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SELF-INJURIOUS BEHAVIOR AMONG ADOLESCENTS: PREVALENCE AND THE ROLE OF CYBERBULLYING

PhD thesis

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I. List of Abbreviations

ADHD: attention deficit hyperactivity disorder

BPD: borderline personality disorder

C: convenience sampling

CASE: Child and Adolescent Self-harm in Europe

CB: cyberbullying

CI: confidence interval

DSH: deliberate self-harm

DSHI: Deliberate Self-Harm Inventory

DSM: Diagnostic and Statistical Manual of Mental Disorders

DSM-5: Diagnostic and Statistical Manual of Mental Disorders 5th Edition

ISAS: Inventory of Statements About Self-injury

LASSO: least absolute shrinkage and selection operator

LGBT: lesbian, gay, bisexual, and transgender

MINI: Mini International Neuropsychiatric Interview

MINI-KID: Mini International Neuropsychiatric Interview for Children and Adolescents

NSSI: nonsuicidal self-injury

NSSI-D: nonsuicidal self-injury met the DSM-5 criteria

OR: odds ratio

RA: randomized sampling

RE: representative sampling

SA: suicidal attempt

SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2

SEYLE: Saving and Empowering Young Lives in Europe

SH: self-harm

SHB: self-harm behavior

SIB: self-injurious behavior

WHO: World Health Organization

II. Introduction

II.1. Self-injurious behavior and nonsuicidal self-injury

The first mentioning of self-injurious behavior (SIB) in the literature was in Favazza's book, called 'Bodies under Siege', and the first edition was published in 1987 (1). He wrote about the cultural, sacral and psychological aspects of SIB (1). Favazza defined the phenomenon self-mutilation, and separated social accepted (e.g. piercing), and deviant/pathological forms (e.g. arm cutting) (1). In newer editions of his book, Favazza provides information on the diagnosis and treatment of the phenomenon, and draws the attention to the fact that self-mutilation is far more common than the clinicians often thought (1). Since then, SIB has become a growing interest in both clinical and research fields (2).

A subgroup of SIB is nonsuicidal self-injury (NSSI), which is a new phenomenon, appeared in the 21st century (2, 3). The definition of NSSI is the following: individuals deliberately and directly damage themselves without suicidal intent (4). It can be considered as an endpoint on the spectrum of SIB, where the other end is suicidal attempt (SA), when individuals have intent to die, and it is a form of suicidal behavior (4-6). Several further terminology can be found in the literature which describe similar phenomenon as NSSI, such as deliberate self-harm (DSH), self-injury, self-harm, self-cutting or parasuicide (5). From these only NSSI has no suicidal intent, other terms are permissive in this respect (2, 5). Self-injury techniques include cutting, biting, burning and scratching the skin (7), and intentionally hitting the body or the head against the wall (8). The most common form is cutting, which occurs most often in the upper extremities (5, 9). Activities such as drug overdose or jumping from high were excluded from the definition (8).

NSSI was included in the Diagnostic and Statistical Manual of Mental Disorders 5th Edition's (DSM-5) Conditions for Further Study chapter (10) in 2013 as a separate category in the first time. According to the DSM-5, the definition of NSSI is the following: it must be occurred 5 or more days in the last year, the functions of NSSI has to be either get relief from a negative feeling, or resolve an interpersonal conflict, or get into a positive emotional state (10). Immediately before the self-harm negative feelings/thoughts or interpersonal difficulties, or a preoccupation with the behavior which is hard to control or thinking about the self-injury must occur. In addition, DSM-5

excludes the behaviors which socially sanctioned, e.g. tattoos and piercings are not in this behavior (10).

It is often very hard to define, whether the individual who had SIB had suicidal intent at the time of the SIB, because individuals with SIB do not always remember to the whole act, and to their feelings in the meantime (4, 11). Moreover, a nonsuicidal act can become suicidal over time (11). According to the literature, the more often and in more ways someone self-harm, there is greater likelihood of a suicide attempt (4). The coexistence of NSSI and SA is approximately 70% in clinical (4, 7) and 50% in nonclinical population (12).

NSSI has a very high appearance in mental disorders (2, 7). Its prevalence is the highest in borderline personality disorder (BPD), which is more than 65% (4, 13). Before DSM-5 NSSI only occurred in BPD (14-17). However, several studies showed, that besides personality disorders, NSSI appears both in internalizing – often in major depression and anxiety disorders – and externalizing disorders, such as substance abuse, attention deficit hyperactivity disorder (ADHD) and conduct disorder (4, 7, 18-20).

Previous research findings have drawn attention to the fact that lesbian, gay, bisexual, and transgender (LGBT) individuals report higher rates of NSSI than their heterosexual and cisgender peers (21-23). The meta-analytic results of Liu et al. (2019) show that the lifetime prevalence of NSSI is approximately 30% among sexual minorities and 47% among gender minority samples (21). Based on the results, NSSI acts are most closely associated with experiences of stigmatization and discrimination. Based on the summary results, bisexual and transgender individuals are most at risk for NSSI acts (21). This may be due to the fact that bisexual individuals are much more likely to suffer from identity crises than gay and lesbian individuals, feel that they receive less social support, and are less likely to disclose their sexual orientation (24, 25). In the case of transgender people, the high rate of self-harming behavior may be due to fear of stigmatization due to the diagnosis of gender dysphoria in the DSM-5, which can greatly limit their willingness to seek help (26).

Previous research focused on understanding the functions of NSSI. Briere et al. (1998) found that dissociation, high emotional stress and posttraumatic stress decrease could be the functions of self-harm (18). Klonsky et al (2007) found that before self-harm

there is a negative emotional state, and the most common function of the act is that the individual try to get rid of it (11). In addition to the functions of NSSI have found to be: self-punishment, search for experience, setting boundaries and exercising interpersonal influence (11). Laye-Gindhu et al (2005) made a L study with 13-18-year-olds (N=424, 236 girls and 188 boys, M=15.34 years, SD=1.06) about the functions of NSSI (27). They also found that a negative affective state preceded NSSI, but conversely feeling of shame, guilt and disgust were increased following self-harm (27). Positive emotions increased only marginally during the act, in exception feeling of relief, which increased after NSSI as well (27). The following functions were found to be the most common reasons why adolescents self-harm: “I felt very unhappy or depressed” (80%), “I did not like myself” (70%), “I felt like I was a failure” (64%), “I was angry at myself” (63%), and “I felt alone” (63%) (27). Other studies emphasize the positive social reinforcement – both online and offline – as a motivation of NSSI (9, 28, 29).

According to the literature, psychotherapy is the first choice to treat NSSI (30, 31). Within this dialectical behavioral, mentalization-based, and cognitive behavioral therapy could be used (31-33). Plener et al in 2016 published the German guidelines for treating NSSI among adolescents (34). According to this consensus, NSSI should be treating in outpatient care unit, but when the self-harm is severe, the patient is suicidal, or there is no option for outpatient care, it should be take place by inpatient unit, especially in a Department of Child and Adolescent Psychiatry and Psychotherapy (34). There is no recommendation for pharmacology treatment, but when the patient is agitated, or there is an underlying mental disorder, it could be used (33, 34). All the studies emphasize the importance of treating NSSI, because in this way the risk of suicidal behavior is decreasing (30, 31, 33-35).

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There is an increasing interest in the prevalence of SIB, especially among adolescents. As I mentioned before, the prevalence of SIB is very high in clinical population (7, 13, 20, 36), but there are conflicting results about the exact prevalence in population samples (37-39). Probably the big differences are due methodological factor (40) and cultural differences (41).

Cipriano et al (2017) made a systematic review on the prevalence of NSSI – based on DSM-5 criteria – among adolescents (42). They found that the prevalence ranges

between 7.5 and 46.5% (42). Even though they did not make a meta-analysis of their study, in the last decade six meta-analyses provided data on the prevalence of SIB among the population samples of adolescents. The main results are shown in Table 1.

Table 1: Previous meta-analyses on the prevalence of SIB among population samples of adolescents. Original table made for the dissertation.

Author	Year range of selected articles	Number of articles	Age range	Recruitment & measurement	Main results
Muehlenkamp et al. (43)	2005-2011	52	11-24	- community samples - single-item, checklist, interview or self-report questionnaire	- lifetime prevalence: 18% NSSI, 16.1% DSH 12-months prevalence: 19% NSSI - average lifetime prevalence did not change between 2005 and 2011
Swannell et al. (44)	1993-2012	34	adults: 25 < young adults: 18-24 adolescents: 10-17	- community, university and school samples - single-item, checklist, interview or self-report questionnaire	- pooled lifetime prevalence: 19.7% (females 19.9%, males 14.7%) 1990-1999: 11.7% 2000-2005: 14.7% 2006-2012: 19.3% - did not find any significant continental differences - prevalence is heavily influenced by features of the measurement tool
Bresin & Schoenleber (45)	1993-2013	116	11.5-55.5 (M= 20.81)	- clinical, college and community samples - self-report questionnaire, single-item or interview	- females NSSI: 33.8% - males NSSI: 26.4% - significant gender differences in every age-group
Gillies et al. (40)	1990-2015	172	12-18	cohort and cross-sectional studies	lifetime prevalence: 16.9% (DSH – 11.4%, NSSI – 22.9%)

			(M= 12.81 years)	self-report questionnaire, interview or parent-report	- significant increase over time - girls were more likely to self-harm - continental differences were due to methodological factors
Lim et al. (41)	1989-2018	66	12.59-19.78 (mean age)	- community samples - no data on the measurement the studies used for NSSI and DSH	- lifetime prevalence: 22.1% NSSI, 13.7% DSH 12-months prevalence: 19.5% NSSI, 14.2% DSH - lifetime prevalence of NSSI: higher in non-Western countries (32.6%) vs. Western (19.4%) - lifetime prevalence of DSH: higher in Western countries (14.2%) vs. non-Western (12.8%) - lifetime prevalence of NSSI was higher among low- and middle-income countries vs. developed - lifetime prevalence of NSSI was highest in Australia (30.9%) lowest in Europe (18.4%) - lifetime prevalence of DSH was highest in Asia (17.4%) and lowest in North America (7.3%)
Xiao et al. (46)	2010-2021	62	10.60-17.03 (mean age)	- non-clinical samples - single-item or questionnaire	- lifetime prevalence: 22% NSSI 12-months prevalence: 23.2% NSSI - females NSSI: 25.4% - males NSSI: 22% - the prevalence of NSSI was found to be higher among adolescents living in urban areas
Liu et al. (47)	1982-2022	58	<13	- community, clinical and mixed samples - questionnaire or interview	- lifetime prevalence: 6.3% NSSI - males appeared to be at greater risk for SITBs in preadolescence than older age groups

Geoffroy et al. (48)	1986- 2021	30	6-12 (M=9.5 years, SD=1.4)	- representative and convenient community samples - self-report questionnaire or interview	- females self-harm: 3% - males self-harm: 3.5% - detailed ethnicity data were not available
Deng et al. (49)	2020- 2021	15	adults: 18< adolescents: 9.3-18	- non-clinical samples - various types of self-report questionnaires	- overall prevalence of NSSI during SARS-CoV-2 pandemic: 32.4% for adolescents, 15.7% for adults 28.4% for developing countries, 18.1% for developed countries 32.8% in Asia, 21.3% in America, 9.6% in Europe - gender, age, location, and suicidal ideation are influencing factors for NSSI

Abbreviations: DSH: deliberate self-harm, NSSI: nonsuicidal self-injury, SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2.

NSSI typically starts in adolescence, and the lifetime prevalence is the highest in this age group (8, 36, 37, 42, 50). While its average lifetime prevalence is around 20% among adolescents, 13.4% among young adults and 5.5% in the adult population (37, 44). Cipriano et al (2017) found in their systematic review that the age of onset of NSSI is often between 12 and 14 years (42). Whitlock et al (2006) made a populational study among 18-24-year-old college students (N=2,875, 56.3% female) about the age of onset of SIB (37). They found that SIB starts 5.1% before the age 10, 24.9% between 10-15, 27% between 15-16 and 34% between 17-20 (37). Only 4.6% started between 21-24, and 4.4% after 24 years of age (37). Plener et al (2016) made a representative study in the German population (N=2,509, M=48.8 years, SD=18.1, 55.4% female) on the prevalence of NSSI (51). They found that the lifetime prevalence of NSSI was 26.9% between 14-24-year-olds, and 28.2% between 25-34-year-olds (51). They found the mean age of onset 17.25 years, and mean age when NSSI stopped 26.74 years (51). The following

populations reported significantly higher prevalence (as risk factors for engaging in NSSI): reporting history of mental health treatment; people, who did not live with a partner; being unemployed; people with a lower household income; female gender (51). As a point of interest, there was no significant difference in the prevalence between being member of a religious group or not and living in cities or in the countryside (51). Only .3% of the reported NSSI met the diagnostic criteria based on DSM-5 (51).

Before 2020, there were only a few studies which report data on the prevalence of SIB among population sample of adolescents in Hungary (2). In Hungarian study population, Csorba et al (2009) made a 18 months longitudinal study among 14-18-year-old adolescents (N=105, 28 boys and 77 girls, M=15.97 years, SD=1.05) in clinical setting (36). They found that in this clinical population the prevalence of NSSI was 71% (36). To measure mental disorders, they used the Mini International Neuropsychiatric Interview (MINI) (52), and for NSSI the Hungarian pilot version of the Ottawa/Queen's Self-Injury Questionnaire (53). The highest prevalence of NSSI was found in major depression: 60% with either past or recent episode (36). In anxiety disorder and dysthymia they also found high prevalence, 26.6% and 19% respectively (36). Balázs et al (2018) found a high appearance of NSSI among adolescents with ADHD (N=52, 23 boys and 29 girls, M=14.75 years, SD=1.25): the prevalence of NSSI was 67% (20). They made the ADHD diagnosis with the Hungarian validated version of the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID) (54, 55), and measured NSSI with Deliberate Self-harm Inventory (DSHI) (20, 56).

There are data from two international studies: the Saving and Empowering Young Lives in Europe (SEYLE) (38) and the Child and Adolescent Self-harm in Europe (CASE) (39). The lifetime prevalence among boys was 14.4% in SEYLE and 3.4% in CASE study, while 19% in SEYLE and 10.3% in CASE among girls (38, 39). These numbers were lower than the average lifetime prevalence, which was 24.6% for girls and 29.9% for boys in SEYLE (38), and 13.5% for girls and 4.3% for boys in CASE (39). Horváth et al (2018) extended the SEYLE study with a matched sample of vocational school students (57). They found the lifetime prevalence of SIB 25.6% among boys and 35.4% among girls, which were significantly higher than the high-school sample (from SEYLE) (57). Horváth et al (2020) found a 23.6% of lifetime prevalence of NSSI among non-clinical sample of adolescents (N=161, 50% girls, M=15.43 years, SD=1.14) (58).

They measured NSSI with the DSHI (56) and found that the number of negative life-events was associated with higher frequency of NSSI (58). Mészáros et al (2020) in the same sample found that both maladaptive and pathological internet use are significantly associated with higher prevalence of NSSI (59). In addition, they found a significantly higher prevalence among girls, than boys (58, 59).

Most of the studies agree on the prevalence of SIB is significantly higher among females (44-46), while others did not report this difference (43, 60), or even report higher prevalence among males (61-67). Where higher prevalence was found among boys, they suggest mostly cultural differences (62, 64-67).

As we can see, there are conflicting results about the prevalence of SIB in the 21st century, both in the risk factors, definitions, gender, and continental differences as well (40, 41, 43-45).

II.2. Cyberbullying

Cyberbullying (CB) is a type of bullying, when the harassment takes place online (e.g., on Facebook, TikTok, Instagram, YouTube, online games) or on any electronic communication interface (e.g., phone call, messages) (68, 69). CB attracted the researcher's attention in 1990's, but since then there is no consensus on the definition of it (69). Patchin and Hinduja defined it in 2006 as "a willful and repeated harm inflicted through the use of computers, cell phones, or other electronic devices" (70). Kowalski in 2014 defined CB as "the use of electronic communication technologies to bully others" (68). In this type of harassment there is a wide range of methods, as in the use of electronic devices (68). It could be an anonymous harassing phone call or message, inciting a quarrel in comments, sending hurtful images, etcetera (68-70).

CB has many similarities with traditional bullying, such as the repetitive tendency, the aggressiveness, and the display of power between the individuals (68). Moreover, in many cases the same person is bullied in both ways (68, 71-74). Waasdorp and Bradshaw (2014) made a populational study with 28,104 adolescents ($M=15.93$ years, $SD=1.33$, 49.4% female) (71). They found that 50.3% of those who engaged in any forms of harassment, reported both traditional and cyberbullying (71). The most important difference between cyber and traditional bullying is anonymity in CB (68, 71). The group of perpetrators has expanded, since hiding behind impersonality, bullies could also be

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people who would not dare to hurt someone face-to-face (68). Another negative aspect of anonymity is that bullying can become more severe online, as the perpetrator does not immediately see the effect of the harassment on the victim (75). Since the bullies cannot see their victims, they could be also different from the traditional harassment victims (71, 76). Sinclair et al (2012) found that adolescents who experience CB are more likely to be female and white, while who experience both traditional and cyber harassment are more likely to be male, non-white and lesbian, gay, bisexual, transgender or questioning identity (76).

The lifetime prevalence of CB is 10-20% among adolescents but there are big differences among the population samples (68, 72, 75, 77-80). There are some systematic reviews and meta-analyses on the prevalence of CB, which are shown in Table 2.

Table 2: Previous systematic reviews and meta-analyses on the prevalence of CB among population samples of adolescents. Original table made for the dissertation.

Author	Year of publication	Type of article	Number of articles	Age range	Main results
Selkie et al. (81)	2015	systematic review	26 about bullies 52 about victims (only from the United States)	10 – 19 years	• prevalence of CB perpetrators ranging from 1% to 41% • prevalence of CB victims ranging from 3% to 72% • prevalence of both 10-30%, when only analyzing high-quality articles*
Bottino et al. (77)	2015	systematic review	10 – most of it from the United States	10 – 17 years	prevalence of CB varied between 6.8% to 35.4%
Brochado et al. (82)	2016	scoping review	159 – 77 from North	12 – 18 years	• highest prevalence of victims in Canada (23.8%) and China (23%)

			America, 65 from Europe		lowest prevalence of victims in Germany (6.3%), Sweden (5.2%) and Austria (5%)
Foody et al. (83)	2017	meta-analysis	26 – from Ireland	4 – 18 years	- victimization: 13.7% in primary and 9.6% in post-primary schools - perpetration: 5.2% in primary and 3.9% in post-primary schools
Jadambaa et al. (84)	2019	meta-analysis	20 – from Australia (4 reported only on CB, 16 on both traditional and CB)	no data	- lifetime prevalence of victims: 7.0% - lifetime prevalence of perpetrators: 3.5%
Zhu et al. (85)	2021	systematic review	63	< 18 years	- prevalence of perpetrators: 6.3% to 32% - prevalence of victims: 14.6% to 52.2% - verbal violence was the most common type

* defined based on the Quality Review Tool (86)

Previous studies found that the prevalence of CB is higher among girls than boys (71, 74, 76, 78-80, 87). Furthermore most of these studies found, that girls engaging more in verbal harassment and CB, than boys; while boys experience more physical bullying, than girls (71, 76, 78), while others did not find any significant gender difference (88), or found that boys are more likely to be perpetrator than girls (89, 90), or even found higher prevalence of CB among boys than girls (91).

Adolescents, who engaged in CB – both victims and perpetrators – experience more emotional stress and has a greater risk for school-related and mental health problems (76, 92-94). Moreover, CB increases the risk of suicidal behavior, due to the adolescents who report CB are more likely to report suicidal ideation, plans and attempts (74, 78, 93, 95). Kodish et al. (2016) made research in a pediatric primary care sample with 5,429 people ($M=16.77$ years, $SD=2.5$, 56.5% female) (95). They found that all types of bullying were significantly associated with higher risk of suicide, and depressive symptoms moderated this relationship (95). Bauman et al. (2013) also found in their populational study (grade 9-12, $N=1,491$, 48.9% female) that depression mediates the relation between cybervictimization and suicidal attempts, but only among girls (96). Przybylski and Bowes (2017) made a representative study in England with 110,788 adolescents ($M=15$ years, 49% female) (94). They found that adolescents who engaged in cybervictimization reported poorer mental well-being, and more seriously they harassed, the poorer their mental well-being were (94).

The phenomenon of bystander inaction has been widely acknowledged and examined since 1968, following the publication of Darley and Latané's seminal work on the bystander effect, which describes the reduced likelihood of individuals offering help when other passive bystanders are present (97). According to these authors, intervention by bystanders requires a series of steps: noticing the situation, recognizing that assistance is needed, assuming personal responsibility, believing in one's ability to help, and making a conscious decision to intervene (97, 98). Although the bystander effect has not been consistently replicated in online contexts, the underlying mechanisms suggested to drive the phenomenon may still help explain the inaction of cyber-bystanders (97). Previous studies have identified factors contributing to bystander inaction that can be broadly aligned with the previously outlined steps, as well as with the three deterrents originally described by Darley and Latané: diffusion of responsibility, evaluation apprehension, and pluralistic ignorance (97). CB witnesses can respond in several different ways: they may step in directly by asking the cyberbully to stop or intervene indirectly by reporting the incident; other witnesses may encourage the behaviour through actions such as liking or commenting on harmful content, others may actively participate by sharing messages or posts; while some choose to remain passive and take no action (99). Despite increasing evidence that traditional face-to-face bullying has harmful effects on witnesses, only a

limited number of studies have explored how witnessing CB affects students' mental health (99, 100). Adolescents may experience cognitive dissonance when observing peer victimization if they fail to intervene, as the discrepancy between their personal values and their inaction creates psychological tension (101). Previous research indicates that exposure to bullying incidents as a witness is associated with a range of psychosomatic disturbances and acute emotional distress (101, 102). Furthermore, witnessing bullying at school has been associated with increased feelings of loneliness among bystanders (99). Adolescents may also experience co-victimization or fear becoming targets themselves after witnessing bullying, which can result in feelings of powerlessness (99, 100). This sense of powerlessness may result in passive behaviour and intensify physical symptoms such as anxiety and depression (99, 100).

II.3. Self-injurious behaviors and cyberbullying

Even though the relationship between traditional bullying and SIB has now been extensively researched (103-110), the associations between CB and SIB has only in the past decade begun to attract the interest of researchers (111, 112). Altogether two systematic reviews and metaanalyses were completed on this topic (111, 112).

Heerde and Hemphill (2019) made a metaanalysis on the relationship between both traditional and CB and DSH among adolescents (111). They found 27 studies, which provided data on this topic among 11-19-year-old adolescents, but only 4 studies reported data on CB (111). Both traditional and CB showed a significant negative association with DSH, both in bullying perpetration and victimization (111). John et al. (2018) made a meta-analysis on the relationship between self-harm, suicide, and CB among people younger than 25 years (112). They found the same as Heerde and Hemphill, but with the significant negative association between CB and suicidal behavior as well (112). In their study 26 independent studies were involved, and 11 provided data on cybervictimization and SIB (112).

As can be seen from the above described meta-analyses, there are only a few studies which examine the relationship between CB and SIB (111, 112). Some of the studies found significant negative association between CB and SIB (73, 76, 109, 113), while others found this correlation when the CB occurs with traditional bullying (87). The next

chapter introduces shortly the studies which measured the association between CB and SIB (in order of the publication year):

Hay and Meldrum (2010) found a significant negative association between SIB and cybervictimization among 426 10-21-year-olds students ($M=15$ years, $SD=2.18$) (109). They also found that this association is mediated by negative emotions (109). They measured SIB with a single-item question, CB with a three-item scale and negative emotions with a composite six-item scale – which contained parts about depression, anxiety and low self-worth (109).

Schneider et al. (2012) made a research on the relationship between CB and SIB 20,268 high-school students (9-11 grades, 50.4% female) (73). They measured both SIB and CB with single-item questions (73). They found that CB was associated with an increased depressive symptoms, psychological distress and SIB (73). From the adolescents who only were victims of CB, 24% reported SIB and 33.9% depressive symptoms, and when the adolescents engaged in both types of bullying (traditional and cyber), these were 37.8% and 47% respectively (73).

Elgar et al. (2014) made a populational study with 18,834 12-18-year-old students (50.7% female) and found that cybervictimization is negatively associated with SIB (3.49 OR) (74). They also draw attention to the potential moderating role of family contact between the two phenomena (74).

Fridh et al. (2019) made a populational study among 6,841 students (14-21-year-olds, 66.7% female) who reported mental distress (90). They measured SIB and CB with single-item questions and defined mental distress as “having experienced psychological distress during prolonged period of time (at least 2 weeks in a row), e.g. due to stress, depressive feelings, worrying, loneliness, exposure to bullying, anxiety of suicidal thoughts (one reason sufficient)”, and the students had to answer ‘yes’, if they had experienced in the last 1 year any (90). They found significant association between SIB and CB among students who involved in any mental distress in the last 12 months (90).

Nguyen et al. (2020) also found that CB is significantly associate with SIB among adolescents ($N=648$, $M=11$ years, 47.7% female) (88). They measured SIB with the Young Risk Behavior Survey (114) and CB with a six-item scale (88).

Eyuboglu et al. (2021) made research among 6,202 11-18-year-old students (M=14.4 years, SD=1.9, 46.1% female) and found significant increasing of SIB among adolescents who involved in CB – among only victims, only perpetrators and both as well (89). They used single-item questions to measure SIB (suicidal intent was not excluded) and CB (89).

John et al. (2022) made a 2-year longitudinal research among 11-16 year-old adolescents (N=6,677, 48.4% female) (87). They found that the prevalence of SIB was significantly higher both in the only traditional and in the only CB groups, than the nonbullied group, and the highest was among the both traditional and CB group (87). They used the Health Behavior in School-aged Children survey (115) to measure the types of bullying and extracted data on SIB from different databases in Wales via secure anonymized information linkage (87).

Most definitions of SIB either do not reveal whether there was suicidal intent in the behavior, or they are not separated and therefore could be included in the category of suicidal attempt (73, 74, 87-90, 109). There is only a few research done about the relationship between NSSI and CB (91, 116, 117). Thomas et al. (2017) found 1.1% comorbidity between CB victims and NSSI, and 9.9% between cyberbullies and NSSI among adolescents (N=2,967, M=14.6 years, 48.4% female) (116). They found that all forms of involvement in bullying were associated with increased risk of psychological distress, emotional and behavioural problems, substance use, NSSI and attempted suicide; and being a victim or a victim-perpetrator was specifically tied to major depressive disorder (116). They used single-item question to identify NSSI and the Revised Olweus Bully/Victim Questionnaire (118) and the Cyber Friendly Schools program (119) to adapt questions about CB (116). To measure emotional and behavioural problems, they used the Strengths and Difficulties Questionnaire (120), to measure psychological distress they used the Kessler 10 Psychological Distress Scale (121), and major depressive disorder was assessed using the Diagnostic Interview Schedule for Children, Version 4 (122). Faura-Garcia et al. (2021) made a research on the relationship between CB victimization and NSSI among 760 12-17-year-old adolescents (M=15.58 years, SD=1) (91). They found significant higher frequency of NSSI among CB victims, and this correlation was partly moderated by higher scores on dysfunctional cognitive patterns and depressive symptoms (91). They measured CB with the Cyberbullying Questionnaire (123), NSSI

with the Functional Assessment of Self-Mutilation scale (124), cognitive patterns with the Young Schema Questionnaire-3 (125) and depressive symptoms with the Center for Epidemiologic Studies-Depression Scale (126). Drubina et al. (2023) made a research among 1011 secondary school students (M=16.81 years, SD=1.41, 66.1% female) and investigated the relationship between online and school bullying, NSSI, externalizing and internalizing problems (117). They found that students who were involved in bullying – whether as bully or victim – used more types of NSSI, and both online and school bullying victims experienced more internalizing problems (e.g. anxiety), while bullies more externalizing symptoms (117). They measured NSSI with Inventory of Statements About Self-injury (127), online and school bullying with the Revised Olweus Bully/Victim Questionnaire (118), externalizing and internalizing problems with Strengths and Difficulties Questionnaire (120).

Dorol-Beauroy-Eustache and Mishara made a systematic review in 2021 about the risk and protective factors for suicidal behavior and SIB among children and adolescents involved in CB (128). They found 29 articles in this topic and formulated 10 risk and 10 protective factors which moderate the relationship between self-harm, suicidal behaviors, and CB (Table 3 and 4.) (128).

Table 3: The protective factors found to moderate and mediate the relationship between CB and suicidal attempt, ideation, and self-harm. Reproduced based on Dorol-Beauroy-Eustache and Mishara (2021) (128).

Protective factors
• School connectedness • Having a connection with an adult at school • Positive perceived school climate
• Restrictive style of parenting • Parental support
• Healthy diet
• Emotional intelligence • Self-control • Life satisfaction

- Subjective well-being

Table 4: The risk factors found to moderate and mediate the relationship between CB and suicidal attempt, ideation, and self-harm. Reproduced based on Dorol-Beauroy-Eustache and Mishara (2021) (128).

	Risk factors	
•	Psychological distress	
•	Negative emotions	
•	Loneliness	
•	Perceived stress	
•	Mental health problems (depressive symptoms, ADHD, autism spectrum disorder, intellectual and developmental disabilities)	
•	Violent behaviors	
•	Substance abuse	
•	Physical characteristics (obesity, asthma)	
•	Sexual orientation (LGB/gender identity)	
•	Gender(girls)?*	
•	Racial/ethnic background?*	

*due to conflicting results, the authors suggest further investigation

III. Objectives

III.1. The first study

Our aim in the first study was to conduct a systematic review and meta-analysis on the topic of prevalence of SIB among adolescents. Our hypotheses were the following:

- 1) During the examined period, the prevalence of SIB did not change over time.
- 2) The prevalence of SIB is significantly higher among girls, than boys.

Commented [KF3]: During?

Additionally, we searched for the differences between:

- the definitions of SIB.
- the assessments used for measuring SIB.
- the place of data collection of the included studies.

III.2. The second study

Our second study was a cross-sectional study about the relationship between NSSI and CB. Our hypotheses were the following:

- 1) The prevalence of NSSI is significantly higher among those who are involved in CB (whether perpetrators, victims, or bystanders) than among those who are not involved in CB.
- 2) Depressive disorders mediate the association between NSSI and CB among perpetrators.
- 3) Anxiety disorders mediate the association between NSSI and CB among victims.
- 4) The prevalence of NSSI is significantly higher among CB perpetrators and victims than among those who merely witness CB.

The first study was published in the European Child and Adolescent Psychiatry journal (129); the second study was published in the Scandinavian Journal of Child and Adolescent Psychiatry and Psychology (130).

IV. Methods

IV.1. The first study

This study was a systematic review and meta-analysis. I did the literature search, the exclusion of the studies, the data extraction (with one of my colleagues), and drafted the manuscript.

IV.1.1. Literature search

On 18th of June 2020, we made the systematic literature search and used six computerized databases: Web of Science, Scopus, OVID Medline, PubMed, EBSCO Discovery Service for Semmelweis University and PsycINFO.

Our search term is shown in Figure 1. We excluded the clinical trials, case reports and reviews, and added filters for English language and date between 1st of January 2015 and 18th of June 2020.

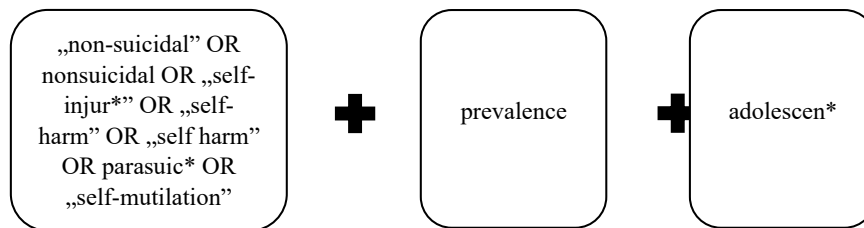


Figure 1: Search-term of the systematic review in the first study. Original figure made for the dissertation.

IV.1.2. Inclusion and exclusion criteria procedure

The included study should report prevalence of SIB in adolescence in a normal population sample and written in English. We only included published papers, and excluded reviews, meta-analyses, and case-report studies. We found the following number of papers: 195 in Web of Science, 121 in Scopus, 101 in OVID Medline, 100 in PubMed, 57 in EBSCO Discovery Service for Semmelweis University and 21 in PsycINFO. We used EndNote X9 software for removing duplicates, so we screened altogether 374 articles. We excluded 221 articles based on the exclusion criteria in three steps: 1. 200 based on their title, 2. 45 based on their abstract, 3. 39 based on the full text. By secondary search strategies we identified an additional seven papers. Finally, 97 papers were included in the meta-analysis.

The whole procedure of the inclusion and exclusion criteria is summarized in Figure 2 and 3. The methodology of this review was followed by the PRISMA guidelines.

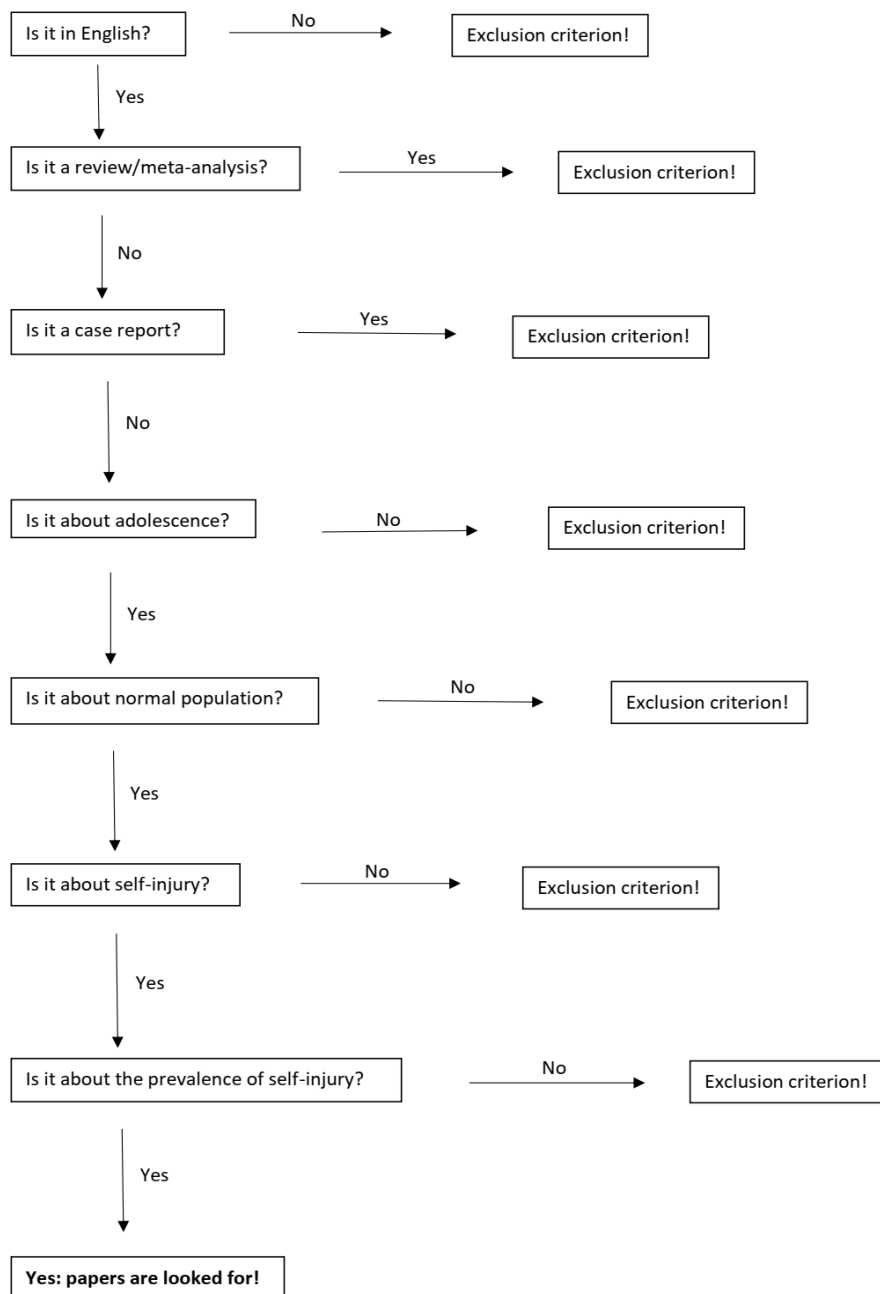


Figure 2: Quorum flowchart of the exclusion and inclusion criteria. Previously published by the candidate in Farkas et al. 2023 (129).

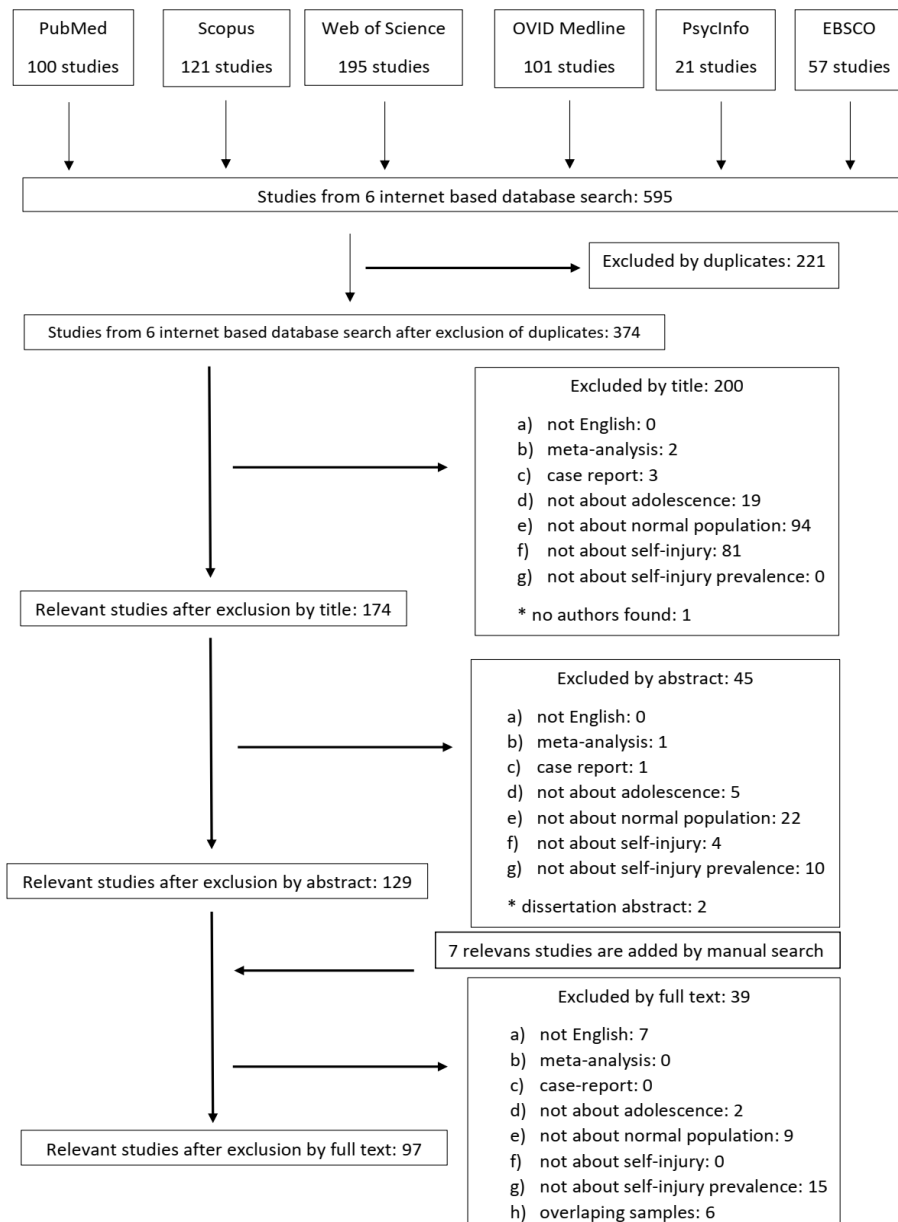


Figure 3: The flowchart of the exclusion process (title, abstract, and full text exclusion criteria). Of the 374 papers that we found, finally, we included 97 to our meta-analysis. Previously published by the candidate in Farkas et al. 2023 (129).

IV.1.3. Data extraction and meta-analytic procedures

We coded the following information from the articles with an interrater reliability ranged between 73 and 100%:

- 1) bibliographic information: authors, year of publications and data collection
- 2) sample information: age range and mean age of sample, gender ratio, country, and continent the sample was recruited in, representativeness of the sample, and design
- 3) measurement of SIB: instrument, suicidal intent, terminology
- 4) information for effect size: prevalence estimates and sample size

We included the prevalence estimates separately for boys and girls if a study reported on those. For longitudinal studies, prevalence was coded at all measurement points. In cases, when prevalence estimates were available separately for males and females only at one time point, we chose to include only the estimates at the time point when it was reported separately. When multiple studies reported the same database, we always included the one that provided data for girls and boys separately, the one with the largest sample size, the one that provided follow-up results too. In addition to all this we contacted the authors to get the missing data on prevalence and other information. Even so we had to impute some scores that were not reported in the primary studies, and we did not get any information from the authors. In these cases we used a procedure similar to Protzko et al. (2020) (131). In studies that only provided the age group, the average age was calculated as the geometric mean of the age group (131). In studies where the year of data collection was not reported, two years were subtracted from the year of publication (131).

We used Comprehensive Meta-analysis Software to conduct analyses (132, 133).

IV.2. The second study

The second study was an empirical, cross-sectional study. I made the data collection with my colleagues, psychology students and volunteers who joined our

research group. I kept in contact with the schools, made the data extraction with one of my colleagues and wrote the manuscript.

IV.2.1. Ethics

We started the data collection after the ethical approval of the Medical Research Council's Committee on Scientific and Research Ethics, Hungary. The ethical approval numbers before and after the outbreak of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic in 2020, are 42020-4/2019/EKU and IV/8167-3/2020/EKU respectively. The anonymity of the study, the code-decode system and the consent in the study could be withdrawn at any time without giving any reasons were explained to the participants. The adolescents and their parents signed informed consents after detailed written and oral information. In the case of an acute risk of suicide – based on a structured psychiatric diagnostic interview – the parents and adolescents were informed and referred to a child and adolescent psychiatrist within 24 hours.

IV.2.2. Participants and procedure

The study was started with the ethical approval of the Medical Research Council's Committee on Scientific and Research Ethics, Hungary (in Hungarian: *Egészségügyi Tudományos Tanács, Tudományos és Kutatásetikai Bizottság*). The ethical approval number is 42020-4/2019/EKU, and IV/8167-3/2020/EKU (extension after the pandemic).

Data collection was made in different parts of Hungary. We collected data in the capital city of Hungary (Budapest) and in the following two towns: 1) Bábolna with 3,789 citizens, placed in the western part of Hungary, 2) Kiskőrös with 14,452 citizens, placed in the south-east part of Hungary. The data collection was made between May 2019 May and April 2022. Meanwhile, on the 11th of March 2020, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic broke out. The first registered case in Hungary was on the 4th of March 2020. Unfortunately, the SARS-CoV-2 pandemic made our data collection significantly more difficult. The schools were closed, and the teaching was online from the 16th of March 2020. Although the schools opened in September 2020, but their area was not allowed to be visited by anyone other than staff and students. On the 11th of November 2020 schools closed again above the 8th grade, and on the 8th of March 2021 further restrictions came into effect, among others the kindergartens and primary schools closed too. On the 6th of April 2021 the kindergartens and elementary schools opened, but other schools were closed until the end of the school

year. Because of all this, data collection was significantly more difficult between the spring of 2020 and 2021.

We conducted our study in a population sample of adolescents in secondary and vocational schools. Inclusion criteria were the following: aged between 13 and 18 years, speaking Hungarian, be able to read the questionnaires and answer all the questions. Exclusion criterion was the inability to complete the self-administered questionnaires for any reason, e.g., not Hungarian mother tongue, inability to complete the test.

After detailed written and oral information, the adolescents and their parents signed the informed consents. We highlighted the study anonymity, the code-decode system (including the rules for breaking the anonymity code in case of the risk of acute suicide), and that the consent of the participants in the study may be withdrawn at any time without giving reasons. The ethical approval and prior anonymity were ensured by a code-decode system. The questionnaires and interview were filled in anonymously, and only the participant's code number were included in them. Prior to completion, adolescents were asked to fill in a code-decode sheet on which they were asked to fill in their own and their parents' contact details. In the event of an acute risk of suicide, they could be contacted by a child and adolescent psychiatrist and within 24 hours to recommend a personal assessment and, if necessary, further care. We stored the code-decode sheets away from the completed questionnaires in a closed wardrobe and only used for the identification of emergency cases not for any other purpose.

The students completed the questionnaire and the interview during class time in about 50-55 minutes. Two research coordinators were present during the completion of the survey to provide information, to answer questions directly related to the survey, and to identify emergencies immediately after completing the survey and contact the child and adolescent psychiatrist colleagues providing clinical background if necessary.

After the outbreak of SARS-CoV-2, we collected data online. We sent out self-reporting questionnaires to the adolescents via email and scheduled an appointment for the interview with them. Unfortunately, this new process was associated with a lower participation rate, as they did not know us in person, we had no face-to-face contact with these adolescents.

IV.2.3. Instruments

IV.2.3.1. Measuring NSSI

To measure NSSI we used the Hungarian translated and validated version (134) of the Inventory of Statements About Self-injury (ISAS), which was developed by Klonsky and Glenn in 2009 (127). It is a self-report questionnaire to assess functions and behaviors of self-injury. First – as an introduction – the questionnaire defines NSSI as a direct and deliberate damage to the person's own body, without suicidal intent. The ISAS has two separate sections. The first part assesses the frequency of 12 different NSSI behaviors (there is a 13th option to write a behavior which has not been listed before). The second part asks about the 13 most frequent NSSI functions using 39 items on a 3-point Likert scale (very relevant, somewhat relevant, not relevant). In the end of the ISAS there are two optional open-ended questions, in which the person can write whether there is another reason or motivation for NSSI that was not mentioned in the questionnaire (127).

The first part of the questionnaire provides demographic data on the incidence and prevalence of NSSI (e.g. last date of self-harm, number of self-harming acts committed in lifetime). Klonsky and Glenn split the second part (the 13 functions of NSSI) into two factors for exploratory factor analysis: 1) interpersonal functions – in which NSSI is socially empowered; and 2) intrapersonal functions – in which NSSI is self-initiated. Both factors have excellent internal consistency, with alpha coefficients of .88 for the interpersonal factors and .80 for the intrapersonal factors (127).

The Hungarian translation of ISAS was made by Reinhardt et al in 2022 (134). The questionnaire was validated on 1015 Hungarian secondary school students aged 14–20 years (66.1% girls, $M = 16.81$ years, $SD = 1.42$) and good reliability results were obtained. They used the same two-factor analyses as Klonsky and Glenn and also obtained excellent internal consistency, with the following Cronbach's alpha values: .84 for the intrapersonal and .82 for the interpersonal factors. (134).

IV.2.3.2. Measuring CB

We measured CB with a self-report questionnaire developed by Demetrovics and Zsila in 2018 (135). The questionnaire starts with a definition of cyberbullying by Robert

S. Tokunaga (136). The first two questions measure the frequency of CB during the past year (in the role of the victim and the bully, separately). The third question is about how different forms and roles a person got involved or not in CB during the past year. This question can be answered in a Likert-scale for all eight forms of behavior, defined by Domonkos (2014) (137). We can identify four roles and five groups: 1) victim, 2) bully, 3) both victim and bully, 4) observer, and 5) none of these (135).

Commented [KF4]: Four roles and five groups?

IV.2.3.3. Measuring depressive and anxiety disorders

Depression and anxiety disorders were measured with version 7.0.2 of the Hungarian version of the Mini International Neuropsychiatric Interview – Kid (MINI-KID) (55), which is a structured diagnostic interview to assist in making DSM-5 psychiatric diagnoses for children and adolescents aged 6-18 years (52, 54, 138). Sheehan et al. (52, 54, 138) developed the MINI-KID and investigated the concurrent validity and reliability, while Balázs et al. (55) developed the Hungarian version of the MINI-KID. Both the interrater and test-retest reliability of the original English and Hungarian versions of the MINI-KID were good, criterion validity was acceptable, and sensitivity and specificity were found to be very good or good for the majority of the disorders tested. (55). The interrater reliability Cohen's kappa coefficient (κ) is very good for most psychiatric disorders ($\kappa > 0.80$) and good for one disorder ($\kappa > 0.73$). Test-retest reliability was excellent for 52% of psychiatric diagnoses ($\kappa > 0.80$), very good for 40% of psychiatric disorders ($\kappa > 0.60$), moderate in one case ($\kappa = 0.46$), and poor in another case ($\kappa > 0.36$). The criterion validity results were also acceptable. Sensitivity was very good or good in 61.5% of the mental disorders examined. According to the validity analysis, no weak sensitivity was found. Specificity was also very good in 89.5% of psychiatric diagnoses (55).

IV.2.4. Statistics

Statistical analysis was performed using R (version 3.5.1; R Foundation for Statistical Computing, Vienna, Austria). Chi-square tests were used to test the first and fourth hypotheses. When testing these two hypotheses, α levels below 0.5 were considered significant. To test hypotheses two, and three, we estimated the "regularized" psychological network, as these models provide an analytical framework for modelling f-complex relationships between variables without predetermining which construct serves as the independent, dependent, or mediating variable.

In psychological networks, the nodes represent variables and the weights of the edges represent the relationship between them (e.g. correlation or odds ratio). (139, 140). For a multivariate normal joint distribution of variables, the network model is called a Gaussian graphical model, and the relationship between nodes is usually captured by partial correlation coefficients (141, 142), which show the relationship between the two variables after controlling for the effects of all other variables. Therefore, the absence of an "edge" between two nodes indicates that the two variables are conditionally independent. However, a third variable linked to both would suggest mediation: If this third variable is the only variable that is linked to the other two, then it alone mediates the entire relationship between the two (unlinked) variables. If variables violate normality (e.g. categorical variables), other specifications are used, such as Ising models for dichotomous variables (143) or mixed graphical models (MGMs) (144, 145) for mixed variable types. Although these models use odds ratios (ORs) rather than correlation coefficients, the edges can still be interpreted as conditionally dependent: a missing edge implies independence, and mediating nodes act as mediators.

However, because of the random pattern of the sample, the weight of the edges will never be exactly zero, and some coefficients will be false positives (146). To reduce the chance of false positives in the network, researchers often use "regularisation" techniques. Regularised networks are widely used in clinical psychology (147-152) and psychiatry (142, 153, 154). The present study made use of the so-called least absolute shrinkage and selection operator (LASSO) (155). This algorithm maximizes the sum of absolute weights compared to the unregulated network. In this way, all the coefficients are reduced, and the small coefficient becomes zero, so the network becomes sparser than the unregulated one. The LASSO technique estimates several networks with different regularization levels and selects the best-fitting model based on some criterion. In our model, we used the expected Bayesian Information Criterion (156) for model selection, which has been shown to perform particularly well in retrieving the true network structure (157-159).

Regularised network models represent potential mediating paths between variables. Bootstrapping with 1000 bootstrap samples was used to determine confidence intervals (CIs) of the edge weights. However, due to the regularization technique, the sampling distribution was biased towards zero (i.e., many edges are forced to be zero), so

the CIs were also biased downwards. To add an alternative measure of CI, we also report the proportion of bootstrapped edge weights that are non-zero ("non0"). In summary, we report the OR values of the variables with CIs and non0 values. For further information on psychological networks, see Györi et al. (2021) (160).

The CB group variable in the survey had five levels: bully, victim, bully and victim, witness and none. Therefore, being a witness and being a bully and/or victim were mutually exclusive categories. Due to the low prevalence of the first category in the sample (only one person indicated that they were a bully only), the bully only variable could not be used in the network models and was therefore grouped together with the bully and/or victim variable. To identify differences between victim and bully, we estimated two networks: in the first network, we grouped the victim-only and bully and/or victim variables, while in the second network, we only included children who were victims but not bullies. Consequently, in both models, we grouped the variables bully only and bully and victim, and both models included the witness variable. The difference was that in the first model, victims could potentially have been bullies, whereas in the second model, victims were not bullies.

V. Results

V.1. The first study

V.1.1. Included studies

Among the 97 included studies, which are shown in Table 5, we identified 178 effect sizes.

Table 5: The included relevant studies. Previously published by the candidate in Farkas et al. 2023 (129).

Author (year)	Country	Year of data collection	Mean age (SD)	Sample size (%female)	Sampling	Terminology	Suicidal intent distinction	Measurement	Prevalence
Aldrich (2018) (161)	USA	2013-2015	12.86 (.85)	121 (55.4%)	C	SITB	no	questionnaires validated for other than SIB	lifetime: 18.2% overall 6-months: 16.1% female, 12% male
Badoud (2015) (162)	Switzerland	—	15.72 (1.74)	130 (50.8%)	C	NSSI	yes	questionnaires validated for other than SIB	1-year: 25.4% overall 24.2% female 26.6% male
Baetens (2015) (163)	Belgium	2011	16.07 (1.12)	358 (48%)	C	NSSI	yes	questionnaires validated for other than SIB	1-year: 9.8%; lifetime: 13.4%
Barrocas (2015) (164)	China	—	16.02 (.61)	617 (51.4%)	C	NSSI	yes	not validate	lifetime: 23.8% overall 26% male 21.7% female
Bhola (2017) (61)	India	2013	17.5 (14.2)	1571 (57.8%)	RA	NSSI	yes	validate for SIB	1-year: 33.8%

Brausch & Woods (2019) (165)	USA	—	13.19 (1.19)	436 (52.7%)	C	NSSI	yes	validate for SIB	6-months: 17.2% overall 14.6% male 18.9% female
Buelens (2020) (166)	Belgium	2018	15 (1.81)	2130 (54%)	C	NSSI/ NSSI-D	yes	single-item question	lifetime: 21.8% → 7.6% met the NSSI-D diagnosis 29.9% female, 12% male; NSSI-D diagnosis: 11.7% female, 2.9% male
Calvete (2015) (167)	Spain	2010	15.32 (1.97)	1864 (51.45%)	RA	NSSI	yes	validate for SIB	1-year: 55.6% overall 58% female 53.3% male
Carvalho (2017) (168)	Portugal	2012	16.75 (1.31)	1763 (52.9%)	C	NSSI	yes	validate for SIB	lifetime: 29.5% overall 29.4% male 29.7% female
Cassels (2018) (169)	UK	2005-2008	—	1238 (54.5%)	C	NSSI	yes	questionnaires validated for other than SIB	lifetime: 11.89%
Castro & Kirchner (2017) (170)	Chile	—	14.98 (1.69)	965 (57%)	C	NSSI	yes	validate for SIB	lifetime: 49.6% overall 41.4% male 55.5% female
Chen & Chun (2019) (171)	Taiwan	2011-2012	15.23 (1.24)	438 (100%)	C	NSSI	yes	validate for SIB	1-year: 36.8%

Çimen (2017) (172)	Turkey	2014	15.00 (1.13)	555 (56.6%)	C	NSSI	yes	validate for SIB	lifetime prevalence: 11.4%
Claes (2015) (104)	Belgium, Netherlands	2013	15.56 (1.32)	785 (44.5%)	C	NSSI	yes	validate for SIB	lifetime prevalence: 20.1%
Copeland (2019) (173)	USA	2009-2010	–	5870 (56.6%)	C	self-cutting	no	single-item question	1 year: 7% overall 4.7% male 11.4% female
Donath (2019) (174)	Germany	2015	14.91 (.73)	10638 (49.8%)	RE	D-SIB	no	single-item question	1 year: 17.8% overall 5.1% male 29.7% female
Doyle (2015) (175)	Ireland	1999-2000	M= 16 years, SD= 0.715	856 (48.8%)	RE	SH	no	validate for SIB	lifetime: 12.1% overall 18.1% female 6.4% male
Duarte (2019) (176)	Portugal	2017-2018	study 1: 16.1 (1.8) study 2: 15.4 (1.8)	study 1: 620 (67.9%) study 2: 411 (67.9%)	C	DSH	no	validate for SIB	lifetime: 21.1% in study 1, 26.5% in study 2
Emerson (2019) (177)	Australia	2000-2001	14	9845 (47.6%)	RE	SH	no	single-item question	1 year: 14.9%
Emery (2017) (178)	Canada	–	13.38 (.51)	639 (53%)	C	NSSI	yes	validate for SIB	lifetime: 18% overall 22.7% female 13% male

Endo (2017) (179)	Japan	2008- 2009	15.2 (1.7)	17347 (50.2%)	C	SH	no	single-item question	1 year: 3.8%
Esposito (2019) (180)	Italy	2016	15.60 (1.65)	640 (60.5%)	C	NSSI	yes	not validate	6-months: 15.3% overall 14.6% male 15.8% female
Farhat (2020) (181)	USA	2000	–	2234 (43.9%)	C	SIB	yes	single-item question	lifetime: 18% overall 24% female, 13.7% male
Fraser (2018) (182)	New Zealand	2012- 2015	15.16 (2.61)	1799 (56.5%)	C	NSSI	yes	validate for SIB	lifetime: 20.6% overall 28.7% female 9.9% male
Gandhi (2015) (183)	Belgium	2014	16.13 (1.47)	568 (61.8%)	C	NSSI	yes	validate for SIB	lifetime: 16.5% overall 12.8% female 3.9% male
Gandhi (2017) (184)	Belgium	2015- 2016	15.0 (1.84)	528 (50.4%)	C	NSSI	yes	single-item question	lifetime: 14.2% overall 20.8% female 7.7% male
Gandhi (2018) (185)	Belgium	2012- 2013	–	3880 (51%)	C	NSSI	yes	single-item question	lifetime: 21% overall 26% female 17% male
Gandhi (2018) (186)	Belgium	2015	16.6 (.96)	401 (51.5%)	C	NSSI	yes	single-item question	lifetime: 16.5% overall 20.8% female 11.9% male
Gandhi (2019) (187)	Belgium	2015- 2017	15.0 (1.85)	528 (50.4%)	C	NSSI	yes	single-item question	1 year: 7.6%

Garisch & Wilson (2015) (188)	New Zealand	2008-2009	16.35 (.62)	1162 (43%)	RE	NSSI	yes	validate for SIB	lifetime: 48.7 % overall 49.4% female 48% male
Gaspar (2019) (189)	Portugal	2014	14.8 (1.2)	3262 (54%)	RE	NSSI	no	single-item question	1 year: 20.3% overall females 23.7% males 16.3%
Geulayov (2018) (190)	UK	2015	–	5520 (51%)	RE	non-fatal SH	no	not validate	1 year: 5.8% overall 8.9 % females 2.6% males
Gromatsky (2017) (191)	USA	2013-2014	14.39 (.63)	550 (100%)	C	NSSI	yes	validate for SIB	lifetime: 7.8%
Guerreiro (2015) (192)	Portugal	2009-2011	15.6 (1.7)	1713 (55.6%)	C	SH	no	validate for SIB	lifetime: 7.3% overall 10.5% females 3.3% males
Hamada (2018) (193)	Japan	2011	13.9 (.2)	1840 (51.4%)	C	self-cutting	no	single-item question	lifetime: 8.9% overall 5.6% males 11.9% females
Han (2018) (194)	China	2013	14.81	5726 (50.3%)	RA	SH	yes	not validate	6 months: 45.3% overall 41.6% male 49% female
Hanania (2015) (62)	Jordan	–	14.53 (1.71)	952 (49.8%)	C	NSSI	yes	validate for SIB	lifetime: 22.6% overall males 26.9% females 18.1%

Heerde (2015) (195)	USA, Australia	2002-2003	Washington State: 14.1 Grade 7, 15.1 Grade 9; Victorian: 13.9 Grade 7, 14.9 Grade 9	3876 (51%)	RE	DSH	no	single-item question	1 year: 1.5% in Grade 7 and 0.9% in Grade 9 for males, 4.1% and 1.3% for Grade 7 and Grade 9 for females
Horváth (2018) (57)	Hungary	2009-2010, 2013	vocational school sample: 15.21 (.77) high-school sample: 15.09 (.75)	vocational school sample: 140 (40%); high-school sample: 995 (59.2%)	RE, C	D-SIB	yes	validate for SIB	lifetime: 29.4% in the vocational school group, 17.2% in the high school group vocational school sample: 25.6% males, 35.4% females high-school sample: 14.4% males, 19% females
Horváth (2020) (58)	Hungary	2015-2017	15.43 (1.14)	161 (50%)	C	NSSI	yes	validate for SIB	lifetime: 23.6% overall 8.64% males 33.8 % females
Huang (2017) (196)	Taiwan	2008-2010	16.02 (.52)	5879 (56.7%)	C	DSH	yes	single-item question	lifetime: 25.0% overall 28.96% female 19.9% male
Jantzer (2015) (197)	Germany	2012	12.8 (1.95)	647 (50.7 %)	C	NSSI	yes	single-item question	1 year: 10.9%
Jiang (2016) (107)	China	2013-2014	13.17 (1.10)	813 (43.4%)	C	NSSI	yes	single-item question	lifetime: 29.0% overall 27.9% male 31.3% female

Kądziela-Olech (2015) (63)	Poland	2013	16.7 (1.64)	2220 (46.3%)		D-SIB, NSSI	yes	validate for SIB	D-SIB lifetime: 8.3 %; NSSI lifetime: 4.8% D-SIB lifetime: 6.7% females, 9.6% males; NSSI lifetime: 6.3% males, 3.0 % females
Kaess (2020) (198)	10 European countries + Israel	2009-2010	14.84 (.9)	1933 (51.47%)	RE	D-SIB	yes	validate for SIB	lifetime: 24.9%; 1-year: 6.7% overall 7.0% male 6.4% female
Kang (2018) (199)	China	–	15.63 (1.67)	3555 (52.0%)	RA	NSSI	yes	validate for SIB	6-months: 13.8% overall 16.6% female 10.4% male
Kelada (2016) (200)	Australia	2014	14.49 (1.38)	117 (56.4%)	C	self-injury	yes	single-item question	lifetime: 19.7%
Kiekens (2015) (201)	Belgium, Netherlands	2012	15.52 (1.34)	946 (44%)	RA	NSSI	yes	validate for SIB	lifetime: 24.3% overall 24.5% male 24.4% female
Kitagawa (2017) (202)	Japan	2008-2009	–	18018 (50.3%)	C	SH	yes	single-item question	1 year: 7.3%
Klemra (2017) (203)	UK	2013-2014	15	1519 (48.8 %)	RE	SH	no	single-item question	lifetime: 21.5 % overall 31.9% females 11.4% males

Koenig (2017) (204)	Germany	2010-2012	14.7	506 (52.1%)	RE	D-SIB	yes	validate for SIB	1-year: 8.3 % overall lifetime: 30.7% male 47.5% female
Latina & Stattin (2018) (205)	Sweden	2008, 2010	13.89 (.75)	2029 (50%)	RE	SH	yes	validate for SIB	6 months: 31%
Law & Shek (2016) (206)	China	—	12.53 (.66)	2023 (52%)	RA	SH	yes	not validate	lifetime: 15.3% overall 13.9% male 16.5% female
Lee (2016) (207)	South Korea	—	14.38 (1.68)	784 (48.8%)	C	SH/N SSI	no	validate for SIB	lifetime: 12.4%
Li (2019) (65)	China	2015-2016	15.36 (1.79)	22628 (51.4%)	RE	NSSI	no	not validate	12 months: 32.1% overall male 35.2% female 29.1%
Lin (2017) (208)	Taiwan	2013	15.83 (.38)	2170 (51.5%)	C	NSSI	yes	single-item question	1 year: 20.1% overall female 23.8% male 16.9%
Liu (2017) (209)	Taiwan	2008-2009	15.44 (.61)	2479 (60.3%)	C	SH	yes	single-item question	1 year: 10.1% overall female 11.2% male 8.3%
Liu (2018) (210)	China	2015	14.97 (1.46)	11831 (49.1%)	RE	NSSI	yes	validate for SIB	lifetime: 23.7%; 1-year: overall 18.9% male 17.8% female 19.9%

Luyckx (2015) (211)	Belgium	–	15.95 (1.30)	348 (100%)	C	NSSI	yes	validate for SIB	lifetime: 20.7%
Lüdtke (2017) (212)	Switzerland	2010	14.95 (.74)	447 (48%)	C	NSSI	yes	validate for SIB	1 year: 5.2% male 13.1% female
Madjar (2019) (213)	Israel	–	14.96 (1.33)	594 (45.6%)	C	NSSI	yes	validate for SIB	1-year: 19.5% male, 10.7% female
Mars (2019) (214)	UK	–	16.8 (2.9)	4795 (73%)	RE	NSSI	yes	single-item question	lifetime: 11.7% overall 5.7% male, 15.9% female
Martinez-Ferrer & Stattin (2019) (215)	Sweden	–	13.94 (.74)	987 (48.3%)	C	SH	yes	validate for SIB	6 months: 36%
McManus (2020) (216)	UK	2000, 2007, 2014	–	2000: 103 2014: 122	RE	NSSH	yes	single-item question	lifetime: 6.1% in 2000, 10.9% in 2014
Monto (2018) (217)	USA	2015	–	64 671 (52.5%)	RE	NSSI	yes	single-item question	1-year: 23.8% female, 11.3% male
Morey (2017) (218)	UK	2013	–	2000 (13-15- 54.2%; 16-18- 50.2%)	RE	SH	no	single-item question	lifetime: overall 15.5% females 23.1%, males 7.1%
Nguyen (2020) (88)	Vietnam	2018	11	648 (47.7%)	RA	SH	no	single-item question	lifetime: 7.1%

Oktan (2017) (64)	Turkey	2016	17.02 (1.59)	263 (54.3%)	C	SHB	yes	validate for SIB	lifetime: 44.9% overall 39.2% females, 51.7% males
Pawłowska (2015) (219)	Poland	–	16.92 (1.15)	6883 (69%)	C	self- injury	no	not validate	lifetime: 24.9% overall 16.2% females, 8.7% males
Pawłowska (2016) (220)	Poland	–	16.91 (1.11)	5685 (30%)	C	self- injury	no	not validate	lifetime: 14% overall 6.9% males, 15.7% females
Peng (2019) (221)	China	2016	13.6 (1.1)	2647 (51.2%)	RE	SH	yes	single-item question	6-months: 1.4% females, 1.3% males
Pisinger (2019) (222)	Denmark	2014	17.9 (1.5)	66284 (62%)	RE	SH	no	single-item question	lifetime: 20% overall 24% females, 12% males
Plener (2015) (223)	Germany	–	14.85 (.58)	452 (46.2%)	C	NSSI	yes	validate for SIB	lifetime: 20.4% overall 29.8% females, 12.9% males
Plener (2016) (51)	Germany	2014	15.91	91 (57.1%)	RE	NSSI	yes	validate for SIB	lifetime: 26.9% overall 1.9% males 12.8% females
Quarshie (2020) (224)	Ghana	2017	16.8 (1.38)	444 (51.8%)	RE	SH	no	single-item question	lifetime prevalence: 23.8% males, 30% females; 1- year prevalence: 24.8% females, 19.2% males

Reigstad & Kvernmo (2017) (225)	Norway	2003-2005	—	4881 (50.1%)	C	DSH	no	single-item question	1-year: 22.3% overall 28.8% females, 15.9% males
Ren (2018) (226)	Taiwan	—	15.45 (.54)	1989 (52.0%)	RE	NSSI	yes	validate for SIB	1 year: 20.8% overall 24.4% females, 16.8% males
Schwartz-Mette & Lawrence (2019) (227)	USA	2016-2018	15.68 (1.49)	186 (69.9%)	C	NSSI	yes	single-item question	1 year: 27.4% overall 21.4% males, 30% females
Sigurdson (2018) (228)	Norway	1998, 1999-2000	BL: 13.7 (.58); FU: 14.9 (.6)	BL: 2464 (50.8%); FU1: 2432 (50.4%)	RE	SH	no	single-item question	lifetime: BL - 2.5% males, 7.2% females; FU - 4.9% males, 11.6% females
Simioni (2017) (229)	Brazil	2010-2011	—	2508 (47.2%)	RE	DSH	no	questionnaires validated for other than SIB	lifetime: 1.5%
Solis-Bravo (2019) (230)	Mexico	2016	12.3 (1.3)	438 (57.2%)	C	NSSI	yes	validate for SIB	lifetime: 11.5%
Somer (2015) (231)	Turkey	2010-2011	16.8 (1.26)	1656 (55%)	RE	NSSI	yes	validate for SIB	lifetime: 31.3% overall 33% female, 29.4% male
Stanford (2017) (232)	Australia	2014-2015	14.9 (1.6)	1521 (56.4%)	C	SH	no	single-item question	6-months: 16.8% overall 12.1% male, 20.5% female

Sutin (2018) (233)	Australia	2014	14.4 (.49)	2948 (48.3%)	RE	SH	no	single-item question	1-year: 8.8% overall 3.68% males, 14.5% females
Tang (2016) (234)	China	2013-2014	14.7 (1.9)	4405 (49.67%)	RA	NSSI	yes	validate for SIB	1-year: 29.2% overall 30.9% females, 27.4% males
Tang (2018) (235)	China	2014-2015	15.2 (1.8)	15623 (48.5%)	RE	NSSI	yes	validate for SIB	1-year: 29% overall 27.9% males, 30.5% females
Tanner (2016) (236)	Australia	2010	14.20 (1.03)	2637 (58.8%)	C	NSSI	yes	validate for SIB	lifetime: 7.2% males, 11.9% females
Tilton-Weaver (2019) (237)	Sweden	2013-2014	13.65 (.64)	2769 (47.3%)	C	NSSI	yes	validate for SIB	6-months: 5%
Tseng & Yang (2015) (238)	Taiwan	—	—	391 (54.73%)	C	NSSI	yes	validate for SIB	1-year: 9.7% overall 18.7% females; 10.2% males
Victor (2019) (239)	USA	2000-2014	13	2127	C	NSSI	yes	validate for SIB	lifetime: 3%;
Wan (2015) (240)	China	2008	16.1 (2.8)	17622 (51.2%)	C	NSSI	yes	single-item question	lifetime: 17.0 % overall 16.9% males, 17.1% females
Wan (2019) (60)	China	2013-2014	15.44 (1.8)	14820 (50.2%)	RA	NSSI	yes	single-item question	1-year: 26.1% overall 24.3% female, 27.9% male

Wan (2020) (66)	China	2013- 2014	15.59 (1.80)	9704 (52.60 %)	RA	NSSI	yes	single-item question	1-year: 38.5 % overall 37.1% female, 40.1% male
Wang (2016) (241)	China	—	14.63 (1.25)	5423 (52.6%)	C	NSSI	yes	single-item question	6-months: 18.3% overall 21.2% female 14.6% male
Zetterqvist (2016) (242)	Sweden	2011	16.56	3060 (50.5%)	RE	NSSI/ NSSI- D	yes	validate for SIB	1-year: NSSI at least one episode: 35.1% overall 10.6% female 11.6% male NSSID: 6% overall 9.9% female 2.1% male
Zhang (2016) (67)	China	2013- 2014	15.18 (1.79)	25378 (51.4%)	C	NSSI	yes	single-item question	lifetime: 27.5 % overall 28.6% male, 26.4% female
Zubrick (2015) (243)	Australia	2013- 2014	15.51 (1.75)	2653 (48.4%)	RE	SH	yes	single-item question	lifetime: 10.9% overall 7.5% males, 17.7% females 1-year: 8% overall 4.6% males, 11.9% females

Abbreviations: BL: baseline sample, C: convenience sampling, D-SIB: deliberate self-injurious behavior, DSH: deliberate self-harm, FU: follow-up sample, NSSI: non-suicidal self-injury, NSSI-D: nonsuicidal self-injury met the DSM-5 criteria, RA: randomized sampling, RE: representative sampling, SH: self-harm, SITB: self-injurious thoughts and behavior.

We excluded six outlying effect sizes, and by the end of the procedure we had altogether 439 818 participants. The overall average prevalence in the studies was 16.0% (95% CI = 14.7 - 17.4, $k = 172$), and there was a heterogeneous effect, $Q (171) = 30136.96$, $p < .001$, $I^2 = 99.43$. When assessing publication bias, while Egger's test showed significant asymmetry (intercept: -2.88, $p = .046$), the funnel plot showed a symmetric distribution based on visual inspection, which was confirmed by no imputed studies in the Duval and Tweedie's trim and fill procedure.

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From the 97 included studies, 74 articles reported prevalence data for females and males separately. 79 effect sizes reported for females, and two effect sizes were outliers, so we excluded these. We found an average prevalence of 19.4% for females (95% CI = 17.5 - 21.4, $k = 77$), and the effect was heterogeneous, $Q (76) = 8660.74$, $p < .001$, $I^2 = 99.12$. 75 effect sizes reported for males, and we excluded one outlying effect size. We found an average prevalence of 12.9% (95% CI = 11.3 - 14.8, $k = 74$), and it was again a heterogeneous effect, $Q (74) = 10315.75$, $p < .001$, $I^2 = 99.2$.

V.1.2. Terms and definitions of self-injurious behavior in the included studies

There was various terminology of SIB among the included studies. All the studies defined SIB as a deliberate damage to oneself, but not all of them defined it as a nonsuicidal intent: 73.5% of the articles (72) made a clear distinction between suicidal and nonsuicidal intent.

From the included 97 papers 11 different terms were used for SIB. The most frequently used term was 'NSSI', which appeared in 60 articles, and was only used in nonsuicidal meaning. In these studies, we found 103 effect sizes, which showed an average prevalence of 18.4% (95% CI = 16.9 - 20). The term 'self-harm' was used in 21 papers showing an average prevalence of 12.7% (95% CI = 10 - 16, $k = 34$). Only 5 articles used the term 'deliberate self-harm' (15.1%, 95% CI = 11.2 - 20.2, $k = 8$), also 5 papers used the term 'deliberate self-injurious behavior' (D-SIB) (16.2%, 95% CI = 9.7 - 25.8, $k = 12$) and 'self-injury' in 3 articles (12.4%, 95% CI = 8.2 - 18.4, $k = 5$). The rest of the papers used the following terms: 'self-injurious thoughts and behavior' (SITB) (14.4%, 95% CI = 9 - 22.2, $k = 2$), 'self-cutting', 'SIB' (18.3%, 95% CI = 10.2 - 30.6, $k = 2$), 'non-fatal SH' (4.9%, 95% CI = 1.5 - 15.3, $k = 2$) and 'self-harm behavior' (45.2%, 95% CI = 33.4 - 57.6, $k = 2$). We found that the terms 'SIB', 'D-SIB', and 'self-harm

behavior' was used only in nonsuicidal meaning, while papers used the terms 'SITB', 'self-cutting', and 'non-fatal SH' did not make the difference. Only two studies measured NSSI based of the DSM-5 criteria, and they called the phenomenon NSSI-D (5.3%, 95% CI = 2.6 – 10.6, k = 4). A similar pattern was found both among females and males (Table 6).

Table 6: The prevalence differences in the terms of SIB. Previously published by the candidate in Farkas et al. 2023 (129).

	Prevalence estimates (95% CI)		
	Overall	Only female samples	Only male samples
DSH	15.1% (11.2 – 20.2) (k = 8)	11.5% (6.2 – 20.4) (k = 4)	6.3% (3.2 – 11.8) (k = 4)
D-SIB	16.2% (9.7 – 25.8) (k = 12)	20.1% (10.8 – 34.4) (k = 6)	12.8% (7.3 – 21.5) (k = 6)
non-fatal SH	4.9% (1.5 – 15.3) (k = 2)	8.9% (7.9 – 10) (k = 1)	2.7% (2.1 – 3.3) (k = 1)
NSSI	18.4% (16.9 – 20) (k = 103)	20.8% (18.2 – 23.7) (k = 47)	17.1% (15.1 – 19.3) (k = 44)
NSSI-D	5.3% (2.6 – 10.6) (k = 4)	10.6% (8.8 – 12.8) (k = 2)	2.5% (1.8 – 3.4) (k = 2)
self-cutting	7.4% (4.8 – 11.2) (k = 4)	10.4% (8.2 – 13.2) (k = 2)	4.9% (4 – 6) (k = 2)
self-injury	12.4% (8.2 – 18.4) (k = 5)	16.1% (15.2 – 17.1) (k = 2)	7.7% (6.2 – 9.6) (k = 2)
SH	12.7% (10 – 16) (k = 34)	18.2% (13.5 – 24.1) (k = 13)	9% (5.5 – 14.4) (k = 13)
SHB	45.2% (33.4 – 57.6) (k = 2)	39.2% (31.5 – 47.4) (k = 1)	51.7% (42.8 – 60.5) (k = 1)
SIB	18.3% (10.2 – 30.6) (k = 2)	24% (21.4 – 26.8) (k = 1)	13.7% (11.9 – 15.7) (k = 1)
SITB	14.4% (9 – 22.2) (k = 2)	16.1% (8.9 – 27.4) (k = 1)	12% (5.5 – 24.2) (k = 1)

Abbreviations: D-SIB: deliberate self-injurious behavior, DSH: deliberate self-harm, NSSI: non-suicidal self-injury, NSSI-D: nonsuicidal self-injury met the DSM-5 criteria, SH: self-harm, SHB: self-harm behavior, SIB: self-injurious behavior, SITB: self-injurious thoughts and behavior, k: number of the included studies.

V.1.3. Measurements of SIB in the included studies

Among the included studies there were single-item questions, self-reported questionnaires and diagnostic interviews to measure SIB. As mentioned previously, only two papers measured NSSI based on the DSM-5 criteria: one used self-report questionnaires (242) and the other used developed single-item questions (166). The Deliberate Self-Harm Inventory (56) was the most frequently used questionnaire, which occurred in 13 articles. Both the Inventory of Statements About Self-injury (127) and the Functional Assessment of Self-Mutilation (124) were used in 5 papers. Effect sizes based on a single item to assess SIB found an average prevalence of 11.6% (95% CI = 9.3 – 14.5, k = 31). For non-validated questionnaires the prevalence estimate was 14.8% (95% CI = 12.8 – 17.2, k = 60). Questionnaires that had been validated for other constructs showed an average prevalence of 14.7 % (95% CI = 9.8 – 21.5, k = 6). Finally, questionnaires that had been validated for SIB showed the highest average percentage: 18.8% (95% CI = 16.8 – 20.9, k = 79). This pattern was confirmed when considering females samples, however the pattern was only partially confirmed for males (Table 7).

Table 7: Comparison of female and male samples in terms of measurement of SIB. Original table made for the dissertation.

	Prevalence estimates (95% CI)	
	Female samples	Male samples
Single-item questions	16.5% (11.9 – 22.4, k = 13)	8.6% (5.3 – 13.6, k = 13)
Non-validated questionnaires	17.2% (15 – 19.6, k = 29)	11.7% (9.2 – 14.9, k = 29)
questionnaires validated for other than SIB	20.4% (13.5 – 29.7, k = 2)	19% (8.3 – 37.8, k = 2)
questionnaires validated for SIB	21.9% (18.4 – 25.9, k = 35)	15.7% (12.7 – 19.2, k = 32)

Abbreviations: CI: confidence interval, k: number of the included studies, SIB: self-injurious behavior.

V.1.4. Sampling

Of the 172 effect sizes 99 were based on convenient sampling and showed an average prevalence of 15.2% (95% CI = 13.4 – 17.2). Only 18 effect sizes were based on samples that applied randomization showing a prevalence of 24.7% (95% CI = 18.9 – 31.6). For 55 sample sizes the sample was representative of the population. The representative samples showed a pooled prevalence of 15.1% (95% CI = 13.2 – 17.4). A similar pattern appeared for females and males (Table 8).

Table 8: Comparison of female and male samples in terms of sampling. Original table made for the dissertation.

	Prevalence estimates (95% CI)	
	Females	Males
Convenience samples	18.5% (16.1 – 21.1, k = 43)	12.8% (10.4 – 15.7, k = 40)
Representative samples	18.2% (15.4 – 21.4, k = 26)	10.9% (8.7 – 13.6, k = 26)
Random samples	29.8% (20.0 – 42.0, k = 8)	22.3% (13.9 – 33.9, k = 8)

Abbreviations: CI: confidence interval, k: number of the included effect sizes.

V.1.5. Place of data collection of the included studies

We found publications from all over the world. From the 97 included papers we found three collaborations in which data was collected in multiple countries, and the rest of the data was collected in a single country.

There were some differences according to the continent the data was collected, when we inspected all the effect sizes. There were 3 effect sizes in two publications from South America that showed an average prevalence of 33% (95% CI = 13.7 – 60.3), while two effect sizes were found in one publication from Africa showing an average prevalence of 24.4% (95% CI = 19.1 – 30.7) and data for two effect sizes published in the same paper were collected in North America and Australia & Oceania as part of an international cooperation that showed a prevalence of 2.6% (95% CI = 1.3 – 4.9). After excluding these, there was a significant difference between the prevalence estimates from the different continents (Table 9), $Q(3) = 10.97, p = .012$. More specifically, prevalence estimates from Asia (19.5%, 95% CI = 17.1 – 22.2, $k = 51$) were significantly larger than those from the other three continents (14.6%, 95% CI = 13.1 – 16.2, $k = 114$), $Q(1) = 11.20, p = .001$. As shown in Table 9, the effect of continent was similar when inspecting effect sizes for female and male samples separately.

Table 9: The prevalence differences among continents. Previously published by the candidate in Farkas et al. 2023 (129).

	Prevalence estimates (95% CI)		
	Overall	Only female samples	Only male samples
Asia	19.5% (17.1 – 22.2) (k=51)	22.3% (19.4 – 25.4) (k = 23)	19.5% (16.6 – 22.8) (k = 22)
Australia & Oceania	14.1% (9.5 – 20.5) (k=13)	18.5% (11.8 – 27.8) (k = 6)	10.0% (4.3 – 21.5) (k = 6)
Europe	14.7% (12.9 – 16.8) (k=87)	19.5% (17.0 – 22.4) (k = 37)	10.8% (8.5 – 13.79) (k = 36)
North America	13.8% (10.2 – 18.4) (k=14)	14.3% (10.5 – 19.2) (k = 7)	11.5% (5.9 – 21.1) (k = 6)

Abbreviations: CI: confidence interval, k: number of the included effect sizes.

For females, there was a tendency-level difference between prevalence estimated from Asia (22.3%, 95% CI = 19.4 – 25.4, k = 23) and other continents (18.5%, 95% CI = 16.1 – 21.2, k = 50), $Q(1) = 3.50, p = .061$. For males, the average prevalence estimates from Asia (19.5% (95% CI = 16.6 – 22.8, k = 22) was significantly higher than that from other continents (10.8% (95% CI = 8.8 – 13.2, k = 48), $Q(1) = 20.54, p < .001$. Figure 3. shows a comparison of publications from Asian and non-Asian countries (SIB prevalences overall, among males and females separately).

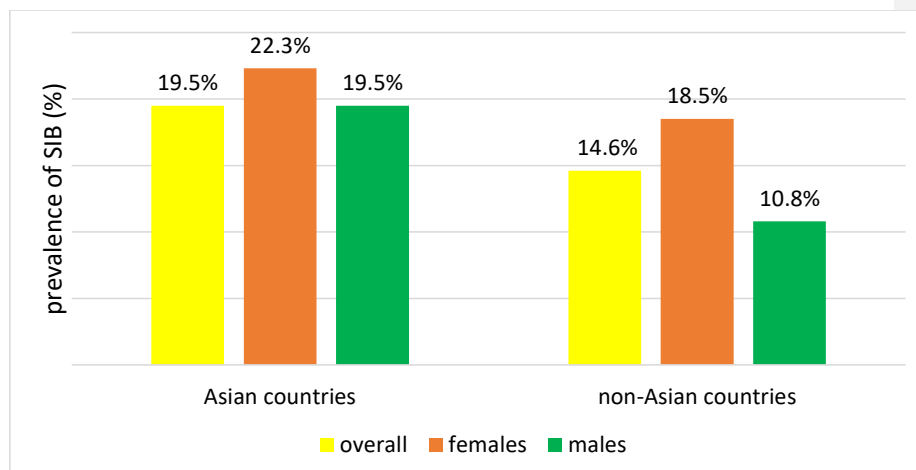


Figure 3: The continental differences about the prevalence of SIB, if we compare Asian publications with non-Asian ones. Original figure made for the dissertation.

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V.1.6. Year of data collection

For assessing the effects of the year of data collection, we chose to focus on the first measurement point in case of the 17 longitudinal studies. In this analysis, 7 outliers appeared that were then excluded. Data for primary studies were collected between 1998 and 2018. The year of data collection had a significant, positive effect on the 171 effect sizes (coefficient: 0.035, $p = .008$), that is, more recent studies found larger prevalence.

For females, three outliers were excluded resulting in 76 effect sizes for this analysis. The year of data collection had a tendency-level effect on the effect sizes (coefficient: 0.031, $p = .06$). For males, two outliers were excluded resulting in 73 effect sizes. For males, year of data collection had a significant positive effect (coefficient: 0.054, $p = .007$), again, suggesting larger prevalence in more recent studies.

For further investigation, we restricted the year of data collection to 2013 and onward in order to assess the effect within a timeframe that corresponds to the publication years of the articles included in our meta-analysis (2015 and onward). Data for 119 effect sizes were collected in or after 2013. When considering only these studies, the effect of year of data collection was not significant on the effect sizes (coefficient: -0.015, $p = .72$). The same was found for the 53 effect sizes for females (coefficient: -0.005, $p = .92$) and for the 51 effect sizes for males (coefficient: -0.05, $p = .49$).

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V.1.7. Mean age of the included samples

For assessing the effects of the mean age of the samples, we chose to focus on the first measurement point in case of the 17 longitudinal studies. In this analysis, 7 outliers appeared that were then excluded. For an additional 6 effect sizes we could not extract the sample's age and thus those were also excluded from this analysis. This resulted in 165 effect sizes. The mean age of the sample ranged from 11.0 to 18.53 years. The mean age of the sample did not have a significant effect on the effect size (coefficient: 0.067, $p = .12$). In a similar vein, for the 74 effect sizes reported for females, the mean age of the sample did not have an effect (coefficient: 0.04, $p = .55$). Nor did it for the 71 effect sizes for males (coefficient: 0.09, $p = .23$).

V.1.8. Suicidal Intent

For 125 effect sizes suicidal intent was excluded and showed a pooled estimate of 18.3% (95% CI = 16.7 – 19.9). This was significantly higher than what was found in studies that did not exclude suicidal intent (11.3%, 95% CI = 9.3 – 13.7, $k = 47$), $Q(1) = 20.52$, $p < .001$. This pattern was also confirmed when assess for only-male and only-female samples (Figure 4). For males, studies that excluded suicidal intent found a significantly higher prevalence (16.5%, 95% CI = 14.6 – 18.6, $k = 53$) than studies that did not (7.1%, 95% CI = 4.8 – 10.4, $k = 21$), $Q(1) = 17.31$, $p < .001$. For females, studies that excluded suicidal intent found a significantly higher prevalence (21%, 95% CI = 18.4 – 24, $k = 56$) than studies that did not (15.5%, 95% CI = 13.2 – 18.2, $k = 21$), $Q(1) = 7.95$, $p = .005$.

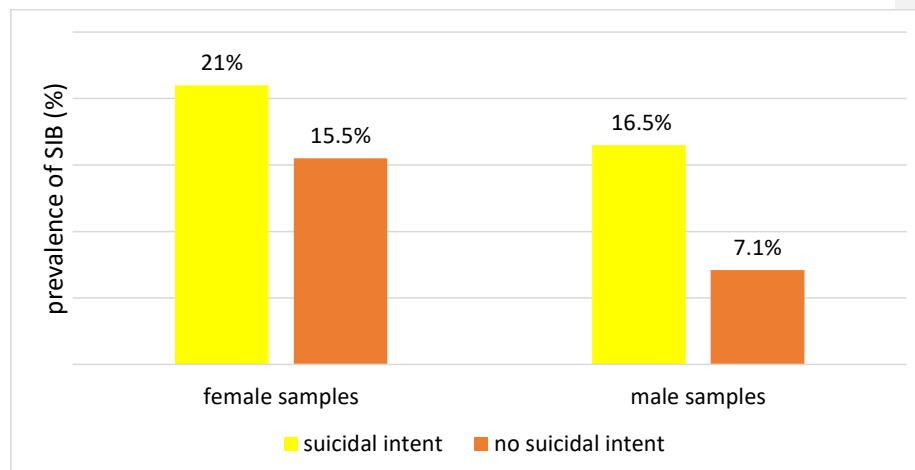


Figure 4: Comparison of female and male samples in terms of both suicidal and non-suicidal intent (“no suicidal intent” means that suicidal intent was excluded in the studies). Original figure made for the dissertation.

Commented [KF8]: Nem lenne jobb a suicidal intent címke helyett valami olyasmí, hogy “both suicidal and non-suicidal intent”

V.1.9. Prevalence of SIB

We found 92 effect sizes reporting on lifetime prevalence, 72 effect sizes that estimated 1-year and 17 that estimated 6-month prevalence of SIB. An average of 17.9% (95% CI = 16.3 – 19.5) was found overall when lifetime prevalence was assessed. This estimate was 22.9 (95% CI = 20.9 – 25.0, $k = 42$) for females and 13.7% (95% CI = 11.2 – 16.8, $k = 39$) for males. An overall average prevalence of 13.4% (95% CI = 11.5 – 15.6) was found when assessing prevalence in the last year. This estimate was 15.9% (95% CI = 12.9 – 19.4, $k = 32$) for females and 10.7% (95% CI = 8.7 – 13.2, $k = 32$) for males. 16.2% (95% CI = 11.0 – 23.3) overall prevalence was estimated when considering only the last 6 months, which was 18% (95% CI = 8.9 – 33.2, $k = 7$) for females and 13.8% (95% CI = 6.2 – 27.9, $k = 7$) for males.

V.1.10. Risk of Bias

Based on the Cochrane Risk of Bias Tool (244), risk of bias criteria was made and adapted for the studies (cohort, cross-sectional and longitudinal).

V.2. The second study

V.2.1. Sample

Altogether, 183 participants provided written informed consent. Due to dropouts (i.e., those who stopped participating or were not available for data collection despite their prior consent, for instance were missing from school or did not respond to calls) and missing data, overall, 119 participants were included in our analysis (female 70%, male 30%, age $M = 15.73$, $SD = 1.17$). The overall prevalence of CB and NSSI were 61.3% and 62.2% respectively.

V.2.2. The first hypothesis

The prevalence of NSSI was significantly higher among those who were involved in CB, compared to those who were not involved in CB, $\chi^2(1) = 5.62$, $p = .02$. Thus, *our first hypothesis was confirmed*. Table 10. shows the proportion of the five CB groups involved and not involved in NSSI: 1) Not Involved = not involved in any forms of CB, 2) Bully = involved in CB as a perpetrator, 3) Victim = involved in CB as a victim, 4)

Bully & victim = involved in CB both as perpetrator and victim, 5) Witness = involved in CB as a witness.

Table 10: The proportion of the five CB groups. Previously published by the candidate in Farkas et al. 2025 (130).

Five CB groups	No NSSI	NSSI
1) Not involved	24 (20.2%)	22 (18.5%)
2) Bully	0 (0%)	1 (0.8%)
3) Victim	5 (4.2%)	16 (13.5%)
4) Bully & victim	5 (4.2%)	15 (12.6%)
5) Witness	11 (9.2%)	20 (16.8%)

Abbreviations: CB: cyberbullying, NSSI: nonsuicidal self-injury.

V.2.3. The second hypothesis

Our network model suggested that the association between CB and NSSI was mediated by anxiety. More specifically, being a victim was associated with being diagnosed with anxiety, $OR_{non0} = 1.36$, $CI95_{non0}[0.55, 2.40]$, $prop0 = .23$, and anxiety disorder was directly related to NSSI, $OR_{non0} = 1.25$, $CI95_{non0}[0.54, 2.32]$, $prop0 = .29$. By contrast, depression was not directly related to CB, only to anxiety, $OR_{non0} = 1.12$, $CI95_{non0}[0.49, 2.03]$, $prop0 = .29$ (Figure 5). Hence, *the association between CB and NSSI was either mediated by anxiety alone or by mixed anxiety-depressive disorder. Consequently, our second hypothesis was not supported.* We found that 27.4% of the adolescents involved in CB were both victims and perpetrators, and only one adolescent was only a perpetrator without being a victim. Due to the low prevalence of the bully category in the sample (only one person indicated that they were a bully only), this variable could not be used in the network models and was therefore grouped together with the bully and/or victim variable. When we combined those who were involved as both CB victims and perpetrators, we saw again that depression did not have a mediating effect. However, anxiety disorders mediated the relationship between CB and NSSI among this combined (Bully & Victim) sample.

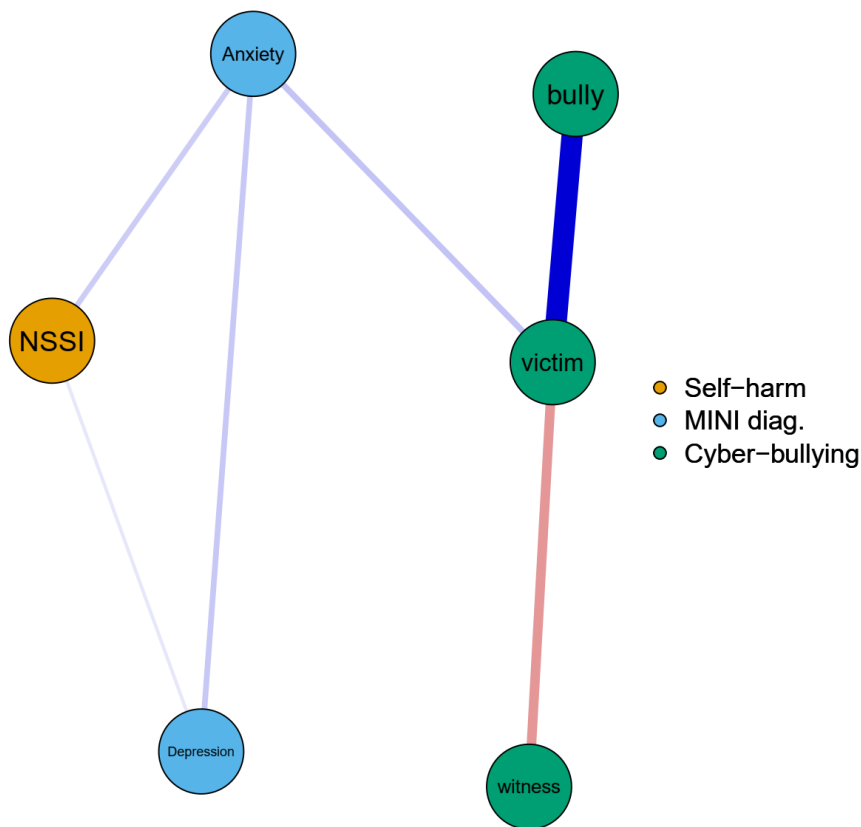


Figure 5: Association between NSSI, mental disorders (i.e., anxiety, depression), and CB (victim, bully, and witness groups): Anxiety = anxiety disorders (according to MINI diagnosis), Depression = depressive disorders (according to MINI diagnosis), NSSI = nonsuicidal self-injury, bully = CB perpetrators, victim = CB victims, witness = CB witnesses. Previously published by the candidate in Farkas et al. 2025 (130).

V.2.4. The third and fourth hypothesis

Victimization (from either witnessing or being a bully) was positively related to anxiety, $OR_{non0} = 1.47$, $CI95_{non0}[0.70, 2.56]$, $prop0 = .30$, which, in turn, was positively associated with NSSI, $OR_{non0} = 1.25$, $CI95_{non0}[0.55, 2.33]$, $prop0 = .29$. Depression mediated, again, only the direct effect of anxiety, $OR_{non0} = 1.13$, $CI95_{non0}[0.55, 1.96]$, $prop0 = .32$ for the first path, and $OR_{non0} = 0.87$, $CI95_{non0}[0.41, 1.67]$, $prop0 = .62$ for the second path (Figure 6). Thus, *our third hypothesis was confirmed: Anxiety disorders*

mediated the association between NSSI and cybervictimization. Finally, our fourth hypothesis was not fulfilled: The prevalence of NSSI was not significantly higher among CB perpetrators and victims compared to witnesses, $\chi^2(1) = 0.68, p = .41$.

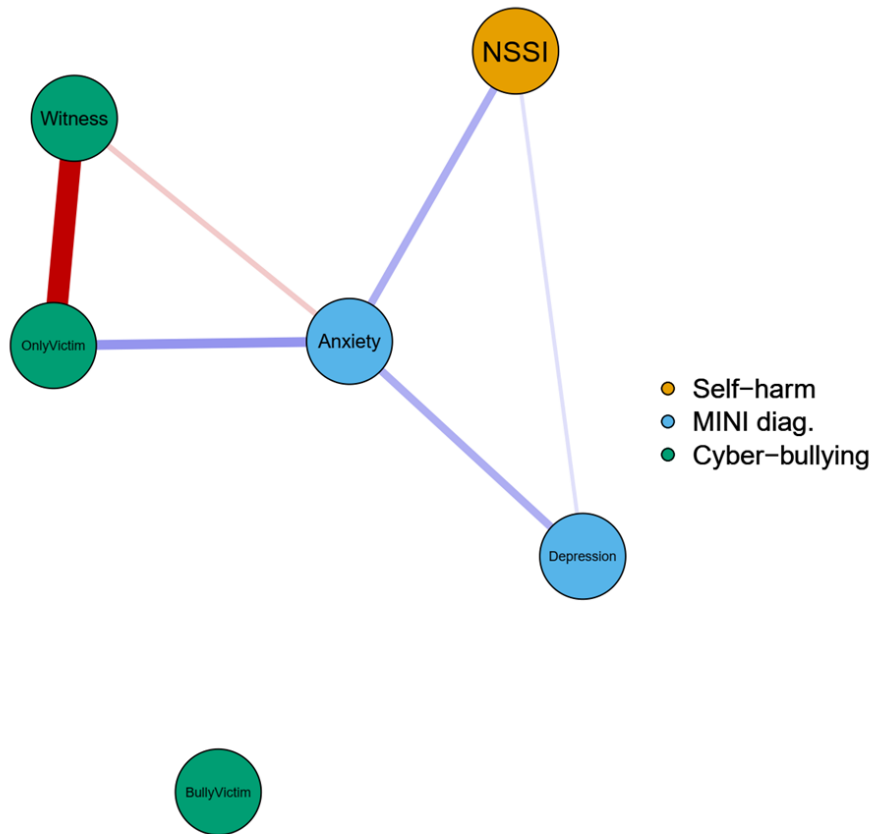


Figure 6: Association between NSSI, mental disorders (i.e., anxiety, depression), and cybervictimization: OnlyVictim = CB victims, BullyVictim = both CB victims and bullies, Witness = CB witnesses, Anxiety = anxiety disorders (according to MINI diagnosis), Depression = depressive disorders (according to MINI diagnosis), NSSI = nonsuicidal self-injury. Previously published by the candidate in Farkas et al. 2025 (130).

VI. Discussion

VI.1. Discussion of the first study

As the first study of my doctoral work, a follow-up meta-analysis was conducted with a clear and rigorous methodology, focusing on newly released data. This was deemed important as previous meta-analyses on the prevalence of SIB in community adolescent populations had produced contradictory findings (40, 45). Based on studies published between 2015 and 2020, we found that the prevalence of SIB in adolescence was 16%. This outcome is similar to the 16.9% estimate from a prior meta-analysis (40). As expected, methodological differences influenced prevalence rates: lifetime prevalence (17.9%) was slightly higher than 1-year (13.4%) or 6-month (16.2%) prevalence estimates. Furthermore, we found that the prevalence was significantly higher when suicidal intent was excluded (18.3%) compared to when it was not (11.3%). The highest prevalence was observed in studies that employed measurement instruments specifically validated for assessing SIB (18.8%). Furthermore, studies with more rigorous methodology and representative populations reported an average SIB prevalence of 15.1%. Self-harm without suicidal intent should be considered a subgroup within self-harm that includes both with and without suicidal intent forms. Therefore, the prevalence of non-suicidal self-harm should logically be lower than that of overall self-harm – a distinction that remains conceptually intriguing and methodologically important. As a result, the prevalence of NSSI should, in theory, be lower than that of overall SIB, given that it represents a more narrowly defined subgroup. However, this is not always the case in reported findings. One explanation might be that studies often use the same terminology, while applying different criteria. Furthermore, measuring discrepancies between the two forms of SIB may also contribute to variability in the prevalence of NSSI and DSH. The significantly higher prevalence when suicidal intent was excluded was also confirmed when assessed for only-male and only-female samples. These gender differences could be also connected to the differences in suicide between males and females and need further investigations. Previous meta-analyses have documented higher prevalence rates when multi-item instruments are used (40, 43), and in our study 65.5% of NSSI assessments employed multi-item measurements, while 60% of DSH assessments relied on single-item measure, potentially impacting comparability. Swannell et al. (2014) conducted a meta-analysis and found that 41% of the variability in prevalence rates

across studies could be explained by checklist versus single-item testing (44), which also supports our findings. Most of the previous systematic reviews and meta-analyses emphasize how measurement instruments have a significant impact on NSSI prevalence estimations (40, 43, 44).

According to our meta-analysis, no significant differences were found in prevalence among adolescents aged 11.0 and 18.5 years. This finding does not support the study by Gillies and colleagues (40), who reported age-related variations, but aligns with the results of Lim's meta-analysis (41). Gillies et al. (2018) found an increasing prevalence among 13- to 16-year-olds and therefore recommend school-based programs for this age group (40). However, based on our findings, prevention programmes should be implemented throughout adolescence – for example, annually at school.

We found that prevalence estimates from studies using representative and convenient samples were largely comparable. Surprisingly, higher prevalence rates were reported in studies that employed random samples. This counterintuitive finding highlights a potential methodological inconsistency and indicates the need for further investigation.

The first hypothesis of my doctoral work was only partially supported. According to this analysis of all studies published between 2015 and 2018, the prevalence of SIB increased significantly between 1998 and 2018. However, as anticipated, when we restricted the analysis to studies conducted between 2013 and 2018 – corresponding with the publication window – we did not find any significant change in prevalence during this period. Previous meta-analyses have reported conflicting findings: Gillies and colleagues (2018) observed an increase in SIB prevalence between 1990 and 2018, whereas Muehlenkamp and colleagues (2012) reported no significant change in prevalence between 2008 and 2015 (40, 43). Our results suggest an increase of the prevalence before 2013 but no change afterward, aligning with the trajectories reported afterwards (40, 43).

Our second hypothesis was confirmed: nonoverlapping confidence intervals showed a significant difference between the estimated prevalence of SIB for males (12.9%) and females (19.4%). When we only focused on lifetime prevalence, this gender difference remained consistent (females: 22.9% and males: 13.7%), further supporting the robustness of this finding. These findings are similar to the meta-analysis conducted

by Bresin and Schoenleber (2015), which found significantly higher prevalence rates of SIB among females (45). In studies that did not include suicidal intent, the average prevalence of SIB was 16.5% for males and 21% for females. Similarly, estimates derived from studies using measurements validated for SIB revealed a prevalence of 15.7% for males and 21.9% for females. However, studies using representative samples reported somewhat lower prevalence estimates: 10.9% for males and 18.2% for females. Therefore, when examining the impact of methodological variations across the original studies, the overall patterns for males and females were relatively consistent. However, cultural differences between Asian and non-Asian countries were more pronounced among males (Asia = 19.5% vs. other = 10.8%) than for females (Asia = 22.3% vs. other = 18.5%). Some possible explanations for this include the fact that girls reach puberty earlier than boys, that more of them experience higher levels of psychological discomfort, anxiety and depression symptoms, and NSSI is frequently linked to psychological distress (245, 246). The higher prevalence of SIB prevalence among females can be explained by findings from in previous research indicating that girls are more likely to engage in internalizing symptoms (e.g. self-injury) compared to boys (247-249).

We found a significant difference between Asian and non-Asian countries, however, there are previous meta-analyses that attribute the differences between countries to methodological reasons (40). The combined prevalence estimate from Asian countries (19.5%) was significantly higher than that of other continents (14.6%), supporting previous meta-analytic findings that suggested a relatively high incidence in Asian countries (41). This distinction was even more pronounced among males, suggesting that gender may play a role in the observed SIB prevalence differences between Asian and non-Asian countries. Lim et al. (2019) highlight that the prevalence of SIB is higher in low- and middle-income countries, which may be due to lower help-seeking behaviour and limited access to mental health services (41). Our findings highlight the need for future research to focus on the transcultural components of SIB in order to better understand the underlying factors contributing to these variations. We found some differences in prevalence estimates across primary studies depending on methodological differences; however, it should be noted that these effects may be confounded by other moderator variables.

In contrast to the findings reported Gillies and colleagues (40), we did not detect a significant difference in prevalence between NSSI (18.7%) and DSH (15.1%). However, we did identify a significant difference between NSSI (18.7%) and the broader category of self-harm (12.7%). Notably, we found a significant difference between males' NSSI (17.1%) and self-harm (9%) and between males' NSSI (17.1%) and DSH (6.3%) compared to females. These findings suggest that definitional distinctions, and differences in measuring instruments may affect prevalence estimates differently across genders, which is also mentioned in previous studies (40, 44).

In contrast to studies that utilized single-item or nonvalidated questionnaires, our research demonstrates that the highest prevalence rates of SIB were found when it was measured by validated questionnaire. This pattern was also independently confirmed among male and female populations. Validated questionnaires are more sensitive than single-item measures, which is probably the explanation of these findings (40, 43).

The original research heterogeneity, namely the sample, assessment tools, and SIB conceptualization, limits our findings. The results of the current meta-analysis verify that the prevalence estimates are significantly impacted by these variations among the primary studies. Our task of analyzing the data is made more challenging by the lack of agreement in the literature at the moment of the conceptualization of SIB (40, 43). The most accurate estimate, however, was obtained by pooling the studies that utilized representative samples and reported on the lifetime prevalence of SIB excluding suicidal intent as determined by a validated assessment tool. We also took this action to prevent these modifiers from having a confounding effect. Moreover, it is debatable whether nonsignificant results in subgroup and meta-regression analyses are caused by the lack of an effect or by a lack of statistical power, even though overall we found a comparatively large number of studies that reported on the prevalence of SIB.

This is the most recent meta-analysis on the prevalence of SIB in adolescents that we are aware of. One in six teenagers has a history of self-harm, according to the total incidence of 16%. Additionally, a higher estimate was discovered for females than for males: one in five adolescent girls reported engaging in self-harm. It is important to note that prevalence estimates of SIB were closest to a 20% frequency in Asian countries

among male populations. To comprehend this distinction, more study should concentrate on the transcultural dimensions of self-harm.

The findings of this study have important for public health implications, and we urge decision-makers and healthcare professionals to recognize and address the significant adolescents in SIB. Clinicians should be aware of the high prevalence of SIB among adolescents as well as key risk factors, such as female gender and Asian ethnicity. Prevention and intervention are crucial for this age range.

VI.2. Discussion of the second study

Consistent with previous studies, our findings indicate that both NSSI and CB are common behaviors among adolescents (85, 129, 160). We found the prevalence of NSSI to be 62.2% and the prevalence of engaging in any type of CB to be 61.3% in our sample. Both prevalences are quite high, also compared to previous findings in the literature (83, 129). Because of biological changes, high levels of emotional distress, an increase in risky behaviors, and increased interpersonal stress, adolescence is a developmentally vulnerable period that can result in the use of unhealthy coping mechanisms like CB and NSSI (250, 251). Furthermore, the prefrontal cortex in this age group, which governs impulse control and decision-making, is still developing, making it easier to engage in impulsive behaviors (252, 253). The extremely high prevalence that we found could be explained by the vulnerable period due to the SARS-CoV-2 pandemic. Adolescents were forced to stay at home, attend classes online, and were unable to see their friends in person for months. The higher time spent online and the lack of adaptive coping mechanisms (e.g. meeting friends, playing sports, social activities outside school, participating in clubs) may partially explain the high prevalence of NSSI and CB in our study. Deng et al. (2023) made a meta-analysis on the prevalence of NSSI during the SARS-CoV-2 pandemic (49). They found 15 articles which provided prevalence and published that NSSI has emerged as a significant public health concern during the pandemic, the prevalence of NSSI increased during this period (49). While the results so far are clear in relation to NSSI, this is not the case with CB. Two meta-analyses made so far on the prevalence of CB during the SARS-CoV-2 pandemic and the findings generally revealed opposite trends: CB decreased in Western countries and increased in Asian countries and Australia (254, 255). Studies reporting a decrease in CB during the pandemic appear to support the arguments put forward by Olweus and Limber, who challenged the simplistic

claim that the more the screen time is the more the CB will be: they emphasize that involvement in CB is not merely a by-product of increased digital device use, but rather a long-standing issue (255, 256). The decrease in CB involvement may reflect increased parental and teacher supervision of young people's online activities because of lockdown measures (254, 255). In contrast, studies identifying rising trends in CB have suggested contributing factors such as heightened loneliness due to social distancing, greater time spent online, and poorer psychological well-being (255). Collectively, these findings reinforce the view that CB emerges from the complex interaction of individual, relational, and contextual factors (254, 255).

Adolescents who participated in CB, whether as victims, perpetrators, or witnesses, reported a higher prevalence of NSSI than those who did not. This finding supports our first hypothesis and is consistent with previous research that found a higher frequency of SIB and NSSI among CB perpetrators and victims (91, 111, 112, 116). Our research may be the first to draw attention to the connection between NSSI and CB witnesses. According to earlier studies, internalizing symptoms and suicidal ideation were positively correlated with witnessing CB (99, 102), and there was a significant correlation between NSSI and both internalizing symptoms and suicidal ideation (4, 36, 58). However, no prior study has examined the relationship between CB witnessing and NSSI. Our findings highlight the need to involve adolescents who observe CB in NSSI prevention and research initiatives.

Our second hypothesis was not confirmed: depression did not play a mediating role in our study, despite earlier research showing that negative emotions and depression mediated the relationship between CB and NSSI (109, 257-259). Instead, anxiety and mixed anxiety-depressive symptoms were found to be highly significant mediators between CB perpetrators and NSSI. Relationship stress from being a perpetrator can be decreased by NSSI (27, 260-262). It is important to emphasize that while earlier research has looked at anxiety and depression symptoms (109, 257-259), we measured depression and anxiety disorders with the MINI-KID, a structured psychiatric diagnostic tool (55). The association between self-harm and CB can only be partially explained by depressive symptoms, according to a closer look at research on their mediation role (91). Furthermore, this association may be mediated by unpleasant feelings, which are signs of depression but can also occur in many other mental health conditions (109). The diathesis-

stress model could help to explain why depression and CB were not directly correlated, but anxiety was. It implies that people who are predisposed to depression could first feel anxious in reaction to stressful situations such as CB, but they might not necessarily act in ways that are directly associated with depression (263, 264). Furthermore, while depression is typically not directly provoked by social contacts, anxiety frequently appears as a reaction to perceived dangers, such as CB (263). Depression may be less directly related to particular negative life events (e.g. CB), entail more complicated, long-lasting mechanisms impacted by cumulative stress, and arise as a subsequent reaction (264, 265).

According to the general strain theory, people may be pressured to externalize and internalize aggression by stressful and tense social connections and situations (109, 259, 266). Previous studies emphasize that adolescents who engaged in CB felt more depressed, and the outcome – whether or not it led to self-harm – depended on how well the person got along with their friends (259). Although depression was not identified as a mediating component in our investigation, it may have been another influence; deviant peer affiliation has played a significant role in the development of CB perpetration (267).

The association between cybervictimization and NSSI was mediated by anxiety, which is consistent with earlier research and supports our third hypothesis (85, 91, 253, 258). NSSI may result from negative perceptions caused by victimization, which may influence how adolescents view themselves and their relationships with others (91, 104, 260, 268, 269). Emotional reactivity – the speed and intensity of an individual's response to an emotion – may provide another reason (270). Psychological distress may result from an individual experiencing negative feelings with ease and intensity when their emotional reactivity is strong (262, 270). Long-term CB can result in negative emotions and rumination, and emotional reactivity may increase due to difficulties regulating emotions (262). Another possible biological explanation is that adolescents are more likely to act impulsively and hostilely when they are under stress since their prefrontal cortex is still developing (253). Adolescents participate in NSSI comparatively more frequently since being a victim of CB can result in severe stress (253). Cybervictimization can result in increased interpersonal pressure, and NSSI can be a maladaptive coping strategy to manage this stress (259, 261, 271, 272). This creates a vicious cycle in which rising

anxiety deteriorates peer relationships and performance, which increases the frequency of both traditional and cyberbullying (258).

Another interesting discovery in our study is that nearly everyone who participated in CB played both roles: only one person was a victim and not a perpetrator. According to some earlier research, CB is known for its high reciprocity, which makes playing several roles usual (257), so our results were in line with this. We also know that due to anonymity in CB, adolescents could play in both roles (68, 71, 257).

The limitations of our study must be taken into consideration when interpreting our findings. We collected our data online during the SARS-CoV-2 pandemic, and since more people dropped out of online data collecting, it was more challenging to contact participants in this manner. Our results are not representative, as our data collection was based on the snowball method. During the pandemic, it was observed that adolescents with mental health problems participated in our research more frequently. Our results may also be affected by the shift from in-person to online data collection, such as differences in disclosure and selection effects. Also, due to the limited sample size, our findings should be regarded as preliminary. We are unable to make any assumptions regarding causality because our findings are based on a cross-sectional study design. To demonstrate a causal link between NSSI and CB, a longitudinal study that examines the potential mediation effects would be necessary. The SARS-CoV-2 pandemic, which occurred around the time of data collection, may have had an impact on the findings and raised the prevalence of CB, anxiety, and depression. In the future, when the pandemic has less impact on adolescents' lives, we intend to replicate the current cross-sectional study in addition to conducting longitudinal research. Lastly, NSSI and CB were evaluated using self-report questionnaires, so we relied on adolescents' subjective responses. In the future qualitative research would be useful in this field.

VII. Conclusions

The findings of the studies conducted as part of my doctoral work – the meta-analysis and the quantitative study – highlight the high prevalence of both CB and NSSI among adolescents. Given that adolescence is a particularly sensitive and formative period in life, young people must receive special attention through effective prevention and intervention strategies addressing both CB and NSSI.

The findings of my doctoral work also raise awareness of the potential impact of the SARS-CoV-2 pandemic. The meta-analysis conducted prior to the pandemic, and although we found no significant increase in the prevalence of SIB between 2013 and 2018, this could be significantly influenced by SARS-CoV-2 pandemic. Therefore, it would be worthwhile to conduct a follow-up meta-analysis in the future to assess potential post-pandemic trends. In the second study of my doctoral work, the impact of the pandemic was already felt and may partly explain the elevated prevalence of NSSI and CB. During the lockdown period, adolescents were required to stay at home and attend classes online, leading to increased screen time and may have experienced more CB. At the same time, they were deprived of adaptive coping mechanisms (e.g. meeting friends, playing sports, engaging in social activities outside school, and attending clubs) which, combined with higher stress levels, all these could lead to NSSI.

It is important to mention that the exceptionally high prevalence of NSSI and CB in the second study can be attributed not only to the SARS-CoV-2 pandemic and the resulting social changes, but also to the specific effects these may have had in the country studied, in Hungary. Previous research has shown that members of minority groups (e.g., the LGBT community) tend to experience more mental health issues due to minority stress (273). If the majority society becomes more polarized and radicalized, these groups are subjected to even greater levels of minority stress, and also greater level of suicide behaviours and self-harm (274, 275). Since the 2010s, Hungary – along with several other Western societies – has become increasingly politically polarized, and social radicalization has intensified (276-278).

The first study of my doctoral work highlights that Asian male populations require increased attention, as their elevated rates of SIB suggest the need for further investigation into its transcultural component. Future research should focus on cultural factors to better

understand this finding. Additionally, the results of this study emphasize – what has been consistently shown in previous studies – that NSSI has an alarmingly high incidence among female adolescents. Healthcare professionals should be aware of both findings in order to provide culturally and gender-sensitive prevention and intervention strategies.

The second study of my doctoral work found that adolescents who witness CB are also at elevated risk for engaging in NSSI, highlighting the need to give them greater attention. Further research should further investigate CB witnesses. Prevention program targeting NSSI should not only address those directly involved in CB but also include adolescents who observe CB. Moreover, future studies should aim to identify predictive risk factors that contribute to both CB and NSSI in order to inform more effective, targeted interventions.

Since the second study of my doctoral work assessed not only disorders but also depressive and anxiety symptoms, our findings highlight the need to extend prevention not only clinical diagnoses to those with subthreshold conditions. Subthreshold psychiatric conditions are known to be associated with reduced quality of life and an increased risk of suicide (160, 279, 280). As this study of my doctoral work also supports this important finding, we wish to emphasize the importance of prevention programs targeting adolescents who have not yet met diagnostic criteria but already show subthreshold psychiatric conditions. School-based prevention programs implemented in early adolescence may be effective in promoting mental health and preventing NSSI (281). In a systematic review, which specifically examined research on international prevention programs aimed at preventing NSSI, but the vast majority of the seven studies included did not report information on post-intervention measurement data, such as changes in the frequency of NSSI (282). However, according to adolescents, sharing their difficulties with friends and having someone who listens to them can be helpful for peers who engage in self-injury, and it is also important that, when needed, they feel able to talk about their problems with adults who provide a sense of safety (283). In order for students to be able to help one another, they need information on how to talk about self-injury and mental health struggles with their peers. Preventive programs can support them in learning how to respond to each other's difficulties and potential self-injurious behaviors, foster more understanding and supportive attitudes toward one another, help them recognize the warning signs of suicidal risk, and inform them about who to turn to

when they wish to seek help from adults (283). Based on previous research findings, peer-involved programs that are integrated into the school curriculum may be the most effective for the prevention of mental health problems, as schools are the places where young people and the adults connected to them are present on a daily basis (284, 285). Two previous international representative studies – the SEYLE and the CASE studies – have emphasized that prevention and intervention programs incorporating experiential components (e.g. Youth Aware of Mental Health) are more effective than those based solely on information delivery (e.g. face-to-face teaching) programs (39, 286). In their systematic review, Bürger and colleagues (2023) specifically examined research on international prevention programs aimed at preventing NSSI, but the vast majority of the seven studies included did not report information on post-prevention program measurement data, such as changes in the frequency of NSSI (282). In those studies that did report data, no actual change in self-harming behavior was detectable after the prevention programs, which can be attributed to various limiting factors. According to the authors, it is noteworthy that, in light of this, there is still a lack of evidence-based professional opinion on NSSI prevention programs (282). Regardless of this, adolescents believe that sharing their difficulties with friends and having someone to listen to them can help their peers who engage in self-harm, or that they can talk about their problems with adults who provide them with a sense of security if necessary. Prevention programs can help them learn how to respond to each other's difficulties and possible self-harming behaviors, increase their understanding and helpful attitude towards each other, learn to recognize the signs of suicide risk, and know who to turn to if they want to ask adults for help (283).

Based on our second study, prevention programs should target CB as well, to reduce the prevalence of NSSI, mental health problems and suicidal behaviors. Polanin and colleagues (2022) made a meta-analysis on interventions to decrease CB perpetration and victimization, and they found that all types of programs (e.g. skill-building, psychoeducation, training, curricula and media materials) were effective, but programs with a focus on cyberbullying were found to have a higher average intervention effectiveness for both CB perpetration and victimization, relative to programs with a focus on general violence prevention (287). Both individual and group targeted prevention and intervention programs were effective (287). It is important to mention that

developing empathy is particularly important during prevention programs focusing on CB (288). A range of CB prevention and intervention materials – including digital resources, informational tip sheets, and classroom-based curricula – have been developed to support adolescents, parents, and educators, and when adolescents and their caregivers share experiences of bullying to healthcare professionals, these must be met with seriousness and handled with appropriate clinical sensitivity (289). Combating CB requires comprehensive strategies that involve the collaborative efforts of mental health professionals, educators, and digital technology experts (290).

When discussing NSSI and CB prevention, it is essential to mention the training of teachers and professionals working with adolescents. Previous research findings show that psychoeducation for school staff is extremely important in the early recognition and appropriate treatment of NSSI, as well as in providing adequate assistance (282, 291).

Adolescents who self-harm more regularly should be given access to programs that can reduce their risk of suicide as soon as feasible, given the substantial correlation between self-harm and suicidal behaviors. Around one in six adolescents worldwide report self-harm, so interventions that enhance their capacity to manage negative emotions may be useful in delaying the initiation of self-harm considering these high rates. Since most people begin self-harming during the beginning of puberty, these prophylactic measures ought to be implemented then. Additionally, since friends are by far the most common group to which adolescents turn for support, strategies for peer groups to assist should be established. Based on the results of my doctoral theses CB and especially bystanders should be included in these prevention programmes. Integrating these elements could enhance the effectiveness of such programs, particularly in reducing the prevalence of SIB among adolescents.

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VIII. Summary

In summary, I would like to highlight the key findings of my PhD research, present the novel contributions of the work and summarize the clinical implications.

To the best of our knowledge, the first study of my doctoral work is the most recent meta-analysis focusing on the prevalence and cultural differences of SIB in adolescents. SIB has a notably high prevalence among non-clinical adolescent populations worldwide. One of the key findings was that Asian male adolescents have a particularly high risk for engaging in SIB. This highlights that further research should focus on the transcultural differences in both risk and preventive factors associated with SIB among adolescents.

The second study of my doctoral work highlights the high prevalence of CB and NSSI among adolescents, and that anxiety plays an important moderating role in the relationship between the two phenomena. To the best of our knowledge, this is the first study to demonstrate that adolescents who witness CB – without necessarily being direct victims – also face a heightened risk of NSSI. These findings underscore the need for further research to focus on the risk and protective factors among CB witnesses cyberbullying, a group that has received limited attention to date.

The results of my doctoral work draw the attention of decision makers and healthcare professionals to the importance of school-based prevention programmes and in particular the high prevalence of NSSI and CB during adolescence. Adolescents are frequently exposed to stressful events, but if they have access to professional support and intervention, the likelihood of developing more severe psychiatric problems later in life could be significantly reduced.

Finally, I would like to draw clinicians' attention to the high prevalence of CB among adolescents, which is associated with significant anxiety and depressive symptoms and, consequently, an increased risk of NSSI. Given the strong link between NSSI and suicidal behaviour, adolescents who engage in NSSI should receive interventions as soon as possible to reduce suicide risk. Approximately one in six adolescents worldwide report a history of self-harm. Given the high prevalence of self-harm, interventions that enhance adolescents' emotional regulation should be implemented at the onset of puberty, when self-harm most commonly begins.

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X. Bibliography of the candidate's publications

X.1. Peer reviewed publications on which the thesis is based

1. **Bernadett Frida Farkas**, Zsófia K. Takács, Nóra Kollárovics, Judit Balázs (2023) The prevalence of self-injury in adolescence: a systematic review and meta-analysis. *European Child and Adolescent Psychiatry*, PMID: 37486387
2. **Bernadett Frida Farkas**, Dóra Győri, Dániel Komáromy, Péter Garas, Nóra Kollárovics, Lili Olga Horváth, Judit Balázs (2025) The association between cyberbullying and nonsuicidal self-injury: the mediating role of depression and anxiety. *Scandinavian Journal of Child and Adolescent Psychiatry and Psychology*, 2025 Dec 10;13(1):139-150.

X.2. Peer reviewed publications independent of the thesis

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X.3. Hungarian publication independent of the thesis

1. **Farkas Bernadett Frida**, Ferenczi-Dallos Gyöngyvér, Garas Péter, Győri Dóra, Horváth Lili Olga, Katzenmajer-Pump Luca, Keresztény Ágnes, Kollárovics Nóra, Komáromy Dániel, Mészáros Gergely, Miklós Martina, Roszik-Volovik Xénia, Szentiványi Dóra, Velő Szabina, Balázs Judit: Gyermekkori pszichés zavarok kutatócsoport friss eredményeinek bemutatása. *Psychiatria Hungarica*, 2021; 36: Különszám pp. 84-96., 13 p.

X.4. Presentations

X.4.1. International

1. **Bernadett Frida Farkas**, Judit Balázs; The relationship between nonsuicidal self-injury and cyberbullying in adolescence; European College of Neuropsychopharmacology, Seminar in Neuropsychopharmacology, Budapest, 2019.
2. Dóra Szentiványi, Lili Olga Horváth, Kirsten Buist, **Bernadett Frida Farkas**, Gyöngyvér Ferenczi-Dallos, Péter Garas, Dóra Győri, Judit Balázs; Coronavirus Pandemic - #STAYHOME: How Are You Holding Up? Questions And Tips For 11-18 Year Olds To Make It Better; The 30th European Congress of Psychiatry, Budapest/online 2022.
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X.4.2. Hungarian

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2. **Farkas Bernadett Frida**, Győri Dóra, Horváth Lili Olga, Mészáros Gergely, Szentiványi Dóra, Balázs Judit; Az önsértés, a pszichopatológia és az életminőség összefüggése serdülőknél; Semmelweis Egyetem Orvos-, Fogorvos- és Gyógyszerésztudományi Diákköri Konferencia, Budapest, 2019.
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X.5. Book chapter

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X.6. Translation

1. Fekete Émi, Evellei Kata, Tompa Orsolya, Hegedűs Orsolya, Kórácz Krisztián. Müller Dóra, Csobó Zsolt, **Farkas Bernadett Frida**, Oroszlány Balázs, Hegedűs Antónia, Zsirka Hella, Balta Flóris Roland, König Egres Ármin, Szabadúszó Fordítók és Tolmácsok Egyesülete, Somorjai Noémi, Szabó A. Zsófia, Baqais Dávid, Kocziha Csenge, Nagy Berta, Dombos Tamás, Polgári Eszter, Egyed Kata; Transznemű és nemi diverz személyek egészségügyi ellátásának alapelvei, 8. verzió: Magyar fordítás (2025); International Journal of Transgender Health SOC 8. magyar változat pp. S1-S295.

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