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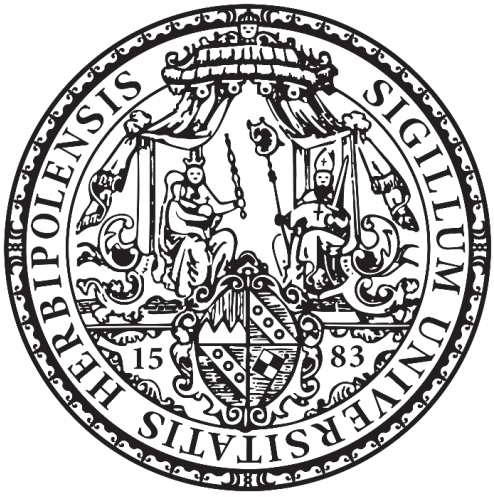

Universal prevention of Nonsuicidal Self-Injury for children and adolescents – A systematic review

Inauguraldissertation

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Table of Contents

1. Introduction and Objective - 5 -

1.1. Non-suicidal self-injury in its clinical presentation - 6 -

Definition und Terminology - 6 -

Clinical manifestation - 8 -

1.2. Classification - ICD-10 and DSM-5 - 8 -

1.3. Epidemiology - 11 -

1.4. Aetiology - 13 -

Neurobiology - 14 -

Risk factors - 16 -

Comorbidities - 20 -

1.5. Functions - 23 -

1.6. Therapeutic intervention - 25 -

1.7. Preventive approaches - 29 -

Why universal prevention of NSSI is needed - 33 -

2. Aims - 34 -

3. Methods - 35 -

3.1. Search protocol and information sources - 35 -

3.2. Eligibility criteria - 36 -

3.3. Study selection - 37 -

3.4. Data collection process - 38 -

3.5. Quality assessment - 38 -

4. Results - 38 -

4.1. Study selection - 38 -

4.2. Study design - 40 -

4.3. Study characteristics - 41 -

Participant group - 41 -

Program length and content - 42 -

Follow-up - 44 -

Drop-out rates - 45 -

Outcome measures - 45 -

Main findings Erst immer main outcome und dann was kam raus! alle drin :) - 47 -

Study Quality - 51 -

6. Discussion - 53 -

5. Limitations - 61 -

7. Conclusion and Outlook - 62 -

8. References - 65 -

Appendix A - 81 -

I List of Abbreviations - 85 -

II List of figures - 87 -

III List of tables - 87 -

IV Acknowledgements - 88 -

V Curriculum vitae **Fehler! Textmarke nicht definiert.**

VI Own publications **Fehler! Textmarke nicht definiert.**

VII Declarations **Fehler! Textmarke nicht definiert.**

1. Introduction and Objective

Over the years, self-harm has become an increasingly important issue. In an executive summary of the World Health Organization (WHO) from 2014, self-harm was listed as the third most frequent cause of death after road injuries and HIV/AIDS among adolescent females and the fourth most among adolescent males between the ages of 15 to 19 worldwide (WHO 2014). The following diagram (figure 1) underlines the death rates, ranging from more than 40.000 cases in boys to more than 80.000 in girls.

Figure 1

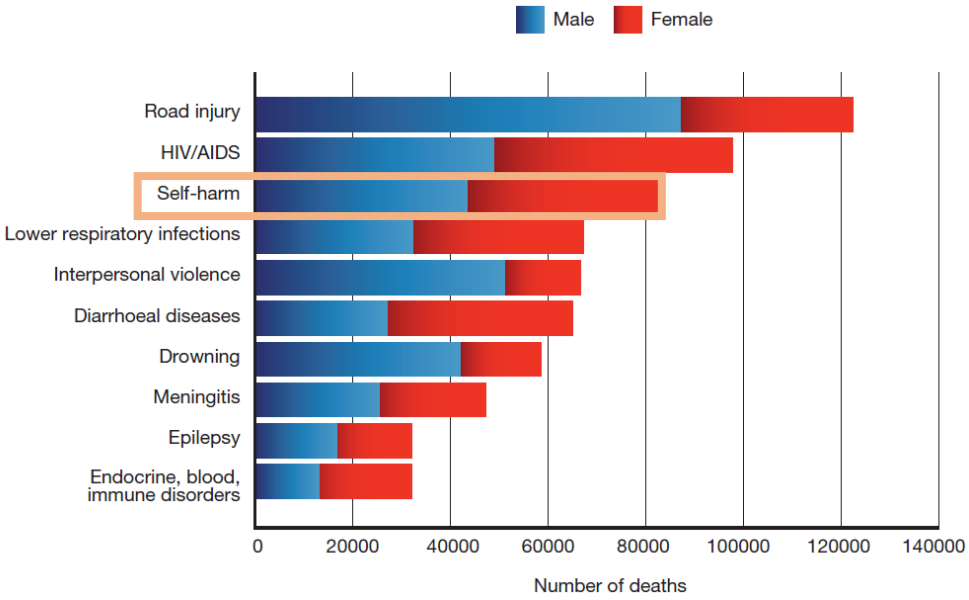

Figure 1: Top 10 causes of death among adolescents worldwide in 2014

It is therefore all the more surprising that although research in this domain increases, literature for a thorough understanding is still limited and empirically grounded diagnostic guidelines, effective treatments and methods of universal prevention are lacking (Klonsky, Victor et al. 2014).

This is why the objective of this thesis is to provide an overview of the current state of research regarding Non-suicidal self-injury (NSSI) and to examine prevention programs on their effectiveness in order to determine their applicability in the clinical, school and home environment.

The introduction of this work is intended to provide an overview of the current state of knowledge in the field of NSSI and allow a precise understanding of why we face a need for concrete universal prevention programs. The following chapter presents the literature research and methods of the review, leading to an overview of the results. These are subsequently discussed, and limitations of the review specified. The final section of this work aims to provide a conclusion of the findings and determine their relevance for future research on NSSI.

It should be emphasized that the studies referred to and included in this thesis classify the two sexes male and female according to binary gender, as exceedingly few studies provide in-depth information about considerations of participants' gender identity.

For those studies that have done so, this is explicitly mentioned, and references of its relevance provided.

1.1. Non-suicidal self-injury in its clinical presentation

Definition und Terminology

One of the first to define and address NSSI was the American author and psychiatrist Armando Favazza, who constructed a purely descriptive classification system in 1996. He differentiates three main categories of self-mutilation (SM): 1) Major SM, including actions such as eye enucleation or castration - often found in patients with psychosis or intoxication, 2) Stereotypic SM, entailing head-banging or self-biting - by his definition commonly associated with Tourette's syndrome and mental retardation, 3) Superficial/moderate SM such as hair-picking, skin cutting and burning, predicting an axis I syndrome of "repetitive impulse dyscontrol with protean symptoms" (Favazza 1998). If Favazza's classification system was to be applied to this thesis, the focus of it lies primarily on characterisations of NSSI of the third category.

The term more commonly used in current literature is non-suicidal self-injury (NSSI) (Klonsky 2007, Hilt, Cha et al. 2008, Whitlock, Muehlenkamp et al. 2011). It is defined as the deliberate destruction of body tissue in the absence of an observable intent to die (Lloyd-Richardson, Perrine et al. 2007). Several other terms have been used in this context, including deliberate self-injury (DSI) (Klonsky 2007), self-injurious behaviour

(SIB) (Whitlock, Eckenrode et al. 2006, Brunner, Kaess et al. 2014); deliberate self-harm (DSH) (Pattison and Kahan 1983, Skegg 2005) and self-mutilation (SM) (Nock and Prinstein 2005). The "Deliberate self-harm syndrome" (DSH) by contrast, firstly described by Pattison und Kahan (1983) differentiates self-injurious behaviour between suicidal or non-suicidal motives (Posner, Melvin et al. 2007)). See table 1 for a graphic overview of the various terms according to the diagnostic and statistical manual of mental disorders (American Psychiatric Association 1980), listed in historical order of the terms used.

Table 1: *Terminology used to describe self-injuring behaviour*

Acronym	**Meaning**
Self-mutilation (SM)	Act of disfiguring oneself through deliberate self-harm.
Self-harm (SH)	Includes all kinds of self-harm, with or without suicidal intent
Deliberate self-injury (DSI), Deliberate self-harm (DSH), Self-injurious behaviour (SIB)	Intentional, direct destruction of body tissue (…) without conscious suicidal intent but resulting in injury severe enough for potentially life-threatening tissue damage to occur
Non-suicidal self-injury (NSSI)	Self-inflicted, socially non-sanctioned, deliberate destruction or alteration of body tissue (…) without suicidal intent

The debate about the various terms of the differing nomenclature is multi-layered. It arises mainly from the attempt to establish a clear distinction between forms of self-injury with and without suicidal intent, the latter of which is referred to by the term NSSI (Kothgassner, Robinson et al. 2020). There is literature suggesting that a nomenclature distinction can be neglected regarding adolescents, as a systematic review found no significant differences in mean prevalence rates when comparing studies using the term self-harm to those using NSSI as a definition (Muehlenkamp, Claes et al. 2012).

For this systematic review, the term NSSI is used instead of self-harm. This decision is based on the fact that whereas self-harm includes all kinds of self-harm, with or without suicidal intent, NSSI describes self-inflicted, socially non-sanctioned and deliberate destruction or alteration of body tissue without suicidal intent, thus excluding suicide

attempts. By choosing to focus on NSSI, the intention behind the self-injuring act is considered. This distinction is supported by various authors (Selby, Bender et al. 2012). However, there are researchers who express doubts on the relevance of this (Muehlenkamp, Claes et al. 2012) and refer to a lack of empirical evidence regarding the distinction of the terms (Kothgassner, Robinson et al. 2020). It remains to await a unanimous view to clearly differentiate the terms in the future.

Clinical manifestation

Most patients present self-injuries including cutting, burning, scratching, and interfering with wound healing, whereas behaviours associated with substance and eating disorders are usually rather considered an unintended side-effect (Klonsky 2007). The actions can occur up to several times a day, are hard to resist and intended to relieve tension or anxiety (Black and Mildred 2013). Motives and reasons are usually neither recognized socially or culturally, nor are artistically sanctioned, unlike piercings or tattoos (Whitlock, Eckenrode et al. 2006, Klonsky 2007, Simeon and Hollander 2008). Most injuries are inflicted with knives, needles, razors, or other sharp objects. Injuries are arranged in parallel and separated by one or two centimetres on volar forearms, frontal thighs, or other easily accessible parts of the body. The depths of inflicted wounds can differ from one NSSI episode to another, forming a characteristic pattern of scars (Association, 2013).

1.2. Classification - ICD-10 and DSM-5

Most established current classification systems are the 10th Edition of the International Statistical Classification of Diseases (ICD-10) and the fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM). At the time of the prior, fourth edition of the DSM (DSM-IV), NSSI was still considered a research diagnosis. It constitutes a major landmark in NSSI research that the amendment of the criteria for the fifth edition resulted in a determination of NSSI as an independent diagnosis. To be precise, six main criteria for NSSI were determined according to frequency, intention, function,

associated thoughts, feelings or behaviours, comorbidities, and consequences of it (see table 2).

Table 2: *Six main criteria for NSSI according to the DSM-5 (Association, 2013)*

A. Engagement in intentional self-inflicted damage on 5 or more days within the last year (…) to induce bleeding, bruising, or pain (…) with the expectation of minor or moderate physical harm without suicidal intent.
B. Engagement in self-injurious behavior with one or more of the following expectations:
   - To obtain relief from a negative feeling or cognitive state
   - To resolve an interpersonal difficulty.
   - To induce a positive feeling state.
C. Association of intentional self-injury with at least one of the following:
   - Interpersonal difficulties or negative feelings or thoughts (e.g. depression, anxiety, tension, anger, generalised distress, or self-criticism), occurring immediately prior to the self-injurious act.
   - A period of preoccupation with the intended behavior that is difficult to control prior to engaging in the act
   - Thinking about self-injury frequently, even when it is not acted upon.
D. No occurrence during psychotic episodes, delirium, substance intoxication, or substance withdrawal. No part of a pattern of repetitive stereotypies in individuals with a neurodevelopmental disorder or better explanation of the behaviour by another mental disorder or medical condition (e.g. psychotic disorder, autism spectrum disorder, intellectual disability, Lesch-Nyhan syndrome, stereotypic movement disorder with self-injury, trichotillomania (hair-pulling disorder), excoriation (skin-picking) disorder).
E. No social sanction of the behavior (e.g. body piercing, tattooing, part of a religious or cultural ritual) and no restriction to picking a scab or nail biting.
F. Cause of clinically significant distress or interference in interpersonal, academic, or other important areas of functioning by the self-injurious behaviour or its consequences.

The latest, eleventh ICD-version from April 2019 (ICD-11) by the WHO lists NSSI in the broad chapter “External causes of morbidity and mortality”. However, it does not come into force before January 2022. Also, clear coding or precise diagnostic criteria are lacking, maintaining NSSI to be a solely symptomatic diagnosis (WHO, 2019).

In the previous version from 2016 (ICD-10), definitions for intentional NSSI appear in the subgroups X60-X84 (see table 3) entailing deliberate self-inflicted poisoning or self-harm.

Table 3: *ICD-10 categories including NSSI (WHO, 2016)*

X 60 – 69	Intentional self-poisoning by and exposure to drugs, medicaments, biological substances, alcohol, pesticides, noxious substances, and chemicals
X 70 – 84	Intentional self-harm by various self-harming actions or unspecified means

Various authors criticise these classification systems. They particularly address the lacking contemplation of NSSI as an independent entity and its frequent association with a borderline personality disorder (BPD), even if NSSI has been empirically shown to occur independently of BPD (Plener, Kapusta et al. 2012). In a study with 110 female adolescents from Switzerland and Germany, authors conclude that 80% of the participants did not meet criteria for BPD. They conclude that NSSI should represent a distinct diagnostic entity and propose establishing adjusted diagnostic criteria (In-Albon, Ruf et al. 2013).

Maria Zetterqvist from Linköping University in Sweden critically reviewed empirical studies applying DSM-5 criteria in respect to prevalence, characteristics, and clinical symptoms on samples of children and adolescents. From her findings, she concludes that NSSI should be considered independently from BPD and emphasizes the need for further empirical studies to enhance DSM-5 criteria for valid diagnoses (Zetterqvist 2015).

1.3. Epidemiology

A systematic review of 52 studies on the **prevalence** of NSSI and DSH in adolescents yielded a comparable prevalence across multiple nations and countries (Muehlenkamp, Claes et al. 2012). A study conducted within the framework of the EU funded project "Saving and Empowering Young Lives in Europe" (SEYLE), found a NSSI lifetime prevalence of 44,5% in female and 24,8% in male pupils between the ages of 14 to 17 in Germany (Wasserman, Carli et al. 2010), agreeing approximately with data of other studies (Muehlenkamp, Walsh et al. 2010, Plener, Fegert et al. 2017). Comparing German students with students of 10 other European countries, the former show the second highest numbers in terms of any lifetime and deliberate self-injurious-behaviour (D-SIB), as well as third highest numbers in terms of occasional D-SIB (see table 4) (Wasserman, Carli et al. 2010).

Table 4: *Prevalence of D-SIB in 11 European countries, with kind permission of Wasserman et al., 2010*

	Any lifetime D-SIB in %			**Occasional D-SIB in %**			**Repetitive D-SIB in %**		
Country	**Females**	**Males**	**Total**	**Females**	**Males**	**Total**	**Females**	**Males**	**Total**
France	43.1	28.6	38.5	27.99	20.44	25.60	15.16	8.18	12.95
Germany	44.5	24.8	**35.1**	27.67	**17.62**	22.88	16.84	7.20	12.25
Estonia	37.6	27.4	32.9	25.9	21.26	23.76	11.69	6.11	9.12
Israel	34.8	32.0	32.6	25.99	21.66	22.51	8.81	10.35	10.05
Spain	32.3	25.8	28.9	25.41	17.61	21.37	6.91	8.14	7.55
Slovenia	29.6	21.8	27.3	19.75	15.03	18.38	9.81	6.75	8.92
Austria	30.2	21.3	26.9	22.26	16.14	20.0	7.93	5.19	6.91
Italy	21.1	20.5	20.9	17.53	13.39	16.20	3.58	7.09	4.70
Romania	19.6	22.4	20.6	17.33	19.01	17.91	2.32	3.39	2.69
Ireland	18.7	21.9	20.4	13.76	16.46	15.21	4.93	5.49	5.23
Hungary	19.0	14.4	17.1	12.71	12.22	12.51	6.27	2.20	4.60

In terms of **age**, authors describe a peak in middle to late adolescence. They find young adolescents at higher risk of NSSI when faced with a similar load of psychosocial risk factors when compared to adults (Briere and Gil 1998, Brunner, Kaess et al. 2014). Some

authors thus argue that NSSI is triggered by puberty and the confrontation with multiple developmental challenges (Plener, Fegert et al. 2015). Furthermore, findings from a systematic review, examining the longitudinal course of NSSI and DSH, showed decreasing prevalence with increasing age (see figure 2).

Figure 2

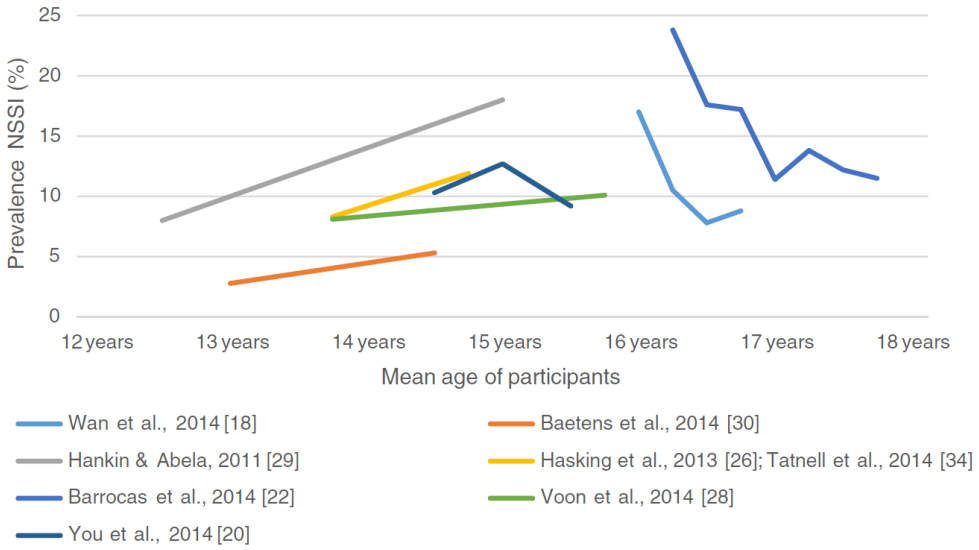

Figure 2: The course of NSSI throughout adolescence, adapted with kind permission of Plener et. al., 2015

Of 2.509 participants, authors found a mean age of NSSI onset at 17.25 years and cessation at 26.74 years (Plener, Schumacher et al. 2015).

As to differences in **methods** of NSSI, a survey of 390 American high school students found respondents to engage in cutting, scratching, and self-hitting most commonly (Muehlenkamp and Gutierrez 2004). Later findings of a US-American retrospective chart review acknowledge cutting as the most common method (34%), stating overdose (25%), burning (7%) and strangling (6%) as subsequent methods of NSSI (Jacobson, Muehlenkamp et al. 2008)). These findings among cisgender persons match surveys with transgender peers, in which cutting is listed as the most common type of NSSI (in 66.4%) (Reisner and Juntunen 2015).

Concerning frequent methods, **gender differences** were detected in NSSI. In line with similar research on the subject (Sornberger, Heath et al. 2012), a review on methods of

NSSI according to gender revealed that females are observed to particularly engage in NSSI in the form of cutting, biting, scratching, hair pulling and interfering with wound healing, while males were found to rather inflict burns on themselves and bang their heads. For an overview of the results found, see table 5 (Bresin and Schoenleber 2015).

Table 5: *Methods of NSSI according to gender,* with kind permission adapted from Bresin & Schoenleber, 2015

	K	Men	Women	OR	95% CI
Cutting	25	30.04 (.6-100)	48.19 (1-100)	2.64	1.78, 3.92**
Burning	22	19.61 (.4-45)	17.88 (0-68)	.63	.37, 1.07
Hitting	23	28.63 (2.3-60)	29.52 (.6-69)	.89	.67, 1.17
Biting	19	16.33 (0-57)	26.71 (1.4-69)	1.48	1.02, 2.14**
Scratching	20	20.88 (1.5-66)	30.65 (1.2-77)	1.65	1.28, 2.15**
Banging the head	17	28.04 (3.6-79)	23.66 (0-55)	.79	.58, 1.08
Carving	12	18.39 (3-30)	26.61 (2-72)	1.27	.62, 2.59
Sticking	13	20.42 (3-50)	24.02 (0-55)	1.19	.73, 1.93
Interfering	14	18.39 (0-41)	29.10 (3.4-85)	1.83	1.01, 3.27**
Pinching	2	23.40 (3-43.81)	21.87 (18-48.93)	1.23	1.06, 1.42**
Swallowing[a]	1	3 (-)	10 (-)	3.59	.18, 69.95
Pulling hair	6	11.95 (0-31.40)	34.56 (11-68.6)	2.95	1.64, 5.12**
Other	14	16.12 (3-40)	21.93 (2.9-82)	1.31	.66, 2.57
Overall	120	26.36 (2.4-100)	33.78 (2.7-100)	1.50	1.35, 1.65**

*Note 1: k = number of studies; OR = odds ratio; CI = confidence interval; Interfering = interfering with wound healing; a = only one study reported swallowing chemicals (thus there is no minimum and maximum); ** p <.05*

1.4. Aetiology

"I felt awesome, satisfied finally, then exhausted", thus describes the fifteen-year-old protagonist in Patricia McCormick's book "Cut" her feelings after an act of NSSI (McCormick, 2002). This quote exemplifies the belief that NSSI includes a typical sequence of temporary relief from negative emotions and tension, linked to feelings of gratification (Brain, Haines, & Williams, 1998). Like in many other psychiatric diseases,

the genesis of NSSI is believed to be most likely multifactorial. The following chapter gives an overview of influencing factors and different approaches to aetiological explanations.

Neurobiology

Due to the complexity of gene behaviour relationship, research is so far discordant about the impact of neurobiological mechanisms which impact the formation of NSSI. Several systems are being discussed in this context (see figure 3) (Groschwitz and Plener 2012).

Figure 3

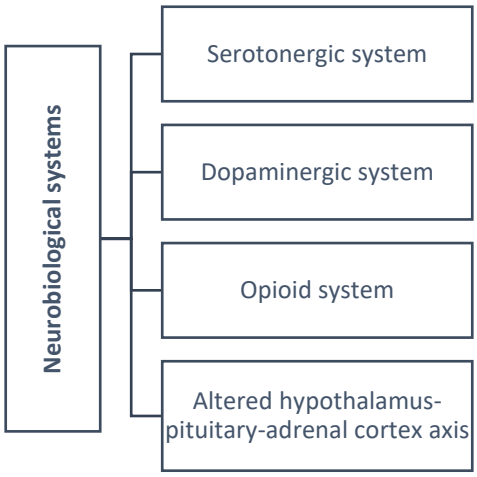

Figure 3: Neurobiological systems involved in the emergence of NSSI

Regarding the serotonergic neurotransmission, it is shown to have an important role in the neurobiology of NSSI (Groschwitz and Plener 2012). Serotonin, or 5-hydroxytryptamine (5-HT), is to the largest extent produced in enterochromaffin cells of the gastrointestinal (GI) tract and after secretion is stored in blood platelets. It is unable to pass the blood-brain barrier and to a smaller extent produced in the central nervous system. Serotonin has among other things effects on the GI-tract, blood clotting, temperature regulation, sleep-wake rhythm, and pain-inhibition. It influences mood, stress moderation, and affect regulation and is related to aggressive or violent behaviours, hereby affecting the likelihood of NSSI (Groschwitz and Plener 2012). A study by researchers of the University of Washington on 41 adolescents showed lower

blood levels of it in participants engaging in NSSI (n=20) than in those appointed to the control group (Crowell, Beauchaine et al. 2008). Compatible with this finding, other authors found variant serotonin transporter sites in the prefrontal cortex and thus reduced serotonin functioning due to a lower of serotonin receptor binding in patients with mental illness (Arango, Underwood et al. 2002).

Dopamine (DA) is primarily produced in neurons, medullary and adrenal gland cells. It has an influence on the extrapyramidal motor system, which has been shown to have a connection with psychiatric diseases such as the development of addiction problems (Berke and Hyman 2000, Di Chiara and Bassareo 2007, Volkow, Wang et al. 2011). As authors describe NSSI to display addictive features, a connection to the dopaminergic effect may exist (Nixon, Cloutier et al. 2002); however, this relation has so far only been explored in humans.

A different study examining cerebrospinal fluid of psychiatric patients with history of NSSI showed no proof for serotonergic or dopaminergic dysfunctions. Instead, significantly lower levels of the two opioids ß-endorphin and met-enkephalin in comparison to the non-NSSI group were found (Stanley, Sher et al. 2010). ß-Endorphin is mostly produced in the basal hypothalamus, binding preferably to μ-opioid receptors, and is released in response to physical injury (Hawkes 1992). It is shown to have analgesic, but also global effects on stress-reduction, inducing pleasant feelings of well-being and behavioural stability (Veening and Barendregt 2015). The authors name several possible reasons for this "opioid deficiency", ranging from a genetic predisposition to chronic and severe childhood stress and trauma – NSSI is in this context discussed to represent an attempt to increase the level of endogenous opioids and restore homeostasis (Stanley, Sher et al. 2010). This may explain the hypothesis that NSSI is in many cases performed in the absence of physical pain (Nock and Prinstein 2005), with the objective to feel pain and mood elevation (Kemperman, Russ et al. 1997).

Another investigation on the neurobiology of NSSI, using verbal responses and functional magnetic resonance imaging (fMRI) to measure arousal in patients with history of NSSI showed significantly stronger brain activity in the amygdala,

hippocampus, and anterior cingulate cortex in both brain hemispheres (Plener, Bubalo et al. 2012). Furthermore, authors compared adolescents engaging in NSSI with healthy peers of the same gender and age and proved those with history of NSSI to present a stronger brain activation in the hypothalamus and thus a higher adrenal distribution of cortisol when expecting emotional strain (Reichl, Heyer et al. 2016). This axis was shown to play a crucial role in the physical reaction to emotional distress, manifesting itself in an increased cardiovascular tone, suppression of the immune system and catabolic reaction. Its mode of action had until then primarily been tested in animal models (Suomi 1991, Diorio, Viau et al. 1993). There are indications for a hyperactivity of the HPA axis and significantly higher volume of the pituitary gland in patients with BPD. According to several authors, this finding justifies the inclusion of measures of the HPA axis in patients at risk (Coryell, Young et al. 2006, Jovev, Garner et al. 2008).
In synopsis of these complementary, but also contrasting findings, the controversial nature of the neurobiological basis of NSSI becomes apparent, implying the need of further research with this focus.

Risk factors

According to a review from 2018 (Plener, Kaess et al. 2018), the three main general risk factors for NSSI are:

1. Female Sex
2. Social factors
    - Familial risk factors, abuse, or physical maltreatment in childhood
    - School bullying and social pressure from peers
3. History of NSSI

In regard to differences in the prevalence between the two **sexes**, there is various literature (Selby, Bender et al. 2012). While most research states that girls are more likely to show actions of NSSI (Martin, Rozanes et al. 1995, Lloyd-Richardson, Perrine et al. 2007, Sornberger, Heath et al. 2012, Bresin and Schoenleber 2015), other authors suggest an equal prevalence and frequency among males and females (Dulit, Fyer et al.

1994, Briere and Gil 1998, Jacobson, Muehlenkamp et al. 2008, Ostertag, Golay et al. 2019). In all German studies found on the topic, girls were found to engage in NSSI more likely or even exclusively (Plener, Allroggen et al. 2016). Consequently, NSSI prevalence by sex may be biased according to national background. A web-based survey of students showed that females were more likely to perform NSSI because they were upset or in hope of attention. Males, however, were 1.6 times more probable to report anger and four times likelier to report intoxication as an initiating factor. Females were identified to make use of therapy for any psychiatric reason twice as much as males (Whitlock, Muehlenkamp et al. 2011). Regarding the frequency of repetition, girls of various ages have moreover been found to be more vulnerable than the opposite sex (Butler and Nolen-Hoeksema 1994).

A study sample of 1.635 transgender and gender non-conforming students in grades 9 and 11 showed that over a half (51.6%) of them had engaged in NSSI in the previous year (Taliaferro, McMorris et al. 2019). This finding is consistent with previous research showing that sexual minority youth were more likely to show repetitive NSSI than cisgender peers (McCartney 2016, Hasking, Whitlock et al. 2017, Taliaferro and Muehlenkamp 2017, Watson and Tatnell 2019). Transgender youth is reported to have an increased risk of recurrent NSSI compared to lesbian/gay and bisexual cis-adolescents (Walls, Laser et al. 2010, Rimes, Goodship et al. 2019). Another large-scale online study on the lifetime occurrence of NSSI among a similar study population revealed a ratio of NSSI history of 41.9% with a mean age of onset at 13.6 years (Reisner and Juntunen 2015). Birth-assigned females were more likely to engage in NSSI than those assigned male at birth (Arcelus, Claes et al. 2016). Although several risk and protective factors for lesbian, gay, bisexual, and transgender youth were identified, there is a gap in the literature addressing these gender groups (Mustanski and Liu 2013).

Social factors are stated to be of major importance by many researchers. In a prospective study with 103 adolescents, exploring predicting determinants for NSSI in adolescence over 2.5 years, a weak social and **familial** environment with lacking social support showed to be a predictor of NSSI (Hankin and Abela 2011).

The assumption of a strong relation between a history of childhood **sexual abuse** and NSSI was widely held for many years. In 2002, Cavanaugh still described NSSI to be "a manifestation of sexual abuse in adolescent girls" (Cavanaugh 2002). It is in these cases – particularly in women - often linked to additional diagnoses like BPD, that a more severe clinical presentation, suicidality, and a poorer prognosis are likely (de Aquino Ferreira, Pereira et al. 2018). Yet, recent research showed sexual abuse to be only a moderate risk factor for NSSI (Klonsky and Moyer 2008, Maniglio 2011). This confirms the importance of the by now independent diagnosis of NSSI and consideration of it decoupled from BPD. A study from psychiatric in-patient units for youth at the University Hospital of Heidelberg showed significant associations with parental antipathy and neglect and paternal physical or sexual abuse, with highest odds ratios for maternal antipathy and neglect (Kaess, Parzer et al. 2013). Other analyses revealed that highly expressed parental criticism was strongly associated with self-injurious thoughts and behaviours, while emotional overinvolvement was not (Wedig and Nock 2007). Girls were in this respect shown to attest to higher levels of parental criticism and alienation than boys (Yates, Tracy et al. 2008).

Regarding **education status**, a representative sample of 2.509 German participants with history of or current NSSI showed a strong impact of the level of **education** on the occurrence of NSSI. For an understanding of the findings, it is important to briefly grasp the German educational system. It consists of several types of secondary schools, among them – serialized according to the increasing academic complexity - "Hauptschule", "Realschule", and "Gymnasium"[1]. The study showed a majority of 41% to have visited the "Realschule", 32% the "Hauptschule", 12% the "Gymnasium" and 2 individuals not completing any school (Plener, Allroggen et al. 2016).

The **school setting** also carries various elements of social risks: Bullying has been shown to increase the likelihood of NSSI and future internalising disorders (Fortune, Sinclair et al. 2008, Klomek, Sourander et al. 2015, Doyle and Sullivan 2017). Besides, the spreading of NSSI within a class was declared a common and problematic phenomenon by school

[1] They all go from class 5 through 10 and finish with a first final school degree. The Gymnasium additionally offers grades 11 to (depending on the state) 12 or 13 in order to graduate with the German "Abitur".

professionals (Plener, Kaess et al. 2011), Jarvi et al. even refer to it as “social contagion” (Jarvi, Jackson et al. 2013). Therefore, teachers can be beneficial in detecting and reporting warning signs, exemplarily listed in figure 4 (Lieberman, Toste et al. 2008).

Figure 4

- Observation of unexplained cuts, scars, bruises, burns on arms/ legs
- Wearing of long sleeves, wrist pants, high-necked shirts, or long pants even when not appropriate for the weather to hide fresh wounds and scars
- Refusal to perform activities in which skin is revealed, such as swimming
- General signs of depression, social isolation, and disconnectedness
- Secretive behaviours such as spending a lot of time in isolated areas
- Risk-taking actions like playing with dangerous objects that are potentially even in their possession, running into traffic or sexually acting out
- Indicators for self-harm in work samples, journals, or art projects

Figure 4: Warning signs of NSSI, with kind permission adapted from Lieberman & Toste, 2008

Social contagion can also be maintained or even reinforced by **social media**. In October 2021, Facebook whistle blower Frances Haugen testified before a Senate panel to believe “that Facebook’s products harm children (…), generating self-harm and self-hate — especially for vulnerable groups, like teenage girls” (Haugen 2021).

A research group in Cambridge investigated visual portrayal of NSSI in social media for four weeks and found pictures showing wounds due to NSSI to be frequently posted. The authors state the hypothesis that social reinforcement might play a role in such posts, calling on social media platforms to take appropriate preventive measures (Brown, Fischer et al. 2018).

Finally, regarding **history of NSSI,** results from a random-effects model demonstrated strong effects for prior history of NSSI as a specific risk factor, stating that “previous

behavior is often one of the strongest predictors of future behavior" (Fox, Franklin et al. 2015).

Comorbidities

The relationship between NSSI and suicidal thoughts and behaviours is frequently the subject of debate. While some scientists emphasize finding little empirical evidence for NSSI as a predictor of suicidality (Willoughby, Heffer et al. 2015), many authors see a close relation between the two phenomena and declare them to occur comorbidly (Lloyd-Richardson, Perrine et al. 2007, MacLaren and Best 2010, Tang, Yu et al. 2011, Gillies, Christou et al. 2018). One underlying difficulty of the discussion is the fact that many studies assess the outcome of self-injurious behaviour as a whole, without regarding whether suicidal intent was present (Stanley, Fineran et al. 2014). In 2006, data was published stating that 70% of adolescents with a recent history of NSSI were reported to have undertaken SA at least once in their lifetime (Nock, Joiner Jr et al. 2006). Reversely, suicides are often described to be preceded by NSSI. A systematic review with data from observational and experimental studies found two-thirds of suicides being preceded by non-fatal self-injury in the previous year (Owens, Horrocks et al. 2002). Studies from earlier data list numbers ranging from 30-47% of successful suicides which were linked to NSSI in the medical history (Barraclough, Bunch et al. 1974, Nordentoft, Breum et al. 1993, Lewis, Hawton et al. 1997). Keith Hawton, professor of Psychiatry at the Oxford Centre for Suicide Research compared NSSI to the base of an iceberg, melting down do suicide. The model may present a wakening call to approve the high number of unreported adolescents who present themselves to clinical services, when "the ice is already melting" and intervention does not come soon enough (Hawton, Saunders et al. 2012). Finally, an interview with 111 adolescent psychiatric inpatients showed an onset of NSSI to be frequently reported significantly earlier than SA and SA (see figure 5) (Groschwitz, Kaess et al. 2015).

Figure 5

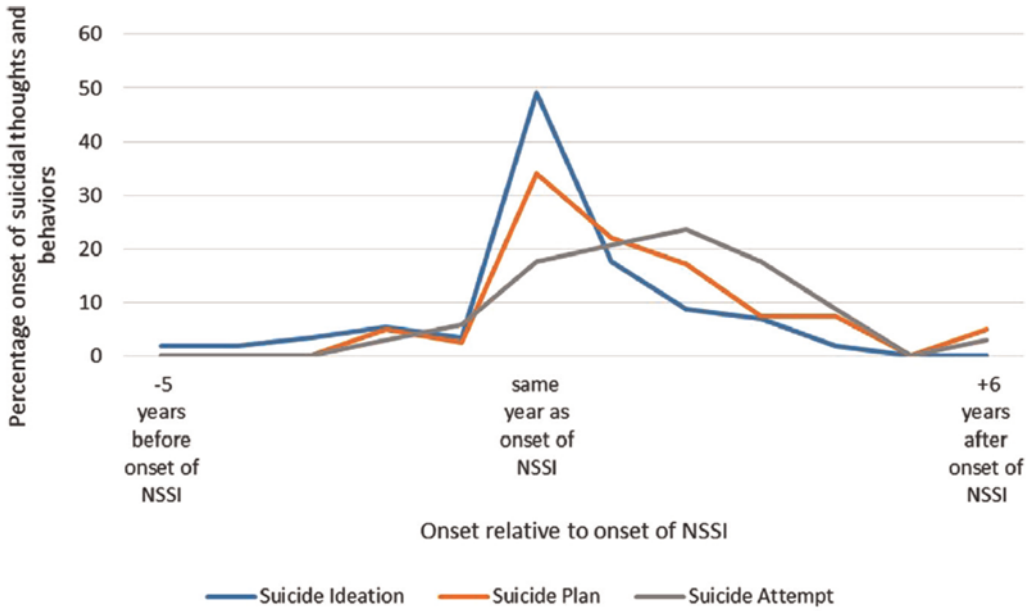

Figure 5: Percentages of first suicidal behaviors and thoughts in comparison to onset of NSSI, with kind permission adapted from Groschwitz & Kaess, 2015.

Even if there is an ongoing debate as to what extent NSSI and suicidal thoughts and behaviours can be understood as comorbidities, it is evident that NSSI does at least represent a dangerous predictor for future SA. This reinforces the urge for early prevention of NSSI.

In terms of further comorbidities among children and adolescents, it is important to become aware of the fact that NSSI is often linked to comorbid psychiatric diagnoses. Researchers reviewing 21 studies on comorbidities of NSSI found an average of at least one affective disorder in almost half (48,19 %) of the adolescents affected (Petermann and Nitkowski 2011). The majority (87,6%) of adolescents engaging in NSSI were shown to meet criteria for a DSM-IV Axis I disorder, including internalizing, externalizing and substance use disorders (Nock, Joiner Jr et al. 2006). Major depression disorders (MDD) form the most common comorbid Axis I diagnosis in many studies (Jacobson, Muehlenkamp et al. 2008, Petermann and Nitkowski 2011, In-Albon, Ruf et al. 2013).

Data from a US-American general psychology clinic show that of patients engaging in NSSI, 37% were patients with depressive episode of a bipolar affective disorder, further 21% having an anxiety disorder, 9% substance use disorders - mainly of cigarettes and

alcohol - and 25% various other disorders (Selby, Bender et al. 2012). Of all personality disorders, BPD was shown to be the most common comorbid diagnosis to NSSI. From a chart review study with 227 adolescents aged 12 to 19, those engaging in any kind of NSSI were found more likely to have features of BPD than those with no history of NSSI. Of patients engaging in NSSI without being diagnosed with BPD, 27% showed four or more symptoms of BPD apart from the self-injury item, while 44% did so in the group with history of NSSI and suicide attempts (SA) (Jacobson, Muehlenkamp et al. 2008).

A follow-up study on former patients engaging in NSSI in the previous year showed that around half of them met diagnostic criteria for BPD, concluding that an early age of onset of NSSI, as well as a long duration of it during adolescence significantly predict adult BPD (Groschwitz, Plener et al. 2015).

Eating disorders are found to be associated to NSSI more in adults than in adolescents (Petermann and Nitkowski 2011). Findings of a relation to anorexia nervosa are rather inconsistent. In contrast to this, proof for comorbid bulimia nervosa subsists. The reason for this may lie in the nature of bulimic patients, who take weight-regulating actions such as self-induced vomiting or laxative measures and thus show similar impulsive and affect-regulating patterns that occur with NSSI (Kaess, von Ceumern-Lindenstjerna et al. 2013).

A longitudinal investigation of young adult women showed that women with histories of childhood attention deficit hyperactivity disorder (ADHD) diagnoses reported higher rates of NSSI than those than those who did not meet criteria for ADHD, in particular when having shown impulsivity as a child (Swanson, Owens et al. 2014).

Regarding comorbid posttraumatic stress disorder (PTSD), a strong relation was shown between interpersonal trauma exposure and the prevalence and frequency of NSSI (Modrowski, Chaplo et al. 2019). Authors found a link between childhood sexual abuse and NSSI in patients with PTSD (Weierich and Nock 2008). Groschwitz and colleagues published a chart showing elevated numbers in the prevalence of psychiatric disorders among patients with NSSI in contrast to those without (see figure 6) (Groschwitz, Plener et al. 2015).

Figure 6

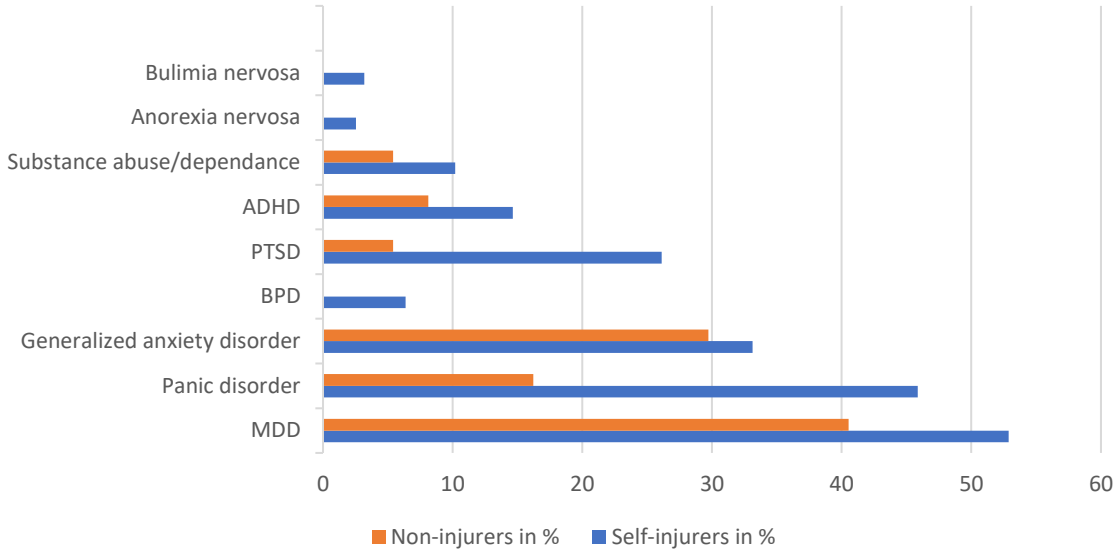

Figure 6: Prevalence of psychiatric disorders among patients with and without NSSI, data extracted from Groschwitz et al., 2015

Note 2: Abbreviations: ADHD, attention deficit hyperactivity disorder; PTSD, post-traumatic stress disorder; BPD, borderline personality disorder; MDD, major depressive disorder

1.5. Functions

Functions of NSSI are multifaceted. There have been numerous attempts to find main reasons for NSSI, without one explanatory approach being universally valid (Briere and Gil 1998, Nixon, Cloutier et al. 2002, Zetterqvist, Lundh et al. 2013).

A review of studies about functions of self-injury by Klonsky from 2007 unfolds seven main functions (see figure 7) (Klonsky 2007), cited by various authors (Lloyd-Richardson, Perrine et al. 2007, Lloyd-Richardson, Nock et al. 2008). These occur exclusively or overlapping.

Figure 7

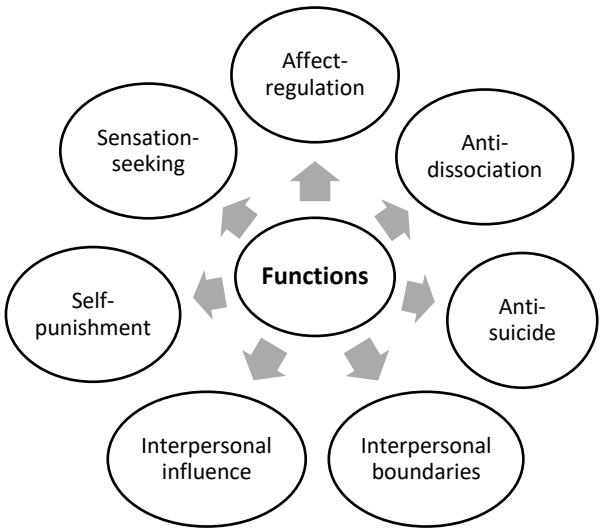

Figure 7: Functions of NSSI, adapted with kind permission from E. D. Klonsky, 2007

The model of **affect-regulation** suggests that NSSI can serve as a strategy to deal with verbally not expressible negative emotions, tension, or arousal, awaken positive feelings and regain control over emotions (Briere and Gil 1998, Nixon, Cloutier et al. 2002, Winkel, Groen et al. 2005). In a Swedish cross-sectional study with retrospective self-report of 836 adolescents aged 15-17 years reporting NSSI in the past year, the reason most frequently reported was “to stop bad feelings” (46,9%) (Zetterqvist, Lundh et al. 2013). In an Irish self-report survey of 103 adolescents who self-injured, the majority (79%) stated “to get relief from a terrible state of mind” as their main reason (Doyle 2017).

The **anti-dissociation** model indicates another potential motive of NSSI to terminate dissociative elements and get back to “feeling oneself”. In the ICD-10 classification, dissociation is characterised by “partial or complete loss of the normal integration between memories of the past, awareness of identity and immediate sensations (…), associated with a traumatic life event” (WHO, 2010). NSSI in those patients can thus have the function of providing emotional and physical sensation and a feeling of realness and liveliness (Klonsky 2007). The two reasons “to relieve feeling numb or empty” (45,6%) or “to feel something, even if it was pain” (38,0%) were the second leading causes for NSSI in Zetterqvist’s study.

The theory of **anti-suicide** entails NSSI as a strategy to bypass or replace suicidal ideation and actions.

Self-punishment as a reason for NSSI represents a common function, more frequently found in girls (Lloyd-Richardson, Perrine et al. 2007). It implies a coping mechanism for frequently sensed feelings of guilt. These feelings can either result from feelings of not fulfilling expectations, but also arise from traumatic events. In the last case, patients try to re-live past traumatic events and process them by engaging in NSSI, thereby regaining control over situations they had thus far experienced as uncontrollable. The American psychotherapist Steven Levenkron hypothesised, that this re-living of traumatic events also serves as self-care in children having experienced physical abuse, and interpreted it to be a way of showing affection (Levenkron 1998). In the Swedish study mentioned above, 40,7% named self-punishment as one of their principal reasons for NSSI, consistent with 38% in the Irish survey.

While the category **interpersonal influence** implies the function to cry for help or attract "solicitous attention" by NSSI (Walsh and Rosen 1988); the model of **interpersonal boundaries** defines NSSI as the desire to claim autonomy and distinction, set boundaries or feel a group identity with peers engaging in NSSI.

Finally, as **sensation seeking**, Klonsky categorizes all patients aiming to trigger feelings of excitement due to an act of NSSI at the expense of physical risks that such experience involves (Klonsky 2007).

1.6. Therapeutic intervention

Regarding therapeutic interventions of NSSI, one thing should be made clear at the outset: even if there is growing research, therapy of NSSI is still frequently based on case-by-case decisions, usually implying hospitalization (Maden 1999) with weak evidence of effectiveness (Dixon-Gordon, Harrison et al. 2012). For an overview of an algorithm of the general procedure for the clinical treatment pathway, see figure 8 (Plener, Brunner et al. 2016).

Figure 8

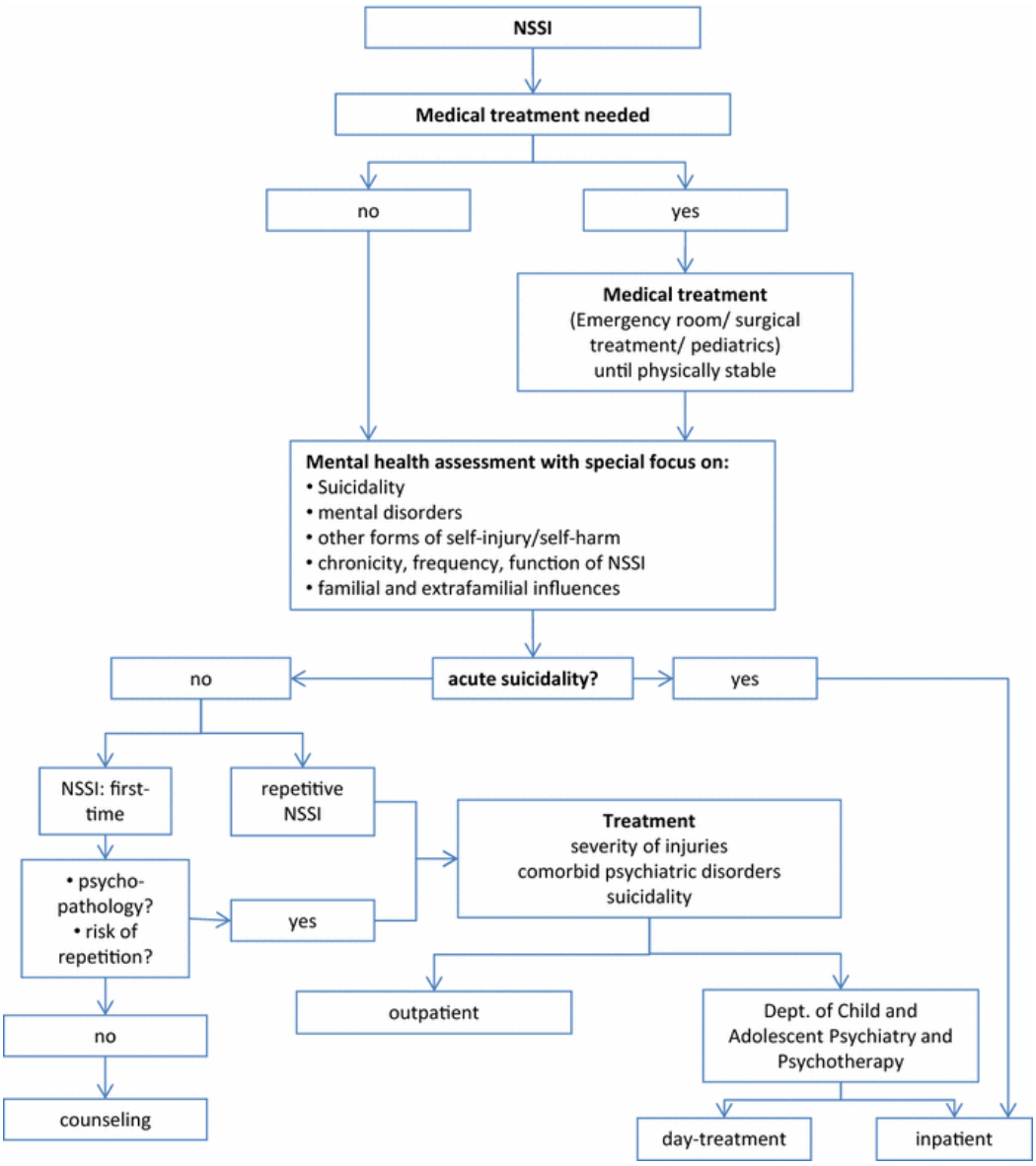

Figure 8: Treatment algorithm for NSSI, adapted with kind permission by Plener & Brunner, 2016

Approaches to therapeutic interventions are based on three main pillars: Primary medical care, pharmacotherapy, and psychotherapy.

Primary medical care implies acute management of wounds, as well as a reliable anamnesis with questions about suicidal tendencies. In case of affirmation, further actions implying inpatient psychiatric admission are indispensable. Concerns about the impact that screening for risk of suicide may have on a person's mental health are

proven to be without reason. This emphasizes the necessity of addressing the issue openly (Gould et al., 2005).

In terms of **pharmacotherapy**, there is no internationally approved medication for children and adolescents engaging in NSSI, resulting in an "off-label" use of psycho-pharmaceuticals (P. L. Plener et al., 2017). Besides, the use of medication is to be considered only in addition to psychotherapeutic interventions and "as short as possible but as long as necessary", to gain a level of functioning without habituation or side effects (Paul L Plener & Schulze, 2014). Prescriptions require stringent medical indication, as side effects frequently occur, causing additional burden (Schulz, Zanarini et al. 2008). For adolescents, groups of pharmaceuticals prescribed include (preferably atypical) antipsychotics (Abraham and Calabrese 2008) and benzodiazepines for the situation of acute crisis, the latter being usually strongly restricted to short-term use due to risk of dependency (Plener, Libal et al. 2008). Antidepressant drugs, most commonly inhibitors of serotonin and/or noradrenaline reuptake, are the preferred long-term treatment (Markovitz and Schulz 1993, Zanarini, Frankenburg et al. 2004, Plener, Brunner et al. 2010), but here too exist concerns regarding their efficacy and adverse effects (Teicher, Glod et al. 1993, Donovan, Clayton et al. 2000, Simpson, Yen et al. 2004, Zanarini, Frankenburg et al. 2004, Isacsson, Holmgren et al. 2005).

Lithium may constitute a viable alternative for patients who do not respond to other antidepressant drugs (Sangdee and Franz 1978, de Montigny, Cournoyer et al. 1983, Alvarez, Pérez-Solá et al. 1997). It is however proposed as a last resort only in case of severe symptoms (Kendall, Morriss et al. 2014) due to its numerous side effects, very limited therapeutic range and risk of unintended intoxication (McKnight, Adida et al. 2012, Gitlin 2016). Further drug groups listed in the context of drug treatment of NSSI are opioid receptor antagonists, showing benefits for populations with neurodevelopmental disabilities engaging in NSSI (Sandman and Touchette 2002, Symons, Thompson et al. 2004), and the so far widely unexplored antihypertensive drug Clonidine for patients with comorbid eating disorders (Sandman 2009, Claes and Muehlenkamp 2016).

Psychotherapy constitutes the third pillar of therapeutic approaches to NSSI. Dialectical

Behaviour Therapy (DBT) constitutes the most widely approved and implemented psychotherapeutic method for NSSI. It was originally developed in 1993 by the American psychologist Marsha Linehan for chronically suicidal individuals diagnosed with BPD (Koons, Robins et al. 2001, Panos, Jackson et al. 2014) and modified for use with adolescents (DBT-A) in 1997 (Miller, Rathus et al. 1997). The different modules are aimed at providing coping skills for stressful life experiences and emotional strain by conveying principles of mindfulness and strengthening emotion regulation, distress tolerance, and interpersonal effectiveness (Fleischhaker, Böhme et al. 2011). Overall however, there is considerable headwind from various sources. First of all, DBT is an approach proven to be effective especially for patients with BPD, but NSSI is increasingly observed in patients who do not meet the diagnostic criteria for BPD (Fleischhaker, Munz et al. 2006, James, Taylor et al. 2008, Mehlum, Tormoen et al. 2014). Additionally, some authors rate DBT programs to be only weakly feasible for several institutions due to their complex extent, demanding the development of more short-term and effective treatment (Dixon-Gordon, Harrison et al. 2012). Regarding outcomes on NSSI, a very recent systematic review and meta-analysis found small to moderate effect sizes for the reduction of NSSI after DBT-A in 12 to 19 year old adolescents and evidence for effectiveness only in pre-post evaluations (Kothgassner, Goreis et al. 2021).

Another therapeutic approach is cognitive-behavioural therapy (CBT), which aims to identify negative thinking and to develop coping skills in order to enhance stress-coping and problem-solving deficits. However, examinations of the efficacy of CBT in treating NSSI are currently lacking (Peat 2014). Mentalisation-based therapy (MBT), has been suggested as an approach to address patients showing NSSI (Robinson 2014). MBT is a psychodynamic therapy that was developed specifically to address mentalization deficits in patients with BPD; by mitigating these deficits, MBT aims to decrease the problems with impulse control and affect regulation that are common in such patients and to improve their interpersonal functioning (Psychology 2020). A meta-analysis comparing the efficacy of several psychotherapeutic approaches regarding NSSI rates, including CBT and DBT, found evidence only for MBT (Calati and Courtet 2016).

In a synopsis of the literature found, it can be **concluded** that standardised therapeutic guidelines are lacking, resulting in few psychological treatments for NSSI that fulfil standards of empirically supported interventions. In addition, it is interesting to take a look at an anonymous web-based survey from eight universities in the USA with a random sample of 36.900 participants: the investigation revealed that 22.6% of the participants kept NSSI behaviour completely to themselves and just 8.9% of the sample had presented themselves to a mental health professional (Whitlock et al., 2011). This finding indicates that only few adolescents find their way into a therapeutic setting (P. L. Plener et al., 2017). To target all those at risk or hiding NSSI, it appears to be the most sensible course of action to intensify research not only on intervention, but also on prevention for a broad target group.

1.7. Preventive approaches

"An ounce of prevention is worth a pound of cure," Benjamin Franklin once said. Prevention, or preventive healthcare, involves all measures taken to promote and improve health of individuals. Post-primary school students engaging in NSSI showed the highest level of agreement (65,3%) regarding the statement that NSSI could be prevented (Doyle 2017). The first to draw attention to the importance of prevention of mental illnesses was Gerald Caplan, who in 1964 established three types of prevention while criticizing how in spite of knowing about the necessity of it, "much remains undone". According to his model,

1) **Primary prevention** targets the reduction of the incidence of new cases of mental disorder and disability in a population, focusing on the modification of environmental risk factors or triggers and individual coping capacities (Caplan 1964). It is intended to prevent the onset of disease by intervening within a large normative population (Baetens, Decruy et al. 2020). Life-modifying activities, such as physical activity, dietary practices, stress relief and the cessation of alcohol consumption or smoking can be quoted as positive examples.

2) **Secondary prevention** aims to interfere with the disease process and duration or delay its onset by focusing on an at-risk group of individuals. This goes along with

organised case finding, diagnostic and medical service in order to detect mental disorders early and prevent aggravation effectively by therapeutic interventions.

3) **Tertiary prevention** is intended to limit residual defects, subsequent diseases and comorbid illness resulting from an illness which has already occurred. It aims to ensure the return to full social participation and reintegration into society, including methods such as rehabilitation or encouragement of patients with histories of severe injury or illness to re-learn activities of daily living to obviate further physical degeneration (Caplan 1964).

Two decades later, the model was supplemented by quaternary prevention, implying actions to identify patients of risk of "ethically unacceptable" overmedicalisation (Jamoulle and Roland 1995). Likewise during the 1980s, Robert Gordon redefined prevention forms, focusing rather on the conceptual purpose, and distinguishing universal from selective and indicated prevention (Gordon Jr 1983). For an overview of the main prevention models, see figure 9.

Figure 9

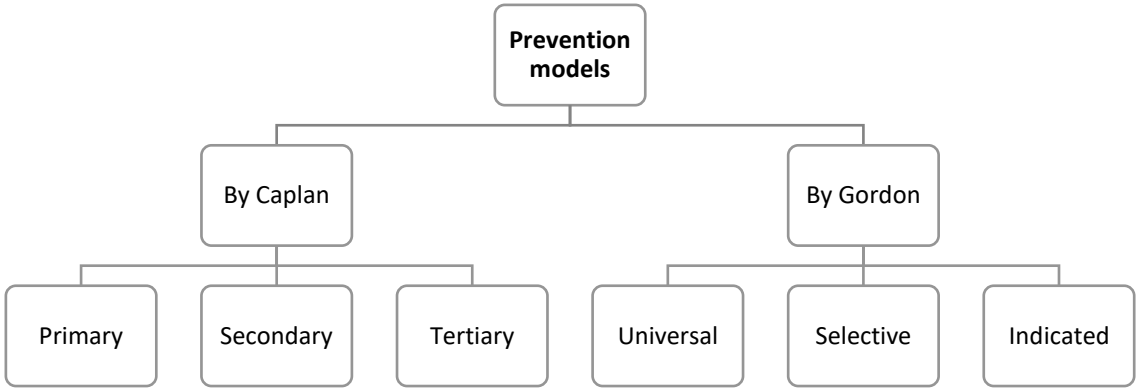

Figure 9: Prevention models by Caplan and Gordon

Universal prevention aims at the general population and does not consider specific risk populations in order to enhance health promotion by strengthening resources (Bürger and Kaess 2020).

Universal approaches show particular benefits, as they are "broadly available to everyone" (Doll, Haas et al. 2007), improve mental well-being and the quality of life, and

are demonstrably effective regarding a reduction of incidence and costs of chronic mental illness (Publishing 2016).

Regarding the prevention setting, most universal prevention programs for NSSI are school based. Schools are considered a safe environment. School staff works closely with adolescents and could – when well trained - act as mediators and strengthen resiliency factors by spreading information on emotional awareness, stress management and coping skills (Lieberman, Toste et al. 2008). A longitudinal pre-post study aiming to evaluate a training package for school welfare staff showed that it did in fact help to improve levels of knowledge, confidence, and skill in the management of NSSI - especially among those participants with low levels of knowledge at the baseline assessment (Robinson, Gook, Yuen, McGorry, & Yung, 2008). However, teachers report facing negative attitudes towards NSSI in schools and lacking information in how to deal with it appropriately (Toste & Heath, 2010). Authors thus call on schools to have "clear guidelines and policies in the form of an NSSI response protocol". Several articles provide Do's and Don'ts for the handling of NSSI in the school context in order to prevent its occurrence and repetition. Authors recommend teachers to approach students in a calm, understanding and caring way, referring, or accompanying them to a school professional and encouraging them in personal strengths and hobbies. Additionally, they strongly suggest not to react shocked or appalled to NSSI, as this may condemn students judgementally and cause deepening feelings of shame (Bowman & Randall, 2004; Toste & Heath, 2010). However, there seem to be various barriers to accept preventive measures. A theory model of stigma, based on perceptions of students and secondary school staff, offers explanation regarding five main barriers in the way of NSSI prevention. These entail word tabooing, (individual) avoidance, a judgmental stance, fear of (public) exclusion, and danger beliefs (Parker 2018).

Selective prevention by contrast specifically targets individuals or population groups, which are at increased risk or already show incipient symptoms (Bürger and Kaess 2020). An example for a population group targeted with selective prevention of NSSI are transgender or gender non-conforming youth, among whom high risk of NSSI is commonly reported (Hasking, Whitlock et al. 2017, Duffy, Henkel et al. 2019, Rimes,

Goodship et al. 2019, Taliaferro, McMorris et al. 2019, Wang, Kou et al. 2019). A common approach to targeted prevention in this field might be to strengthen "sociocultural norms of acceptance, tolerance, and positive identity development to reduce risks" (Taliaferro and Muehlenkamp 2017). Looking at meta-analyses by Kothgassner et al. on the topic, there is evidence that 148 selective/targeted prevention programs show moderate effect sizes in reducing NSSI (e.g. d=0.51; 149 g=−0.44 for DBT-A). This finding raises the question why selective approaches to NSSI prevention outweigh universal approaches. The higher expected effect sizes for prevention in patients may be one factor (Bürger and Kaess 2020). Another factor may be represented by the fact that selective prevention program show higher feasibility, as they can occur in a controlled, clinical setting.

Third, and finally, **indicated prevention** addresses people with manifest symptoms of a disorder. An Irish cross-sectional anonymous survey of 856 post-primary school students showed that among students who self-injured, the three favoured preventive approaches stated were to talk to someone (in particular to a young person or friend who "get how you are feeling because they probably feel something similar"), to relieve precipitating factors (e.g. bullying at school, loneliness or depression), and to receive professional help (claiming school counsellors as a low-threshold service in secondary schools to be able to talk to someone without parents knowing) (Doyle 2017). Due to the fact that this mostly entails clinical samples and therapeutic approaches, the line between prevention and therapy of NSSI is blurred. Regarding NSSI, a pilot study on the effect of DBT-A on adolescents aged 13 to 19 engaging in NSSI yielded promising success, showing a significant reduction of NSSI (Fleischhaker, Munz et al. 2006). This finding is consistent with further research in that field (James, Taylor et al. 2008, Mehlum, Tormoen et al. 2014). However, authors suggest a weak therapy motivation among adolescents, naming the lack of psychological strain and omission of NSSI as helpful distress coping strategy as main reasons (Plener, Fegert et al. 2017). Latest research in this field is provided by Kothgassner and colleagues in their meta-analysis on the efficacy of dialectical behavior therapy for adolescent engaging in NSSI, proving it to be a

valuable treatment of NSSI, as well as prevention of its aggravation (Kothgassner, Goreis et al. 2021).

One important issue to consider in the contemplation of prevention programs of NSSI is the fact that there is concern about potential **iatrogenic effects**. The phenomenon of peer influence and social learning may entail putting vulnerable adolescents at higher risk for NSSI by treating the topic (Albert, Chein et al. 2013, Jarvi, Jackson et al. 2013), and exposing them to negative experiences through the survey (Whitlock, Pietrusza et al. 2013). However, recent studies refute negative effects of NSSI education, both short-term and over the follow-up period (Muehlenkamp, Walsh et al. 2010, Hasking, Tatnell et al. 2015, Muehlenkamp, Swenson et al. 2015). Researchers examined the impact of NSSI-related stimuli in a series of three studies with a total of 3.493 participants both with and without history of NSSI and found a moderate mood decline to the presentation of NSSI images, but no increase in the urge to engage in NSSI (Cha, Glenn et al. 2016). Consequently, the aim should be to minimize potential iatrogenic effects, i.e. by applying well-tailored and individualised questionnaires and by conveying programs via specialists in the field of NSSI who are also trained to encounter emerging risks of adverse effects (Hasking, Lewis et al. 2019).

Why universal prevention of NSSI is needed

In consideration of the fact that targeted prevention programmes of NSSI have been shown to be effective, the question is raised why there is a scarcity of universal prevention programs addressing NSSI. Clearly more research and development in this field is urgently needed. A reason for the deficiency of progress may be the fact that universal prevention programs proved to be more resource-intensive and required higher case numbers and often collaborations outside the clinic (e.g. with schools), as evaluation studies showed. However, the urge to tackle prevention among the general population and at an early stage before manifestations of NSSI occur is not covered by selective or indicated prevention. In an article on how to maximize prevention efforts by the American Society for Community Research and Action, further important aspects in the consideration of the necessity of universal interventions are highlighted: in

comparison with targeted programmes, authors designate universal approaches to be less stigmatized, as interventions are not related to the potential barrier of consciously choosing participation ((SCRA)). Additionally, universal programmes do not depend on particular locations and participation can be enabled in the participant's familiar environment. An implementation in school-based, sports group, home, or community settings may result in a higher acceptance of programmes compared to a clinical setting. Finally, an advantage of universal prevention may lie in the fact that investments in social services are more sustainable and cost-effective, especially as assessment data can be drawn from universal services. (Lonne, Scott et al. 2019). From a salutogenetic perspective (Publication 1986), universal approaches are also considered as particularly important, as they strive to maintain health rather than reduce symptoms. Furthermore, research shows that universal programs are highly accepted in adolescents (Berger, Hasking et al. 2017). One step to make universal programs more feasible/ viable, despite their costs, could be to establish independent institutions only focusing on maintaining mental health (Israel, Parker et al. 2005).

In summary, NSSI has become not only a clinical but also a major public health problem. It represents a high-risk marker for the development and persistence of mental health problems including high rates of morbidity and mortality and causes substantial costs for the health system. It thus needs a closer look on how to intervene at an early stage and effectively tackle the incidence of NSSI via universal prevention, before first signs of it arise.

2. Aims

It can be assumed that universal prevention of NSSI represents an essential approach to meet and tackle the high prevalence rates of NSSI among children and adolescents. To verify this hypothesis, the objective of this thesis is to (1) collect evidence-based findings regarding universal prevention of NSSI in youth and provide a comprehensive overview of the current state of research; (2) identify studies on concrete universal prevention of NSSI among adolescents across the globe and examine their empirical evidence and effectiveness in form of a qualitative systematic review; and (3) in case of sufficient data

create a meta-analysis on the basis of the available studies and compare effects of universal prevention programs in terms of reducing NSSI incidence, occurrence and frequency.

3. Methods

3.1. Search protocol and information sources

The strategic literature review was based on the search of the two electronic databases PubMed (1960 – March 10th, 2021) and Google Scholar (1960 – March 5th, 2021) for English or German language articles on universal prevention programs of NSSI with the following search terms: ("non-suicidal self-injury" OR "self-injury" OR "self-harm" OR NSSI OR Suicide) AND (prevent*) AND (adolescen* OR child* OR youth). For details on the search string, see Appendix A. The last search was performed on the 10th of March 2021. Subsequently, references in publications found were pursued and screened for further relevance. After removing duplicates, titles and abstracts were screened. If studies were relevant to the topic, full texts were obtained.

As the terminology for and definition of NSSI gradually changed over time, broad terms implying self-injuries of any method or motive were entered to detect all programmes on the subject. The decision to include the search term “suicide” in indexing was made in order to allow a broad search and to initially cover studies which do not clearly differentiate NSSI from suicidal thoughts and behaviours. The term “self-harm” was included in order to enable older studies for inclusion which historically used the term even when implying non-suicidal intentions. To fulfil the objective of this review and focus on NSSI without suicidal motives, studies were then screened and included into the analysis only when providing data on NSSI independent of suicidality. This meant that a broad range of studies was considered in the first step of the literature search and in the following filtered according to eligibility regarding the non-suicidal background of self-injuring acts.

3.2. Eligibility criteria

Within the framework of the literature search, several restrictions were set to examine the eligibility of studies for inclusion into the analysis. For an overview of the main inclusion and exclusion criteria, see table 5.

Table 5: *Inclusion and exclusion criteria*

Criteria	**Included**
Study design	RCT, pre-post or cohort-studies, controlled or uncontrolled
Intervention	Universal prevention program of NSSI, targeting adolescents directly or via gatekeepers
Target population	General population of children and adolescents with a mean age under 18 years
Outcome	NSSI actions (occurrence, frequency, method) or knowledge (attitudes, handling, coping skills)
Publication language	German or English

Studies were included under the following conditions: They had to have (a) administered a universal prevention program of NSSI, (b) to an average population of children and adolescents, (c) under the age of 18, (d) via RCT, prospective pre-post or cohort-study design.

Systematic reviews, meta-analyses and study protocols were excluded. Subsequently, references of prior meta-analyses and reviews were screened for further relevant articles. If studies were suitable to the topic, full texts were obtained. Due to the limited number of studies found, uncontrolled study designs were allowed for inclusion to broaden the pool of studies. Programs were accepted for the review when either addressing youth directly or school staff (e.g., teachers, psychologists, or social workers) via gatekeepers.

Gatekeeper programs train individuals who have regular face-to-face contact with a targeted group to identify peers or pupils at risk early and direct them towards professional help (Mo, Ko et al. 2018). The interest to include gatekeeper training

programs for the review bases on the assumption of their distinct value in the field of prevention among youth (Isaac, Elias et al. 2009, Brown, Straub et al. 2018). Programs targeting clinical subgroups were excluded, since they do not represent the target group of universal prevention.

The method and manifestation of NSSI addressed in the programs was not considered relevant, as long as NSSI was determined as independent and primary **outcome measure** at baseline and post-intervention. To be precise, the effectiveness of programs was expected to be evaluated in terms of reducing the incidence of NSSI. A standardized questionnaire or interview was not presupposed, but accurate measurement regarding NSSI actions according to the diagnostic guidelines of the DSM-5 (occurrence, frequency, or method) or knowledge (attitudes, handling, coping skills) was required (Edition 2013). Secondary outcome measures were allowed to involve further parameters such as comorbid symptoms (including suicidal thoughts and behaviours), general well-being and the acceptance of the program.

No restriction was set in regard to the **data collection**, permitting broad, potentially self-designed and not necessarily validated assessment methods. This was justified by the fact that currently, there is no standardised diagnostic data collection method regarding NSSI (Miller and Brock 2010).

A conduction of **follow-up** investigations was not determined obligatory for inclusion; still, if conducted and recorded, they were included in the analysis.

3.3. Study selection

After removing duplicates, abstracts were screened by the authors (AW, CS, CvS) and independently screened by another member of the research group (AB) to determine their relevance to this review. Full texts of the remaining articles were subsequently screened (AB, CS, CvS). Studies were included in the review if they reported outcomes on reducing the incidence of NSSI.

3.4. Data collection process

Data extraction was independently performed by two authors of the research group (AW, CS, CvS). All data was extracted and classified with requisite categories determined in advance. These were set up according to the following pattern: Author, year of publication, sample size, characteristics of trial participants (age, sex, medical history), type of intervention (content, intensity, duration, setting), measurement time points, type of outcome measure (instruments, blinded assessment), key findings (effect sizes), treatment fidelity and adherence checks, drop-out rates, study limitations, and funding sources. At every step of the data collection, findings were cross-checked and discussed. Discrepancies were resolved through discussion. If no consensus could be reached, an independent member of the research group (JG) assessed the data.

3.5. Quality assessment

The overall study quality was evaluated according to the Canadian Effective Public Health Practice Project (EPHPP) recommendations on the domains selection bias, study design, confounders, blinding, data collection methods, withdrawals and dropouts (Project 1998). The global study quality was determined in the next step depending on ratings of the particular components mentioned above and then defined as weak, moderate, or strong. Studies without areas rated as weak were deemed as “strong”. One weak area led to a rating of “moderate” quality. Studies with two or more weak domains were classified as “weak”.

4. Results

4.1. Study selection

Figure 10 shows the flowchart of study inclusion, demonstrating the process of identification, screening, eligibility, and inclusion of studies.

In total, 11,368 studies were identified through the literature search, from which duplicated articles (n = 82) were removed. The remaining abstracts (n = 11,286) were screened by two further raters (AW, CS) to determine their relevance to this review.

Disagreement was resolved through discussion. 11,149 studies were deemed unsuitable for the subject of the review and excluded. Two independent authors (AB, CS) screened full texts of the remaining articles (n = 137) and excluded another 130 records which did not meet the inclusion criteria. Eventually, seven studies remained for the inclusion into the final analysis.

Figure 10

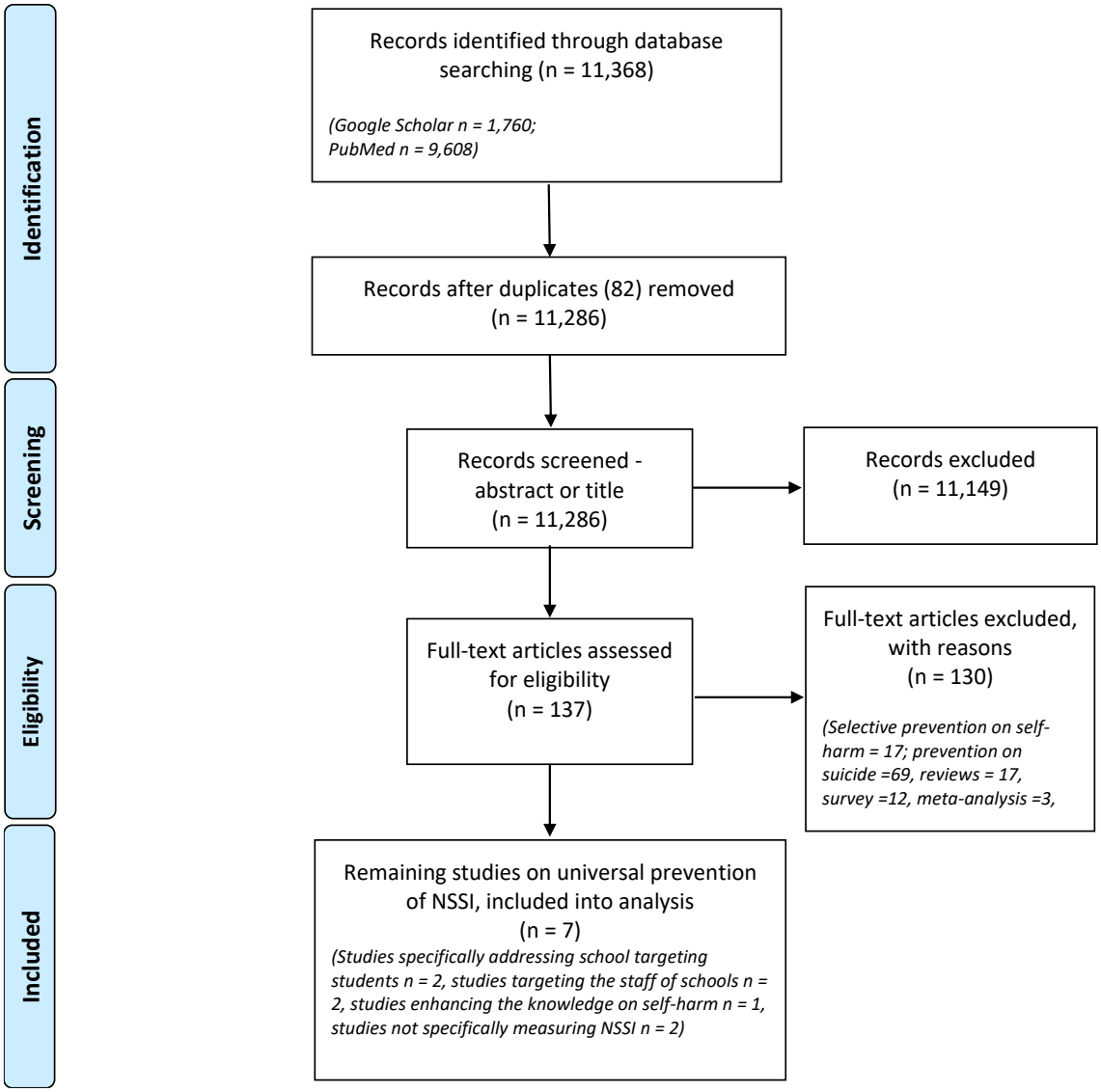

Figure 10: PRISMA Flow Chart

4.2. Study design

Six of the seven studies included were conducted in a pre-post design with just one of them being a randomised trial with both an intervention and control group (Baetens, Decruy et al. 2020). All studies included used a pre-post design and designed their programs for the school setting. All seven studies focused on universal prevention since this was one of the defined inclusion criteria. Five of them implemented the study with students directly.

Most of the studies were designed as **pilot studies** (Klingman and Hochdorf 1993, Muehlenkamp, Walsh et al. 2010, Baetens, Decruy et al. 2020), one of them within the framework of a Mexican student's master's thesis (Byrum 2019). One study represented an evaluation study, applying a training package developed in the previous year (Robinson, Gook et al. 2008). Two study groups developed **psychoeducational** "in classroom" modules with a strong focus on reducing NSSI incidences. Baetens and colleagues' study was the only one of those following a randomized and controlled design with two arms: an intervention group "Happyles", and a control group "HappylesPLUS" (Baetens, Decruy et al. 2020). The American authors designed a classroom module implementing the Signs of Self-Injury programme (SOSI) (Muehlenkamp, Walsh et al. 2010), originally designed for samples of high-school students, their teachers and parents in 2009 (Jacobs, Walsh et al. 2009).

Two studies implemented **gatekeeper training** programs (for a definition see 3.2.), addressing school staff in order to enhance knowledge on NSSI. The programs were either targeted at school welfare staff (Groschwitz, Munz et al. 2017), or at secondary school pupils (Klingman and Hochdorf 1993).

The remaining three studies set the primary focus on the transfer of **knowledge about NSSI** prevention, conveying it in different ways. They developed either informational booklets on NSSI prevention (Shabbir, Kapoor et al. 2021), established multi-step training programs for school staff including case vignettes (Robinson, Gook et al. 2008), or combined CBT with DBT techniques in order to "reduce stress and behaviors such as cutting" (Byrum 2019).

Consent was usually obtained in the form of a passive informed consent via the schools or research teams directly. One study did not mention the gathering of written consent (Klingman and Hochdorf 1993, Shabbir, Kapoor et al. 2021). Parents or guardians were involved in the consent of participation as soon as minors were included in the studies (Muehlenkamp, Walsh et al. 2010, Byrum 2019, Baetens, Decruy et al. 2020).

4.3. Study characteristics

Seven studies were included into the analysis. Table six on page 49 illustrates the main characteristics of the respective studies.

Participant group

The seven studies included a total of 1.929 participants. The mean sample size comprised 237 adolescents (SD ±176.30), with a minimum of 79 (Byrum 2019) and maximum of 651 participants (Baetens, Decruy et al. 2020).

They were carried out in seven different **countries**. Two studies were conducted in Europe, precisely Germany (Groschwitz, Munz et al. 2017) and Belgium (Baetens, Decruy et al. 2020). All further interventions were carried out in Non-European countries, namely the USA (Muehlenkamp, Walsh et al. 2010), Israel (Klingman and Hochdorf 1993), Australia (Robinson, Gook et al. 2008), India (Shabbir, Kapoor et al. 2021) and Mexico (Byrum 2019).

Two studies used a **sample** of school staff as gatekeepers (n = 480) (Robinson, Gook et al. 2008, Groschwitz, Munz et al. 2017), one pupils as gatekeepers (n = 237) (Klingman and Hochdorf 1993), the remaining four addressed a general population of secondary school pupils (n = 1.212) (Byrum 2019, Baetens, Decruy et al. 2020, Shabbir, Kapoor et al. 2021). All programs but one targeted general population students from schools, mostly from public schools, except for the Indian study which included equal numbers of students from public and private schools (Shabbir, Kapoor et al. 2021). In contrast to this, Muehlenkamp and colleagues used a selected sample with smaller class units of primarily students “at risk, with emotional/behavioural problems” in four schools and

health classes in one. How these adolescents were identified was not specified (Muehlenkamp, Walsh et al. 2010).

The mean **age** among adolescent participants ranged from 12 to 17 years, with a mean of 14.16 years. Of those, the three programs by Baetens et al., Muehlenkamp et al. and Byrum et al. state ages with an average of 13.77 years (SD 2.01) (Muehlenkamp, Walsh et al. 2010, Byrum 2019, Baetens, Decruy et al. 2020), whereas two authors outline mean age ranges of participants from 12.5 to 13.5 years (Klingman and Hochdorf 1993, Byrum 2019), or 16 to 17 years (Shabbir, Kapoor et al. 2021). Among the two studies addressing school staff, the mean age was 42.5 years (Robinson, Gook et al. 2008), or else not specified (Groschwitz, Munz et al. 2017). For standard deviations in age, see table six.

The **gender relation** revealed a slightly stronger mean ratio of female participants (57.28%, SD ±20.83). Four of the seven studies list reasonably balanced numbers of the sexes (Klingman and Hochdorf 1993, Muehlenkamp, Walsh et al. 2010, Byrum 2019, Baetens, Decruy et al. 2020). Two studies showed major differences in the gender distribution with female participation outweighing male by 85.9% (Robinson, Gook et al. 2008) and 82.1% (Groschwitz, Munz et al. 2017). The Indian study in contrast reported a female participation of 24.3%, which is attributable to the low female representation in the schools in India (Shabbir, Kapoor et al. 2021).

Program length and content

Two interventions were in-classroom psychoeducational programmes, named “HappylesPLUS” (Baetens, Decruy et al. 2020) and “SOSI” (Muehlenkamp, Walsh et al. 2010). The **Belgian** program included a “Happyles” control group (n = 311), which followed the regular program consisting of two in-classroom prevention lessons with classroom discussions and interactive assignments and two guided e-health lessons, all of which lasted about 50 min. The “HappylesPLUS” intervention group (n = 340) by contrast received the Happyles program, complemented with a psychoeducation module on NSSI which conveyed basic knowledge on NSSI prevalence, functions, and

risk factors, the role of social media, (de-)stigmatization of NSSI and help-seeking for NSSI in a one-hour module (Baetens, Decruy et al. 2020).

The **American** study provided participating students with scripts about the content, followed by a collection of pre-surveys about (1) knowledge of NSSI, (2) engagement in actual NSSI behavior, and (3) attitudes towards peers who self-injure and help seeking. The SOSI programme was then implemented according to the original manual (Jacobs, Walsh et al. 2009) during one school class period of 50 minutes. This involved video components, self-assessment forms to complete along with index cards it in order to allow statements about the personal needs of help-seeking among the pupils (Muehlenkamp, Walsh et al. 2010).

The **German** intervention comprised 16 voluntary and free of charge two-day workshops with on average 17 participants each in different towns over a period of one and a half years. They comprised presentations about the epidemiology, aetiology, and risk factors of NSSI with video examples of affected patients and video feedback assisted role-plays on how to react to NSSI and motivate students to seek professional help. Authors emphasize having clearly separated NSSI and suicidality, focussing on each topic for one of the two days. The concept was scheduled within the framework of a “Strong Schools against Suicidality and Self-Injury” programme in order to educate school staff, parents, and students on NSSI, also providing help hotlines and online material for school welfare staff free of charge (Groschwitz, Munz et al. 2017).

The **Australian** study with school welfare staff was delivered over two days with voluntary attendance of either one or two days. Each workshop day consisted of seven hours with five sessions. Day one started with a provision of information on NSSI, its relation to suicide and evidence regarding school-based interventions. This was followed by case vignettes in small groups, assessments of personal risk, and management of NSSI via role-plays and group discussions. Day two built upon the programme of the previous day and complemented it with techniques shown to be useful when working with people who engage in NSSI, also giving examples of good practice (Robinson, Gook et al. 2008).

The **Israeli** authors approached the training during twelve weekly sessions of 50 minutes each with on average 18 participants at a time and implemented three phases

(educational-conceptual, exercise-training and implementation-application) of the training in order to transfer therapeutic CBT techniques into prevention approaches of NSSI. The first phase consisted of theoretical knowledge, pertaining to adolescence and distress, learned helplessness and self-destructive behaviours, help-seeking, and the purpose of prevention. The second phase was designed to provide instrumental coping skills by employing case-vignettes, biblioguidance, newspaper clips and handouts. The third phase focused on the modification of irrational thinking and automatic thoughts via homework and in-class discussions in order to rehearse and strengthen acquired skills (Klingman and Hochdorf 1993).

Shabbir and colleagues designed a study of two phases. The first phase was designed to assess the prevalence, social determinants, and risk of NSSI among adolescent school children in New-Delhi and the association to sociodemographic variables and psychological factors. Subsequently, a health education intervention on the knowledge of prevention was implemented via an information booklet on self-injuring behaviour in order to advance primary prevention. It remains an open question in the short description of the intervention how exactly this was conceptualised (Shabbir, Kapoor et al. 2021). No further information could be obtained even by contacting the authors.

Byrum developed a program for three sixth grade classes over three days, implementing practices of CBT and DBT within sessions of 90 minutes. The course started with an icebreaker activity and was followed by sessions with focus on an understanding of physical manifestations of stress and coping techniques, in order to acquire ways to offer positive support to peers. It also included active listening and exercises demonstrating automatic thinking and mindfulness. Finally, the intervention was rounded off with a relaxation exercise (Byrum 2019).

Follow-up

Follow-up measures were performed for most of the studies. The minimum time frame used for follow-ups were two weeks (Klingman and Hochdorf 1993) or four to six weeks after the intervention (Muehlenkamp, Walsh et al. 2010, Baetens, Decruy et al. 2020). The two trainings delivered to school staff included a 6-month follow-up (Robinson,

Gook et al. 2008, Groschwitz, Munz et al. 2017). The Mexican study re-evaluated participants after 12 months (Byrum 2019). One study however did not design separate follow up points and performed post-assessments directly after the intervention (Shabbir, Kapoor et al. 2021)

Drop-out rates

Drop-outs resulted in an exclusion from analysis in all cases. Rates of drop-outs were relatively low in most studies, ranging from 2.8% (Muehlenkamp, Walsh et al. 2010) to 11.6% (Groschwitz, Munz et al. 2017), 13.3% (Baetens, Decruy et al. 2020) and 20.7% (Robinson, Gook et al. 2008). The US American authors declared to have dropped 3% (n = 8) of the participants from analyses due to incomplete protocols (Muehlenkamp, Walsh et al. 2010). Baetens stated either illness, conflicts in schedules, parental concerns, or too high intellectual demand of the content as reasons (Baetens, Decruy et al. 2020). Groschwitz justified the high drop-out rates with the voluntary principle of the study which may have effected rather motivated employees to complete pre–post assessments more dutifully (Groschwitz, Munz et al. 2017). Robinson did not mention any reasons for lacking returns of the two expected questionnaires post intervention (Robinson, Gook et al. 2008). Two studies did not provide data on drop-out rates and no further information on this could be gathered by contacting the authors (Klingman and Hochdorf 1993, Shabbir, Kapoor et al. 2021). In Byrum's master thesis, there was a drop-out rate of 35.5% of the initial 97 students. However, the participant group was extended by a comparison group of 25 students after one year for the follow-up survey, who were then also included in the final analysis (Byrum 2019).

Outcome measures

The process of data collection and outcome measures did barely overlap in the studies included. Two research groups measured the incidence of NSSI behaviours specifically (Muehlenkamp, Walsh et al. 2010, Baetens, Decruy et al. 2020). For this purpose, different tools were applied: Muehlenkamp et al. measured NSSI with the Self-injurious Thoughts and Behaviors Interview (SITBI), which has been demonstrated to be reliable

and valid for the measure of NSSI thoughts and behaviours in adolescents (Nock, Holmberg et al. 2007). However, they chose to administer the NSSI items in an adapted form as a self-report questionnaire instead of using the original interview format (Muehlenkamp, Walsh et al. 2010).

Baetens in contrast worked with the Brief Non-Suicidal Self-Injury Assessment Tool (NSSI-AT), which was shown to be evidentially highly valid, reliable and the first tool to assess NSSI independent of potential suicidality (Whitlock and Purington 2011). The questionnaire was translated into a Dutch version (BNNSI-AT-NL) by the authors in order to prevent cultural barriers and obstacles in the assessment on NSSI. It thereby assessed primary outcome measures of NSSI (e.g., delay in NSSI onset and decrease in NSSI frequency, urges, probability of future engagement), as well as secondary outcomes (e.g., psychological distress, emotion regulation, help-seeking, and stigma) using a mixed-method design (Baetens, Decruy et al. 2020).

Concerning the remaining studies, one scale was applied twice: the Knowledge of Deliberate Self-harm Questionnaire (KDS). It was originally developed in 2003 without having been evaluated in terms of its validity and reliability (Crawford, Geraghty et al. 2003). The KDS was used in two programmes for the training of staff to measure knowledge, attitudes, and training needs for NSSI in adolescents (Robinson, Gook et al. 2008, Groschwitz, Munz et al. 2017).

Shabbir and colleagues designed a self-structured questionnaire based on the demonstrably validated and reliable Non-Suicidal Self-Injury–Assessment Tool (NSSI-AT) (Whitlock, Exner-Cortens et al. 2014), applying a self-structured rating scale for both evaluation of NSSI risk factors and pre-post test knowledge about NSSI and its prevention (Shabbir, Kapoor et al. 2021).

Klingman applied several rating scales, however none of them specifically measured NSSI behaviour or knowledge (Klingman and Hochdorf 1993).

Byrum operated with the validated Spanish version of the Stress in Children scale (Caqueo-Urízar, Urzúa et al. 2014) in her thesis, yet without clarifying how the NSSI component “negative stress behavior outcome (…) cutting” was specifically evaluated (Byrum 2019).

Programs were delivered by members of the research group. Facilitators were either qualified, trained psychiatrists and psychologists (Robinson, Gook et al. 2008, Groschwitz, Munz et al. 2017, Baetens, Decruy et al. 2020), or research personnel working at mental health services (Byrum 2019, Shabbir, Kapoor et al. 2021), or else were school counsellors or psychologists trained to convey the programmes. Klingman et al. did so by holding a three-hour workshop and handing out a curriculum guide (Klingman and Hochdorf 1993), Muehlenkamp et al. authorized school staff as study contact facilitators and obtained their data via phone interviews (Muehlenkamp, Walsh et al. 2010).

Main findings

Regarding the main results, six of the seven studies found their interventions to show positive effects on their participants without any signs of iatrogenic effects.

To start with, the **HAPPYLES**(PLUS) program set onset, frequency, urges and likelihood of future engagement in NSSI as primary outcomes. Secondary outcomes included psychological distress, emotion regulation strategies, help seeking, and de-stigmatization. Findings revealed participants to benefit from the study in terms of increased knowledge and enhanced help-seeking attitudes, as well as lower probability of future engagement in NSSI acts. However, incidence rates and the number of occurrences and the level of desire of self-injury among participants with history of NSSI did not differ between the two groups (Baetens, Decruy et al. 2020).

The "**SOSI**" programme evaluated NSSI-related primary outcomes regarding thoughts and knowledge about it, concrete NSSI acts including their frequency, intensity, and concomitant discomfort, as well as the desire for help. Findings showed that the frequency and intensity of self-reported NSSI acts or thoughts in the month before and after the programme implementation showed no significant increase refuting iatrogenic effects, yet only a slight decreasing trend (Muehlenkamp, Walsh et al. 2010).

The remaining studies measured knowledge, awareness, and attitudes of NSSI among students (Shabbir, Kapoor et al. 2021) or school staff (Robinson, Gook et al. 2008, Groschwitz, Munz et al. 2017): **Groschwitz** and his team measured knowledge and

attitudes about NSSI, the confidence in and performance level of own skills in dealing with it and satisfaction with the programme. They revealed high effect sizes for both an improved confidence and knowledge about NSSI among the school staff. Interestingly, there were differences in the perception between the different professions with teachers showing the highest increase of knowledge, confidence, and satisfaction with the workshop, followed by social workers and finally school psychologists. Changes of NSSI behaviour among the pupils was not measured (Groschwitz, Munz et al. 2017).

Robinson et al. explored the confidence, skills, knowledge, and attitude towards NSSI and stated an increased knowledge on NSSI due to the training course. Still, this finding relates particularly to the small number of participants with low knowledge about NSSI at baseline (1.4%), while the majority of participants demonstrated moderate or high levels of confidence and no significant change of it over the study course (Robinson, Gook et al. 2008).

The gatekeeper training for pupils by **Klingman** et al. surveyed level of distress, self-reported emotional states, the awareness of distress-coping skills, and change in peer behaviour. The program yielded positive effects on attitudes, emotions, knowledge, and awareness of distress coping skills. It received a high satisfaction rating in terms of the tools it provided to help friends in distress. Yet, concrete behavioural changes in self-injuring peers were not examined (Klingman and Hochdorf 1993).

Shabbir et al. measured variables associated with NSSI and the effectiveness of health education regarding an increase in knowledge. They found factors such as impulsive personalities, academic issues, inter-personal relationships, peer influence, abuse and influence of media or fantasy to be associated with a higher risk of NSSI, and found their health education to be effective for both cohorts (Shabbir, Kapoor et al. 2021).

Finally, as indicated above, **Byrum** assessed negative stress relieving activities in the form of “cutting”, alcohol, and drug use, as well as participants’ confidence level to help themselves. The thesis represents the one study which reported iatrogenic effects in terms of an increased (doubled) number of "cutters", even if the level of perceived stress was reported to be lower than in the comparison group (Byrum 2019).

Table 6: *Characteristics of the seven universal prevention programs included*

Publication	Country	Target group	Study design	N	Mean age (SD), sex	Intervention	Duration of intervention	Main Findings on NSSI
Baetens et al., 2020	Belgium	Secondary school pupils	Randomized pre-post	651	M = 12.85 (±.769), 49.8% female	In-classroom module: Happyles (in-classroom educational program focusing on general mental well-being & social connectedness) vs. HappylesPLUS module (with an additional one-hour psychoeducation on NSSI)	Two class periods of each 50 minutes	Pre-survey: 14.9% with a lifetime history of NSSI (girls>boys); mean onset of NSSI at 11.34 years (SD 2.14); cutting as most common NSSI method (44.1%). Post-intervention: No iatrogenic effects; no significant group difference regarding NSSI; incidence rate of 6%; among students with history of NSSI less perceived probability of future engagement in NSSI acts in both groups
Byrum, 2019 (master thesis)	Mexico (presented in NC, USA)	Secondary school pupils	Pilot study, baseline + 12 months follow-up	79	M = 12.40 (±0.56), 54.4% female	Combination of preventive CBT and DBT techniques to reduce self-injuring behaviours, e.g. cutting	Three sessions over three days of 90 minutes each	Questionable iatrogenic effects: majority (18.99%) of the final sample indicated they had cut themselves to relieve stress; number of "self-cutting" adolescents doubled for the intervention group. Lacking information on how DSH was assessed.
Groschwitz et. al., 2017	Germany	Gatekeepers: School staff of secondary schools	Pre-post, 6 months follow-up	267	Not specified, 82.1% female	Workshop for school staff (teachers, social workers, and psychologists) to increase knowledge on NSSI and suicidality	Two-day workshop of 7 hours each	Post-intervention: Large effect sizes for improvement in confidence and perceived knowledge (highest increase among teachers); significant decrease of negative attitudes towards NSSI; high satisfaction with the program (highest among teachers); differences between professions; largest difference in knowledge about the place where to seek help for adolescents with NSSI
Klingman & Hochdorf, 1993	Israel	gatekeeper: selected pupils	Pre-post	237	12.5 to 13.5 years	Gatekeeper training based on CBT to enhance knowledge on DSH	12 weekly 1-hour sessions	Positive effect on attitudes, emotions, knowledge and awareness of distress coping skills

Publication	Country	Target group	Study design	N	Mean age (SD), sex	Intervention	Duration of intervention	Main Findings on NSSI
Muehlenkamp et al., 2010	USA	Secondary school pupils	Pre-post	282	M = 16.07 (±1.32), 48.5% female	In-classroom module: Psychoeducational "Signs of Self-Injury Program" (SOSI) to increase knowledge, improve help-seeking attitudes and behaviours, and decrease acts of NSSI	One class period of 50 minutes	Pre-survey: 25.9% with a lifetime history of NSSI; mean score for frequency 3.21 (SD = 1.89); over 10% had engaged in at >1 act of NSSI in the month prior to the survey (range = 2.4–20.0%); 70.0% indicated someone knew about the self-injury, most often a friend (35.9%); 46.24% had >1 friend who engages in NSSI. Post-intervention: No iatrogenic effect; increased accurate knowledge + improved help-seeking attitudes and intentions among students; no specific effects on NSSI acts measured
Robinson et al., 2008	Australia	School welfare staff	Pre-post, 6 months follow-up	213	42.5 (±10.6), 85.9% female	Information on the epidemiology of DSH, the relationship to suicide and interventions. Inclusion of case vignettes	1- or 2-day workshop of each 7 hours	Post-intervention: Significant positive effect on both perceived confidence, attitudes and skill when dealing with NSSI; increase of knowledge especially for participants with low knowledge in the beginning
Shabbir, Kapoor & Biswas, 2021	India	Secondary school pupils	Pre-post	200	16-17 (±2), 24.5% female	Information booklet on knowledge of strategies to prevent DSH and suicidality	One-time	Pre-intervention: marginally higher prevalence of reported incidents of NSSI in government schools, risk of self-harm significantly higher in private schools, impulsiveness only significant risk factor; no correlation between NSSI and demographic and socio-economic characteristics. Post-intervention: Increase of knowledge on DSH; assessment of associated risk factors; higher level of knowledge on NSSI and its prevention, higher level among private school compared to government school pupils

Study Quality

The assessment of respective study qualities via the EPHPP quality assessment tool described above (see 3.5.) (Evans, Lasen et al. 2015) showed an overall weak study quality for all seven studies with distinct deficiencies in ratings of study design, confounders, and blinding. Considering that all studies used a pre-post-design and already received a weak rating for this category, it needed only one further weak or moderate rating in the composition of the study to be rated as overall weak. Most of the studies were rated as weak for four components (Klingman and Hochdorf 1993, Robinson, Gook et al. 2008, Muehlenkamp, Walsh et al. 2010, Groschwitz, Munz et al. 2017), two studies in five domains (Byrum 2019, Shabbir, Kapoor et al. 2021); Baeten's pilot study was rated as strong in three and as weak in two categories (Baetens, Decruy et al. 2020). Regarding the cumulative evidence, there is a high risk of publication bias considering that uncontrolled studies are easy to conduct. Additionally, there may be selective reporting within studies as to whether samples from the same group were truly independent. Studies also possibly lacked reporting adherences to protocols and/or blinding of raters.

For individual study quality ratings according to the EPHPP, see Table 7.

Table 6: *Study quality ratings according to the EPHPP*

Authors	Selection bias	Study design	Confounders	Blinding	Data methods	Withdrawals/dropout	Total
Baetens et al., 2020	Strong	Weak	Weak	Moderate	Strong	Strong	**Weak**
Muehlenkamp et al., 2010	Moderate	Weak	Weak	Weak	Strong	Strong	**Weak**
Groschwitz et. al., 2017	Moderate	Weak	Weak	Weak	Moderate	Strong	**Weak**
Klingman & Hochdorf, 1993	Moderate	Weak	Strong	Moderate	Weak	Weak	**Weak**
Robinson et al., 2008	Moderate	Weak	Weak	Weak	Moderate	Moderate	**Weak**
Shabbir, Kapoor & Biswas, 2021	Moderate	Weak	Weak	Moderate	Weak	Weak	**Weak**
Byrum, 2019	Moderate	Weak	Weak	Weak	Weak	Moderate	**Weak**

5. Discussion

This qualitative review examined the empirical evidence of universal prevention programs of NSSI among children and adolescents globally. Despite the broad search string set and the many articles gained, the small number of seven studies met the criteria for inclusion. Of these, all studies followed a pre-post design and found support for the necessity and effectiveness of prevention programs targeting NSSI among youth. They mostly demonstrated beneficial effects, particularly on awareness, knowledge or coping skills in terms of NSSI - either to participants themselves, or to gatekeepers in interactions with pupils. However, all studies missed significant effects, making all findings and the conclusions drawn to be questioned. Also, the pool of studies included comprised mostly pilot studies without evident replication studies, which further reduced their statistical significance (Muehlenkamp, Walsh et al. 2010, Byrum 2019, Baetens, Decruy et al. 2020).

The basis of studies was insufficient for the conduction of a **meta-analysis** due to (a) a wide range of outcome measures regarding NSSI and a pronounced inhomogeneity of assessment methods, (b) uncontrolled conditions, (c) lacking sample size estimates, and (d) weak quality ratings according to the EPHPP criteria. Consequently, the analysis of the studies remained purely qualitative.

The hypothesis of a weak study situation regarding NSSI prevention was resumed and further substantiated when applying the **EPHPP quality assessment tool** explained above (see 3.5.) on the existent studies (Evans, Lasen et al. 2015). The tool was proven fair as to the inter-rater reliability for individual domains and excellent for the final grade assigned when compared to another established Risk of Bias Tool (Armijo-Olivo, Stiles et al. 2012). Ratings on six categories revealed an overall weak study quality for all seven studies with distinct deficiencies as to study design, confounders, and blinding. This reaffirms the gap of high-quality studies regarding universal studies of NSSI and strongly points to the hypothesis of an alarming scarcity of high-quality preventive approaches specifically targeting NSSI.

Altogether, the seven studies found support for the necessity and efficacy of prevention programs targeting NSSI among youth but entail several limitations.

The two in-classroom **psychoeducational programmes** "HappylesPLUS" (Baetens, Decruy et al. 2020) and "SOSI" (Muehlenkamp, Walsh et al. 2010) focused on psychoeducational elements in order to reduce the incidence of NSSI. They were well received by participants and showed promising findings as to no iatrogenic effects and an increased knowledge of help-seeking. However, findings remained without significant effects. The authors note several methodological limitations: Muehlenkamp et al. included a rather small study sample, no control group, no evaluation of school staff and showed no observable behavioural outcomes of NSSI, possibly due to lacking track of students by the staff (Muehlenkamp, Walsh et al. 2010). Baetens et al. referred to have noted a significant diversity of school climates and cultural differences within the participating schools without taking those factors into account for their analysis. The study also lacks long-term follow-up data and sufficient blinding of conditions (Baetens, Decruy et al. 2020). Meta-analyses on universal prevention in anxiety, depression, or eating disorders showed that methods from cognitive behavioural therapy, skill training or cognitive dissonance seem to be more effective in reducing symptoms. By contrast, psychoeducational methods have even produced iatrogenic effects (Stice, Shaw et al. 2007, Werner-Seidler, Perry et al. 2017). Ultimately, a promising future avenue might be to strengthen protective factors in order to improve adolescents' management of their everyday lives. It might be worthwhile to focus on improving emotion regulation as a generalizing factor rather than merely mitigating possible risk factors.

The remaining five studies reviewed addressed NSSI without any sufficient measures of it during and post-intervention, hindering definitive conclusions regarding changes in actual NSSI behavior. This is surprising, as the primary goal of universal prevention is to reduce the incidence of mental disorders or high-risk behaviors and a reduction of NSSI incidences. Following further crucial observations on the respective studies were made: Two programs were designed as **gatekeeper trainings** in a time interval of 24 years and included similar sample sizes and program durations, just differed regarding the country and target group (school welfare staff vs. secondary school pupils). The German workshop worked primarily with informative videos and feedback-assisted role-plays, while the Israelian authors approached the training by conveying therapeutic CBT

techniques regarding stress levels and coping skills (Klingman and Hochdorf 1993). Both programmes found positive effects on attitudes, emotions, knowledge, and awareness of distress coping skills after the intervention, as well as a high satisfaction of the program among the participants. Klingman et al. state a lack of extensive and thorough assessments covering pre-tests and effects of skills improvement as limitations and justify these with limited resources, little available time at school and concerns about iatrogenic effects (Klingman and Hochdorf 1993). Groschwitz acknowledges a small number of participating schools and lack of evaluation in the school setting (e.g. regarding inquiries on student's perspective), which could have enhanced the validity of the study. Another downside of the study represents the voluntary principle of the gatekeeper workshop, which may have convinced rather motivated school staff with interest in the topic to participate and thereby have caused a self-selection bias of participants (Groschwitz, Munz et al. 2017). In general, the approach to perform prevention via gatekeeper trainings can be countered with the critique that they entail iatrogenic effects and the risk of maintaining and reinforcing NSSI by making health issues a subject of discussion. Particularly with regard to NSSI, the risk of causing a "free-rider phenomenon" or "epidemic" in school settings in order to gain more attention is frequently stated (Plener, Kaess et al. 2011). Authors thus advise against universal school interventions for all pupils and recommend identifying affected adolescents and work with them specifically (Lieberman, Toste et al. 2008). Concerning the two studies presented above, it constitutes a major shortcoming that measures of concrete changes in NSSI incidences among youth were not conducted. It is highly problematic that this is accepted as a study limitation and raises the question whether the measures were neglected due to concern about low benefits of the intervention. According to a successor of the study group, the decision not to include pupils into the analysis was attributed to the fact that this was for one thing not approved by the ethics committee and then again due to the fact that financial and personnel capacity was too short to include pupils in such a way that possible iatrogenic effects of the study could be counteracted.

The remaining three studies set the primary focus on the transfer of **knowledge about NSSI** prevention, conveying it in different ways. They developed either informational booklets on NSSI prevention (Shabbir, Kapoor et al. 2021), established multi-step trainings for school staff including case vignettes (Robinson, Gook et al. 2008), or combined CBT with DBT techniques in order to "reduce stress and behaviors such as cutting" (Byrum 2019). However, all three studies entailed several limitations important to address: Due to the absence of other research on the effectiveness of information booklets on NSSI prevention, Shabbir's study stands alone and cannot be compared in its effects (Shabbir, Kapoor et al. 2021). Robinson et al. speak of statistically non-significant results regarding changed pre and post course attitudes of NSSI and did not measure any changes in rates of NSSI practices or help-seeking, which would have enhanced the study's information value. Further study sample deficiencies in regard to a lacking random collection of the non-compulsory study sample are stated, causing a self-selection bias of participants and less representative or transferable findings. Besides, the consent rate for postal questionnaires of merely 39% was low and the short time period of two days casts doubts on whether findings can be interpreted as the result of the training, or perhaps effect of repeated testing (Robinson, Gook et al. 2008). Finally, the Mexican study by Byrum lacks statistically significant results and showed questionable iatrogenic effects. The finding of an increase of the level of perceived stress and doubling of self-cutting from pre-survey to follow-up is concerning and opposes the primary goal of prevention. More than that, it is not described clearly how numbers of "cutters" were assessed in the first place. The study misses a thorough background research, planning process, comparison group from baseline and evaluation of the appropriateness of the school chosen. The potential influence, which the participants' change from primary to middle school during the study period might have had on their stress level, remains unexplored (Byrum 2019).

When closely reviewing the individual studies precisely, further aspects add up to the hypothesis of deficient preventive approaches regarding NSSI: Overall, the majority of studies did not include **control groups** at all (Robinson, Gook et al. 2008, Muehlenkamp, Walsh et al. 2010, Groschwitz, Munz et al. 2017, Shabbir, Kapoor et al. 2021), or did so

with a restricted balance of baseline characteristics (Klingman and Hochdorf 1993) or insufficient blinding of conditions (Baetens, Decruy et al. 2020).

Sample sizes were relatively small in most of the studies, consisting of a minimum of 79 (Byrum 2019), average of 200 to 300 (Klingman and Hochdorf 1993, Robinson, Gook et al. 2008, Muehlenkamp, Walsh et al. 2010, Groschwitz, Munz et al. 2017, Shabbir, Kapoor et al. 2021) and maximum of 651 participants (Baetens, Decruy et al. 2020). Case number calculations were not performed in any of the studies. It remains to hope for future studies involving these in the study planning and carrying out further studies on a larger scale in order to draw better conclusions on a general population.

Adding to that, the studies reflect a wide range of approaches to the study planning regarding blinding conditions, data collection, and follow-up dimensions. Most studies (70%) entirely miss **blinding** conditions (Robinson, Gook et al. 2008, Muehlenkamp, Walsh et al. 2010, Groschwitz, Munz et al. 2017, Byrum 2019, Shabbir, Kapoor et al. 2021) or involve blinding only for participants (Klingman and Hochdorf 1993, Baetens, Claes et al. 2011).

In terms of **data collection**, the wide range of survey strategies illustrates the lack of standardized data collection methods to assess NSSI. Outcome measures applied remain to be questioned within all studies, as all authors chose different surveys and referred to specifically designed (self-report) questionnaires. Even if these based on existing questionnaires, a re-test reliability or validity of the modified versions was not thoroughly reported in any of the studies. The fact that NSSI outcomes were defined independently by each study brings with it the particular difficulty to create a foundation for the possibility of calculations and comparability with other studies' effects. For future research, it is essential to address this issue, in order to allow more diagnostic objectivity and comparability. It needs more uniform standardized questionnaires and assessments which measure NSSI occurrence, frequency, and method metrically to allow distinctions of estimates of the severity.

Regarding **follow-ups**, the fact that only one study followed up participants after 12 months and others were usually conducted after a shorter time period of six months at most, underlines an urge for future studies with larger follow-up dimensions.

Drop-out rates need to be stated as a further substantial limitation of several studies: Byrum registers a relatively high (35.5%) rate of dropout (Byrum 2019), two other authors leave drop-out rates fully unmentioned (Klingman and Hochdorf 1993, Shabbir, Kapoor et al. 2021). Groschwitz et al. emphasise a possible bias towards participants with high satisfaction of the workshop, who might have been more committed to complete follow-up assessments (Groschwitz, Munz et al. 2017). Baetens regrets a dropout from post to follow-up (21%), and a lack of long-term follow-up data beyond the six months (Baetens, Decruy et al. 2020). Other authors agree on a shortcoming of long-time observations of their programmes, underlining a necessity of further study implementations with an extended and broad longitudinal follow-up (Klingman and Hochdorf 1993, Muehlenkamp, Walsh et al. 2010). For future research, there is an urge for more regular and long-time follow-ups in order to ensure study validity and increase the significance of the research effort.

The **aim for future research** should be to establish more studies (a) defining precise outcomes and choosing strong reliable, valid, and established data collection methods for a study in (b) a randomized controlled design with (c) control and balance of confounders, (d) double blinded conditions, at best with (d) large sample sizes of a representative population. Researchers are called up to build upon existent programmes and further develop them with the aim to ameliorate them on a large scale through a thorough study planning. For an optimal study design, this could involve planning a randomised controlled study with double blinded participants and study investigators. The size of the study sample could be calculated using G* Power (Bartlett 2019) in order to draw statistically valid conclusions about the intervention effects and allow classifications of these as mild, moderate or strong. An ideal program would include both participants of an intervention group as subjects of the intervention, and a control group receiving a divergent programme as a comparison group. Outcome measures would be determined precisely in advance and measured by valid and reliable assessment methods by the use of firmly established and standardized questionnaires. Follow-up should at best be performed within later school years but still within adolescence, e.g. after 6 or 12 months, however without choosing a long period which

might entail higher rates of drop-out. In addition, it is essential to establish standards for prevention research, equivalent to Good Clinical Practice (GCP) in clinical trials in order to obtain binding guidelines for future study planning (Gottfredson, Cook et al. 2015).

It should also be kept in mind that currently, major differences regarding the **gender distribution** persist within many study samples. The fact that most studies include more female than male participants into analysis constitutes an apparent risk of bias and limits findings regarding their transferability to participants of a differing sex. Current research increasingly criticises the so-called "gender blindness" in sampling, resulting in a missing consideration of sex differences in study planning and analyses, as gender-specific factors are left out of the equation (Holdcroft 2007, Hamberg 2008). Future studies should aim to intensify considerations of the relevance of sex and gender, in order to establish implications for both male and female adolescents. To complement this, more data in terms of gender identities in the summary of participant characteristics is crucial, as elevated rates of NSSI among transgender or gender non-conforming youth are frequently stated (Hasking, Whitlock et al. 2017, Duffy, Henkel et al. 2019, Rimes, Goodship et al. 2019, Taliaferro, McMorris et al. 2019, Wang, Kou et al. 2019). It is crucial to report on adolescents who identify as lesbian, gay, bisexual, transgender, queer, intersex, asexual, and/or gender diverse (LGBTQIA+) in study analyses separately, as they still frequently confront discrimination and psychological distress due to their gender identity and show higher risk of NSSI when compared to binary gender conforming peers (McCartney 2016, Watson and Tatnell 2019).

Furthermore, separate evaluations for each sex should be incorporated into future study analyses in order to gain significant effects also for individual populations, as – at least for German-speaking regions – impacts of the biological sex and gender identity are currently still subject of debate.

In addition, it is interesting to note that there are so few broadly established **school-based prevention** programs of NSSI. This raises the question, which institutional barriers bar the way to progress in this field. Authors point to the key element of costs after experiencing confrontations with school authorities who were repeatedly reluctant to

permit studies on NSSI at their schools due to concomitant expenditures (Gould, Marrocco et al. 2005, Lloyd-Richardson, Perrine et al. 2007). It thus appears essential to promote low-threshold and cost-effective programs regarding NSSI prevention among school staff and provide them free of cost for schools, in order to reinforce the willingness to open up to new programs. Another barrier in the way of broad universal prevention of NSSI in schools might be owed to a neglect of considerations of prevention as important. The low level of knowledge and recognition of NSSI issues, as well as usual adherence to classical school curriculums may lead to a limited willingness to make room for new, not purely academic school content. In relation to this, it is vital to conduct extensive education about NSSI in order to receive recognition of programs and governmental fundings for their implementation. It may also be of interest to expand universal prevention work to settings beyond the classroom, such as sport and leisure groups.

Overall, given the high prevalence of NSSI among children and adolescents, the key developmental period that adolescence represents (Kothgassner, Goreis et al. 2021) and the remarkable benefits that broad primary prevention poses for health issues (Doll, Haas et al. 2007), universal prevention of NSSI appears essential. All the more it is alarming, that the findings of this review strongly illustrate that there is not one universally valid path to effective prevention of NSSI. This raises the question as to why there are so few preventive programmes setting a focus explicitly on NSSI behaviour and including measurements of it at baseline and post intervention.

In attempt to draw generalizations from the findings, complexity arises not only from the small number of eligible studies, but also from the blatant variety of outcome measures and assessments. On the whole, it remains to conclude that even though there is a fertile base for future research on NSSI prevention, current studies on universal prevention of NSSI remain fragmentary. There is an urge for larger scale studies that enable a better analysis of possible confounders, imply a more extensive longitudinal follow-up, and provide a transnational transferability. However, as long as research on universal prevention of NSSI is as scarce, it remains to rely on selective

prevention programmes regarding NSSI which currently provide a much more profound data base.

6. Limitations

The review may be countered with the critique that only two online databases (PubMed and Google Scholar) were searched for articles and that this could possibly have restricted the pool of references found. It may have been beneficial to search further databases, such as Psychinfo, Embase, scopus or clinicalgov.it. However, this decision was based on the grounds that even within two databases, 11.368 articles were obtained. Cursory search entries of other data bases such as PsychInfo, Embase and the Cochrane Library databases revealed no additional studies of interest. Consistent with that, recent research demonstrated no major supplementary finding when searching comparable terms with only two databases (Pubmed and Google Scholar) (Kothgassner, Robinson et al. 2020) versus with three additional databases after one year (Kothgassner, Goreis et al. 2021).

Another limitation of this review is that is remained purely qualitative and that it was decided against conducting a meta-analysis on basis of the studies, which might have provided a higher generalizability of the results. However, standards of empirical evidence regarding a randomised program design providing calculability were fulfilled by just one study (Baetens, Decruy et al. 2020). The overall diversity of measures of NSSI, lack of sample size estimates, and weak study quality after application of the EPHPP criteria and preponderance of pilot studies raised fundamental doubts on the benefits of a meta-analysis on the present study base. Moreover, the programs which met the inclusion criteria showed a number of methodological limitations. Thus, it remains to highlight again that findings of this review should be interpreted with caution.

The onset of NSSI within a given timeframe for a prevention study (on average 6 months) is certainly quite rare, so it is not surprising that the effect sizes are low. In any case, the scope of the relevance of effect sizes remains subject of discussion: Recent research argues for instance, that “generic benchmarks for interpreting effect sizes (…) should be

abandoned, given that they are devoid of context and ignore important variation in effects across interventions and outcomes" (Tanner-Smith, Durlak et al. 2018).

Another limitation of this work concerns the eligibility criteria. Since from more than 11.000 studies identified, 93.84% were excluded after the revision, one could ask whether the inclusion criteria and research focus could have been too narrow. Relating thereto, the question is raised whether the review might have benefited from including a wider range of studies that represent the state of the art. A proposal for future trials might be to expand the study focus and also include studies (e.g. on socioemotional prevention) with potential effect on NSSI. Yet, to counter this argument, it cannot be assumed with certainty which correlations to NSSI exists. The decision to focus on NSSI prevention was deliberately reached due to the deficiency of literature on this subject. Finally, it might be argued that it seems odd to take DSM-5 criteria as golden standard for NSSI measurements, although a dichotomous question (presence/absence of NSSI) may be sufficient in this line of research, as we are looking at populations of adolescents who do not always fulfil criteria of a NSSI disorder according to DSM 5.

7. Conclusion and Outlook

In a synopsis of the current state of research regarding NSSI, there are two key findings of this thesis: Firstly, there is a severe scarcity of studies and currently no evidence base for effective universal prevention of NSSI in youth. Secondly, not only the number but also quality of those few studies found were considered too little reliable data to draw wide-ranging conclusions and insufficient for the conduction of a meta-analysis. This conclusion based – among other factors listed in chapter six – on the application of the EPHPP quality assessment tool (Evans, Lasen et al. 2015), which brought out distinct deficiencies and revealed a weak overall study quality for all seven studies.

Even if the high prevalence of NSSI among adolescents and importance of this field of research is increasingly emphasized in contemporary studies (Muehlenkamp, Walsh et al. 2010, Wasserman, Carli et al. 2010, Brunner, Kaess et al. 2014, Plener, Schumacher et al. 2015), the shortage of concrete programs addressing the issue appears manifest. The potential to tackle it via prevention is underlined in view of the facts that many

recent studies prove the effectiveness of community based primary prevention regarding mental health issues (Evans, Hawton et al. 2005, Fortune, Sinclair et al. 2008). Regarding the findings of the respective studies included for this review, it can be concluded that most interventions show positive effects in raising awareness, knowledge, an understanding of risk factors and help-seeking attitudes among school staff or students, particularly when starting with low knowledge at baseline (Robinson, Gook et al. 2008). Yet, most studies focus on training of gatekeepers and only two programmes addressed students directly and measured actual NSSI behaviour among them as primary outcome measure. This finding highlights the importance for more investigation into concrete NSSI measurement targeting mainly the group of youth.

Looking into the future, several considerations are substantial to advance universal approaches to NSSI: To start with, there is a severe lack of literature on *primary* prevention with suitable contexts and target groups, while reviews on secondary and targeted prevention deliver much more potential in the quantity of research (Kothgassner, Robinson et al. 2020, Kothgassner, Goreis et al. 2021): There is inspiring research about the inclusion of social media in the form of mobile phone apps or websites all with the intent to promote health prevention, create a virtual mental health screening and strengthen coping skills by obtaining low-threshold access to target populations without the expenditure that study settings entail {Stallard, 2016 #1199;Alternatives, USA #9;, Bristol #7;, Oxford #6;, Germany #10}. Nevertheless, it strikes the attention that most of them are aimed at the social environments of adolescents at risk of NSSI and not at affected persons directly.

Regarding the study planning, it is crucial for future research to pursue a thorough background research, examine the feasibility of interventions, and evaluate the appropriateness of study samples chosen. Moreover, research groups are expected to ensure a close observation of participants in cases of adverse events, in order to offer support, but also detect potential deficiencies in the study organisation.

Additionally – in accordance with other research in this field (Plener, Brunner et al. 2010) – findings of this review highlight the necessity to expand fundamental research on

functions of NSSI and its neurobiological mechanism of formation in order to enhance the knowledge of correlations and improve effective preventive approaches.

As to intervention costs, it appears indispensable to include more cost calculations in the study planning of future research. Cost-effectiveness analyses assess the eligibility of studies from an economic perspective. They are considered beneficial if benefits from the intervention outweigh invested costs. In contrast to therapeutic interventions of NSSI, which are usually conducted in an in-patient setting and entail high measurable expenses as compared to preventive interventions, preventive approaches may in case of success result in a reduction of clinical presentation (O'Connell, Boat et al. 2009).

A promising outlook is entailed by a skills-based universal prevention program of NSSI ("DUDE - Du und deine Emotionen/You and your emotions"), a cluster- randomized controlled trial scheduled for 16 German schools with a total of 3.200 adolescents (Buerger, Emser et al. 2022). The program is tailored to decrease the incidence of NSSI and avert potential and associated long-term consequences like suicidality among adolescents. It is aimed to provide easy access for adolescents due to its implementation during lesson time at school and is declared cost-effective. Furthermore, DUDE is a promising approach to effective NSSI prevention, as it is intended to improve mental health through the pathway of emotion regulation. It remains to await the implementation of the protocol, which is currently delayed due to the SARS-CoV-19 pandemic.

In sum, initial research is promising and suggests that the approach to tackle NSSI via prevention is meaningful. Yet, high-quality studies on the development and evaluation of universal NSSI prevention in adolescents are urgently needed.

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Appendix

Search string PubMed:

(("non-suicidal self-injury" [All Fields] OR "self-injury" [All Fields] OR "self-harm" [All Fields] OR NSSI [All Fields] OR ("suicide"[All Fields])) AND (prevent' [All Fields]) AND (adolescen* [All Fields] OR child* [All Fields] OR youth [All Fields]). AND ("2021/03/10"))

Indexing Google Scholar:

1. ("non-suicidal self-injury" OR "self-injury" OR "self-harm" OR NSSI OR suicide)
2. (prevent*)
3. (adolescen* OR child* OR youth)
4. ([Date - Publication]: "2021/03/10"[Date - Publication])

Conclusion in German language

Von den Ergebnissen des systematischen Reviews zu universeller Prävention nicht-suizidalen selbstverletzenden Verhaltens (NSSV) bei Kindern und Jugendlichen lassen sich zwei Hypothesen bestätigen. Wie bereits angenommen, zeigte sich zum einen durch die Literaturrecherche, dass es aktuell einen eklatanten Mangel an Studien und daraus folgend fehlende Evidenz für wirksame universelle Prävention von NSSV bei Kindern und Jugendlichen gibt. Zum anderen ergab eine Bewertung der in das Review eingeschlossenen Studien nach EPHPP Kriterien (Evans, Lasen et al. 2015) eine schwache Studienqualität für alle bestehenden sieben Studien. Auf Basis der unkontrollierten Studienbedingungen und großen Bandbreite primärer Endpunkte und Messungen von NSSI Parametern, konnte keine Meta-Analyse erfolgen und die Analyse der Studien erfolgte rein qualitativ. Diese ergab, dass die meisten präventiven Interventionen positive Auswirkungen auf die Sensibilisierung, das Wissen, das Verständnis von Risikofaktoren und die Einstellung zur Hilfesuche beim Schulpersonal oder bei den Schülern haben, insbesondere dann, wenn das Wissen zu Studienbeginn gering war, (Robinson, Gook et al. 2008). Die meisten Studien konzentrieren sich aktuell auf die Schulung von Gatekeepern, und nur zwei Programme adressierten Schülerinnen und Schüler direkt und maßen NSSV-Parameter (Prävalenz, Inzidenz und Frequenz) als primären Endpunkt. Dieses Ergebnis macht deutlich, wie groß der Mangel an Studien ist, die Jugendliche als Zielgruppe in den Fokus rücken.

Vor dem Hintergrund der hohen Prävalenz von NSSV bei Kindern und Jugendlichen (Brunner, Kaess et al. 2014, Plener, Schumacher et al. 2015) und dem Hochrisikomarker, den es für Folgeerkrankungen wie Suizidalität darstellt (Owens, Horrocks et al. 2002, Wasserman, Carli et al. 2010, Hawton, Saunders et al. 2012, Groschwitz, Plener et al. 2015, Gillies, Christou et al. 2018), ist die schmale Datenlage universeller Prävention eklatant. Die Tatsache, dass viele Studien das Potential und den Nutzen von Primärprävention von NSSV belegen, (Evans, Hawton et al. 2005, Fortune, Sinclair et al. 2008) unterstreicht den Bedarf zukünftiger hochqualitativer Forschung in dem Gebiet.

In Betrachtung aktueller Literatur zu dem Thema fällt auf, dass Übersichtsarbeiten zu selektiver und indizierter Sekundärprävention ein weitaus höheres Potenzial für

Studienprogramme liefern (Kothgassner, Robinson et al. 2020, Kothgassner, Goreis et al. 2021) – viele von ihnen auch unter Einbezug sozialer Medien, was durch die leichte niederschwellige und anonyme Umsetzbarkeit insbesondere in Zeiten der Pandemie spannende Ansätze liefern {Stallard, 2016 #1199;Alternatives, USA #9;, Bristol #7;, Oxford #6;, Germany #10}. Auch hier fällt allerdings auf, dass sich die meisten dieser Angebote an das soziale Umfeld von Jugendlichen mit NSSI-Risiko richten und nicht an die Betroffenen selbst.

Insgesamt lässt sich zusammenfassen, dass erste Studien darauf hindeuten, dass der Ansatz, NSSI durch Prävention zu vermindern, sinnvoll ist {Berger, 2017 #10065}. Dem gegenüber steht jedoch eine geringe Anzahl an Studien, die Präventionsprogramme etablieren oder anwenden. Für zukünftige Forschung sollte folglich der Anspruch bestehen, bestehende Programme dahingehend weiter zu entwickeln, dass sich die Inzidenzen von NSSI verringern. Optimalerweise würde eine solche Studie mit universellem Ansatz in doppelblindem randomisiert kontrolliertem Studiendesign konzipiert und nach Fallzahlschätzungen in einer möglichst repräsentativen und großen Stichgruppe durchgeführt werden. Darüber hinaus wären im besten Fall präzise Endpunkte definiert und zuverlässige, gültige und für die Erhebung bewährte Datenerhebungsmethoden herangezogen, sowie ein Langzeit Follow-Up inbegriffen, das bestenfalls in späteren Schuljahren, aber noch im Jugendalter erfolgt. Es wäre wünschenswert, dass die Studienplanung dahingehend erfolgt, dass Kapazitäten bestehen, Teilnehmerinnen und Teilnehmer bei unerwünschten Ereignissen infolge der Studie abzufangen und ihnen Unterstützung anzubieten. Es ist essentiell, klare Standards für Präventionsforschung zu etablieren, die der Guten Klinischen Praxis (GCP) bei klinischen Studien entsprechen, um verbindliche Richtlinien für die zukünftige Studienplanung zu erhalten {Gottfredson, 2015 #10064}. Es gibt sogar den Vorschlag, unabhängige Institutionen zu etablieren, die sich spezifisch auf Prävention psychischer Erkrankungen konzentrieren (Israel, Parker et al. 2005). Darüber hinaus könnte es wichtige Erkenntnisse liefern, Grundlagenforschung zu NSSV in seinen Funktionen und (neurobiologischen) Entstehungsmechanismen zu vertiefen, um zukünftige Präventionsprogramme gezielter zu planen. Eine Motivation hierfür könnte aus

wirtschaftlicher Perspektive darstellen, dass Kosten präventiver Interventionen geringer zu denen erscheinen, die durch die Folgekosten einer Erkrankung und ggf. Hospitalisierung entstehen (O'Connell, Boat et al. 2009).

Einen vielversprechenden Ausblick bietet ein kompetenzbasiertes universelles Präventionsprogramm für NSSI ("DUDE - Du und deine Emotionen/You and your emotions"), eine cluster-randomisierte kontrollierte Studie an 16 deutschen Schulen mit insgesamt 3.200 Jugendlichen {Buerger, 2022 #10079}. Das Programm ist darauf zugeschnitten, die Häufigkeit von NSSI zu verringern und potenzielle Langzeitfolgen wie Suizidalität unter Jugendlichen zu verhindern. Es ist für Jugendliche leicht zugänglich, da es während der Unterrichtszeit in der Schule durchgeführt wird, und wird als kostenwirksam eingestuft. Außerdem ist das Programm ein vielversprechender Ansatz für eine wirksame NSSI-Prävention, da es die psychische Gesundheit über den Weg der Emotionsregulation verbessern soll. Es bleibt abzuwarten, wie das Protokoll umgesetzt wird, da sich der Studienbeginn aufgrund der SARS-CoV-19-Pandemie um ein Jahr verzögert hat.

I List of Abbreviations

5-HT	5-Hydroxytryptamine
AA	Atypical antipsychotic
ADH	Attention deficit hyperactivity disorder
AMP	Affect Misattribution Procedure
BPD	Borderline personality disorder
BSI	Brief Symptom Inventory
CASUS	Child and Adolescent Service Use Schedule
CBT	Cognitive Behavioural therapy
CGI-I	Clinical Global Impression of Improvement
CSQ	Coping Strategies Questionnaire
DBT	Dialectical Behaviour Therapy
DSH	Deliberate self-harm
DSI	Deliberate self-injury
D-SIB	Deliberate self-injurious-behaviour
DSM	Diagnostic and Statistical Manual of Mental Disorders
EPHPP	Effective Public Health Practice Project
ERS	Emotion Reactivity Scale
HPA	Hypothalamus-pituitary-adrenal cortex
ICD-10	International Statistical Classification of Diseases and Related Health Problems, Tenth Edition
IDB	Index of Dysregulated Behaviors
HPA	Hypothalamus-pituitary-adrenal cortex

ICD-10	International Statistical Classification of Diseases and Related Health Problems, Tenth Edition
IDB	Index of Dysregulated Behaviors
IDD	Infants with intellectual and developmental disabilities
MDD	Major depression disorder
MFQ	Mood and Feelings Questionnaire
NSSI	Non-suicidal self-injury
PSI-SF	Parenting Stress Index-Short Form
RCADS	Revised Child Anxiety and Depression Scale
RCT	Randomized controlled trial
SA	Suicide attempt
SDQ	Strengths and Difficulties Questionnaire
SIB	Self-injurious behaviour
SIQ	Suicidal ideation questionnaire
SIT	Self-injury Trauma Scale
SITBI	Self-Injurious Thoughts and Behaviours Inventory
SM	Self-mutilation
WHO	World Health Organization

II List of figures

Figure 1: Top 10 causes of death among adolescents worldwide in 2014 ..... - 5 -
Figure 2: The course of NSSI throughout adolescence, adapted with kind permission of Plener et. al., 2015..... - 12 -
Figure 3: Neurobiological systems involved in the emergence of NSSI ..... - 14 -
Figure 4: Warning signs of NSSI, with kind permission adapted from Lieberman & Toste, 2008 ..... - 19 -
Figure 5: Percentages of first suicidal behaviors and thoughts in comparison to onset of NSSI, with kind permission adapted from Groschwitz & Kaess, 2015. ..... - 21 -
Figure 6: Prevalence of psychiatric disorders among patients with and without NSSI, data extracted from Groschwitz et al., 2015..... - 23 -
Figure 7: Functions of NSSI, adapted with kind permission from E. D. Klonsky, 2007- 24 -
Figure 8: Treatment algorithm for NSSI, adapted with kind permission by Plener & Brunner, 2016..... - 26 -
Figure 9: Prevention models by Caplan and Gordon ..... - 30 -
Figure 10: PRISMA Flow Chart..... **Fehler! Textmarke nicht definiert.**

III List of tables

Table 1: Terminology used to describe self-injuring behaviour..... - 7 -
Table 2: Six main criteria for NSSI according to the DSM-5 (Association, 2013) ..... - 9 -
Table 3: ICD-10 categories including NSSI (WHO, 2016)..... - 10 -
Table 4: Prevalence of D-SIB in 11 European countries, with kind permission of Wasserman et al., 2010..... - 11 -
Table 5: Methods of NSSI according to gender, with kind permission adapted from Bresin & Schoenleber, 2015 ..... - 13 -
Table 7: Study quality ratings according to the EPHPP ..... - 52 -

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I (Cornelia v. Schönfeld) declare that I have no competing interests.

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VI Publications

1) Part of the data from this doctoral thesis was published in the form of a study protocol in the journal "Springer Nature" on February 1st 2022 with the title "DUDE – a universal prevention for non-suicidal self-injurious behaviour in adolescence based on effective emotion regulation: study protocol of a cluster-randomized controlled trial".

Buerger *et al. Trials* (2022) 23:97
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Trials

STUDY PROTOCOL Open Access

DUDE - a universal prevention program for non-suicidal self-injurious behavior in adolescence based on effective emotion regulation: study protocol of a cluster-randomized controlled trial

Arne Buerger[1,2*], Theresa Emser[1], Alexandra Seidel[1], Christin Scheiner[1], Cornelia von Schoenfeld[1], Viktoria Ruecker[3], Peter U. Heuschmann[3] and Marcel Romanos[1,2]

Abstract

Background: Non-suicidal self-injury (NSSI) has become a substantial public health problem. NSSI is a high-risk marker for the development and persistence of mental health problems, shows high rates of morbidity and mortality, and causes substantial health care costs. Thus, there is an urgent need for action to develop universal prevention programs for NSSI before adolescents begin to show this dangerous behavior. Currently, however, universal prevention programs are lacking.

Methods: The main objective of the present study is to evaluate a newly developed universal prevention program ("DUDE – Du und deine Emotionen / You and your emotions"), based on a skills-based approach in schools, in 3200 young adolescents (age 11–14 years). The effectiveness of DUDE will be investigated in a cluster-randomized controlled trial (RCT) in schools ($N = 16$). All groups will receive a minimal intervention called "Stress-free through the school day" as a mental health literacy program to prevent burnout in school. The treatment group ($N = 1600$; 8 schools) will additionally undergo the universal prevention program DUDE and will be divided into treatment group 1 (DUDE conducted by trained clinical psychologists; $N = 800$; 4 schools) and treatment group 2 (DUDE conducted by trained teachers; $N = 800$; 4 schools). The active control group ($N = 1600$; 8 schools) will only receive the mental health literacy prevention. Besides baseline assessment (T0), measurements will occur at the end of the treatment (T1) and at 6- (T2) and 12-month (T3) follow-up evaluations. The main outcome is the occurrence of NSSI within the last 6 months assessed by a short version of the Deliberate Self-Harm Inventory (DSHI-9) at the 1-year follow-up (primary endpoint; T3). Secondary outcomes are emotion regulation, suicidality, health-related quality of life, self-esteem, and comorbid psychopathology and willingness to change.

2) Another paper on the systematic review of universal prevention of NSSI for children and adolescents is yet to be accepted and published.

VII Statutory declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

.....	.....
Date	Signature