	-	.13	-

<sup>a</sup> Crude: bivariate logistic regressions including one control/independent variable at the time.

<sup>b</sup> Model 1 includes control variables and impulsivity.

<sup>c</sup> Model 2 includes control variables and psychological problems.

<sup>d</sup> Model 3 includes control variables, impulsivity and psychological problems.

<sup>e</sup> Model 4 includes control variables, impulsivity, psychological problems, and impulsivity \*psychological problems.

\*\*\*  $p < .001$ .

\*\*  $p < .01$ .

\*  $p < .05$ .

**Table 3**

Binary logistic regressions of heavy episodic drinking. Odds ratios (OR) with 95% confidence intervals (CI) and Nagelkerke's  $R^2$  ( $R_N^2$ ).  $n = 21,886$ .

	Crude <sup>a</sup>		Model 1 <sup>b</sup>		Model 2 <sup>c</sup>		Model 3 <sup>d</sup>		Model 4 <sup>e</sup>	
	OR	95% CI	OR	95% CI	OR	95 % CI	OR	95% CI	OR	95% CI
Gender										
Girl (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Boy	0.94*	0.88-1.00	1.04	0.98-1.12	1.06	0.99-1.14	1.06	0.98-1.13	1.06	0.98-1.13
Grade										
9 (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
11	3.20***	2.98-3.43	3.26***	3.03-3.50	3.13***	2.91-3.36	3.26***	3.03-3.50	3.25***	3.02-3.50
Year										
2014 (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
2016	0.81***	0.76-0.86	0.86***	0.80-0.92	0.82***	0.77-0.88	0.86***	0.80-0.91	0.86***	0.80-0.92
Family structure										
Two parents in the same household (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
Other	1.32***	1.24-1.41	1.30***	1.22-1.40	1.36***	1.27-1.45	1.30***	1.21-1.39	1.30***	1.21-1.39
Parental university education										
No parent (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
At least one parent	1.21***	1.13-1.29	1.30***	1.21-1.40	1.22***	1.13-1.30	1.30***	1.21-1.40	1.30***	1.21-1.40
Migration background										
≥ 10 years in Sweden (ref.)	1.00	-	1.00	-	1.00	-	1.00	-	1.00	-
< 10 years in Sweden	0.37***	0.32-0.43	0.37***	0.32-0.43	0.35***	0.30-0.41	0.37***	0.32-0.43	0.37***	0.32-0.43
Impulsivity	2.26***	2.14-2.40	2.34***	2.20-2.48	-	-	2.32***	2.18-2.47	2.87***	2.40-3.43
Psychological problems	1.16***	1.12-1.20	-	-	1.15***	1.10-1.20	1.02	0.98-1.07	1.26**	1.06-1.50
Impulsivity *psychological problems	-	-	-	-	-	-	-	-	0.92*	0.86-0.98
$R_N^2$	-	-	.15	-	.10	-	.15	-	.15	-

<sup>a</sup> Crude: bivariate logistic regressions including one control/independent variable at the time.

<sup>b</sup> Model 1 includes control variables and impulsivity.

<sup>c</sup> Model 2 includes control variables and psychological problems.

<sup>d</sup> Model 3 includes control variables, impulsivity and psychological problems.

<sup>e</sup> Model 4 includes control variables, impulsivity, psychological problems, and impulsivity \*psychological problems.

\*\*\*  $p < .001$ .

\*\*  $p < .01$ .

\*  $p < .05$ .

#### 4. Discussion

This study aimed at exploring the effect of impulsivity and psychological health on risk gambling and HED among 15–18-year-old students. More specifically, we analyzed whether psychological health moderated the association between impulsivity and risk gambling/HED. The results showed that impulsivity was a risk factor for both risk gambling and HED among adolescents. As for psychological health, the associations were weaker, but indicated that psychological problems might be a risk factor for risk gambling and HED, too. The effects of impulsivity and psychological problems on risk gambling were independent of each other. With regard to HED, psychological problems negatively moderated the association between impulsivity and HED, but only among girls. Here, both impulsivity and psychological problems increased the likelihood for HED. However, the negative interaction implied that the more (respectively less) severe psychological problems were, the weaker (respectively stronger) the association between impulsivity and HED was. Among boys, impulsivity was also associated with a higher risk for HED. In contrast, psychological problems decreased the likelihood for HED (only in the adjusted model) and the predictors did not interact significantly. Unlike psychological problems, psychosomatic problems and also overall subjective health problems did not moderate the relation between impulsivity and HED, implying that this association was modified only by purely psychological problems rather than somatically manifesting problems.

Taken together, impulsivity appeared to be a robust risk factor for risk gambling and HED among all participants and among all examined subgroups, including both genders, both grades and particularly “vulnerable” participants scoring high on impulsivity and psychological problems. The effect of psychological health seemed to be more differentiated. Most importantly, psychological problems had a negative moderating effect on the relationship between impulsivity and HED among female students. With regard to our previous hypotheses, results confirmed hypothesis (1); as for hypothesis (2), results supported the assumption of an interaction between impulsivity, psychological health and HED, but not in the way we anticipated.

Furthermore, the study revealed that a number of sociodemographic variables may be considered as risk respectively protective factors for risk gambling and HED. Regarding risk gambling, male gender, not living with both parents in the same household, not having a university educated parent, and living in Sweden < 10 years were associated with an increased likelihood. As for HED, older age (17–18 years), not living with both parents, having no migration background, and having at least one university educated parent were linked to a higher risk. Notably, also female gender was associated with a greater risk for HED, but only in the crude analysis.

The prevalence for risk gambling of 3.4%, as found in this study, is in line with previous research on at-risk gambling among adolescents in northern European countries (Calado et al., 2017, for a review). According to the present study, 22.8% of the students were engaged in HED. In comparison to the worldwide prevalence of 16.0%, as stated by the WHO (2014), this figure seems considerable. However, the result is approximately congruent with the country-specific prevalence rate for HED of 23.8% in the Swedish population aged 15 years and older (WHO, 2014). The reduction of the likelihood for HED between 2014 and 2016 observed in this study is in accordance with the literature showing a decline in alcohol use by youth (Pape et al., 2018), and more specifically, a decrease in HED among adolescents in northern European countries for both genders in contrast to other European regions (see Kraus et al., 2018). In addition, results revealed that students in the 11th grade were at greater risk for HED than students in the ninth grade. It can be assumed that drinking was more normative among the older students, as some of them already had come of age. Meanwhile, in the younger students the effect of impulsivity on HED was stronger than in the older ones, implying that HED among younger teenagers may be considered as an expression of impulsive and thrill-seeking rather than

normative behavior. The finding that migration background was linked to a lower likelihood for HED may be explained by the relatively high proportion of immigrants from Muslim oriented countries in Sweden. A systematic review on parental socioeconomic status and binge drinking in adolescents yielded mixed results in terms of the association between parental educational level and binge drinking (Kwok & Yuan, 2016). Yet, the result of the present study is in line with previous research in Sweden demonstrating that adolescents with highly educated parents were at risk for frequent HED (Stafström, 2014). Country-specific alcohol policies may be discussed as a reason for this finding (see Stafström, 2014). Furthermore, our study revealed marginal gender differences in the likelihood for HED with girls potentially having been at greater risk. This result underpins past research from Sweden showing that gender differences on alcohol consumption have been converging from having been significantly higher among boys in the mid-1980s and slightly higher among girls in the early 2010s (Hagquist & Rydelius, 2013).

The finding that impulsivity was a risk factor for risk gambling and HED is in line with previous research (e.g., Verdejo-García et al., 2008). The—although weaker—indications for an association between psychological problems and risk gambling respectively HED are also consistent with earlier studies. In contrast, the negative interaction between impulsivity and psychological problems for HED among girls is not in accordance with our hypothesis. A possible reason might be that impulsivity and psychological problems, as indicated by low self-esteem, depressive, and anxiety related symptoms, etc., represent different constructs. Impulsivity as a personality trait is suggested to confer vulnerability to externalizing disorders, such as SUDs or antisocial personality disorder, whereas depression and anxiety are regarded as manifestations of an internalizing way of dealing with psychological distress (Beauchaine, Zisner, & Sauder, 2017; Krueger, 1999; Krueger & Finger, 2001). It can be assumed that co-occurring these two constructs level out, meaning that externalizing behavior such as HED is decreased by the occurrence of internalizing tendencies, such as psychological problems. It is also noteworthy that women were shown to exhibit higher levels on the internalizing and lower levels on the externalizing dimension than men, providing a possible explanation for the gender difference regarding the interaction term found in this study (Kramer, Krueger, & Hicks, 2008). Another interpretation refers to the contemplation that HED could be seen as an indicator for social life. It is quite common among young people to engage in HED as a group rather than alone. Pupils suffering from psychological problems might be less likely to engage in peer group events, and in turn may be less prone to HED.

However, for the interpretation of the results several limitations and weaknesses should be considered. First, the study was based on self-report data indicating proneness to response biases and thereby limitations of psychometric goodness. Second, many of the items used for the measurement of the different variables were not previously validated respectively extracted from pre-existing scales, a circumstance that limits the validity of the study. Yet, as part of this study the measures of risk gambling, impulsivity, and subjective health problems were validated, providing indications for the measurement of these constructs in future research. However, the low reliability of the impulsivity scale constitutes a limiting factor. Ultimately, the data was cross-sectional, and hence cannot provide indications about causality. Future research should therefore explore the association between impulsivity, psychological health and risk gambling/HED using longitudinal data measured with established scales. Nevertheless, the strength of the study consists in the large-scale data and big sample size, allowing for examination of multiple phenomena and robust statistical analyses. With regard to the question of generalizability of our results, the context of this study and potential country-specific differences should be taken into account. For instance, as the European School Survey Project on Alcohol and Other Drugs (ESPAD) revealed, the prevalence of gambling among 16-year-old students in Sweden (16.9%)

is lower than in the Europe-wide comparison (22.6%) (Molinaro et al., 2018).

Eventually, as a practical implication, this study provides knowledge for practitioners developing prevention and intervention measures for adolescent mental health promotion: Primary prevention measures for risk behaviors may specifically target vulnerable individuals exhibiting for example predisposing personality traits, such as impulsivity, or specific sociodemographic features, like adverse family background. Moreover, prevention measures for risk gambling should address particularly boys, and for HED both genders equally. A possible aim of interventions within secondary prevention might be the reduction of psychological distress with emphasis on developing self-esteem and decreasing depressive symptoms. Although initially counter-intuitive, our results indicate that interventions do not necessarily have to target those adolescents having high impulsivity and psychological problems simultaneously. A concrete suggestion could be the development and implementation of school-based prevention programs comprising for instance (mental) health education as well as intra- and interpersonal skills training, such as coping strategies or problem solving, and being delivered by health professionals and supported by the school staff.

## 5. Conclusion

In conclusion, this study augments the evidence that impulsivity represents a risk factor for risk gambling and HED among adolescents. Moreover, results indicate that psychological problems are also associated with these two forms of risk behavior, and may attenuate the effect of impulsivity on HED among girls. This complex interaction should be subject of future research. However, as a practical implication it can be suggested that prevention measures should address adolescents who exhibit the mentioned risk factors for risk gambling, HED or both, and aim at reducing psychological problems, but not necessarily target the adolescents showing impulsivity and psychological problems at the same time.

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## Declaration of Competing Interest

None.

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