

## Article

# Adolescents' Experiences of Close Relatives Having Physical Illness, Mental Illness, Addiction/Gambling Disorders, or Death Are Associated with Poor Mental Health and Non-Suicidal Self-Injury

Ylva Tindberg<sup>1,2,\*</sup>  and Sanna Tiikkaja<sup>2,3</sup> <sup>1</sup> Department of Women's and Children's Health, Uppsala University, 751 85 Uppsala, Sweden<sup>2</sup> Centre of Clinical Research Sörmland, Uppsala University, 631 88 Eskilstuna, Sweden; sanna.tiikkaja@fou.sormland.se<sup>3</sup> Department of Public Health and Caring Sciences, Uppsala University, 751 22 Uppsala, Sweden

\* Correspondence: ylva.tindberg@kbh.uu.se

**Abstract:** Adolescents' lives are negatively influenced by experiences of close relatives having severe health conditions. This study aimed to investigate the associations between adolescents' experiences of close relatives with severe health conditions (RSHCs) and poor mental health and non-suicidal self-injury (NSSI). Cross-sectional population-based data on 15–18-year-olds ( $n = 3483$ ) in Sörmland, Sweden, were used to analyse the associations between RSHC experiences, such as physical illness, mental illness, addiction/gambling disorders, or death, and poor mental health and NSSI. Logistic regression models (odds ratios) were generated for having one or multiple types of RSHC experiences in different combinations, adjusting for background factors and protective factors for mental health, and stratifying by gender. Adolescents reporting multiple types of RSHC experiences had significantly increased odds ratios for poor mental health (1.74–3.07) or NSSI (1.83–3.02) compared with peers without such experiences. Adjustments for mental health protective factors attenuated the associations with poor mental health or NSSI. These associations remained significant among girls with multiple types of RSHC experiences, while boys' vulnerabilities included having a relative who had died or had an addiction/gambling disorder. In conclusion, adolescents with RSHC experiences are at increased risk of poor mental health and NSSI. This vulnerability is most pronounced among girls with multiple RSHC experiences and especially for NSSI.

**Keywords:** mental illness; self-harm; improving mental health; protective factors; next of kin; illness in the family; adolescent medicine



**Citation:** Tindberg, Y.; Tiikkaja, S. Adolescents' Experiences of Close Relatives Having Physical Illness, Mental Illness, Addiction/Gambling Disorders, or Death Are Associated with Poor Mental Health and Non-Suicidal Self-Injury. *Psychiatry Int.* **2023**, *4*, 380–393. <https://doi.org/10.3390/psychiatryint4040034>

Academic Editor: Domenico De Berardis

Received: 31 August 2023

Revised: 16 October 2023

Accepted: 10 November 2023

Published: 15 November 2023



**Copyright:** © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

The situation of young people who are dealing with close relatives that have severe health conditions (RSHCs) can be grim. They constitute a large group in society since nearly 10% of young people have a parent with a somatic condition [1] and up to 20% have a parent with mental illness [2,3]. An additional 7–17% of young people are estimated to have a sibling with a chronic physical or mental condition [4]. In a Swedish study, 10% of adolescents reported alcohol (9%) and/or other drug (3%) problems among their parents during their childhood [5].

Adolescents with RSHCs such as somatic illness, mental illness, or addiction disorders, or who have died, are at increased risk of poor mental health [1,6–9]. Illness in parents or siblings is associated with both somatic symptoms and problems such as depressive and anxiety symptoms in young people [1,7]. Poor mental health has been defined as the part of mental illness that does not meet the requirements for psychiatric diagnoses [10]. It often occurs as a normal reaction to stress in life, depending on the type and to what extent it

affects the person's ability to cope with everyday life. In adolescence, longstanding poor mental health may impair natural development, i.e., disrupt the transition from childhood to an independent and secure adulthood [11], and adolescents' poor mental health is seen as a global public health challenge [12]. In 2022, the Swedish Public Health Agency reported that 73% of girls and 46% of boys showed symptoms such as anxiety or worry [13].

A particularly vulnerable group of adolescents are those that self-harm, i.e., non-suicidal self-injury (NSSI), defined as "intentional destruction of body tissue without suicidal intent and for purposes not socially sanctioned" [14]. NSSI is considered a significant clinical problem [15,16]. Globally, NSSI has been estimated to affect 14% of adolescents [17], and a Norwegian [18] and a Danish [19] study reported a prevalence of 10–12% among boys and 22–23% among girls. The association between self-harm and poor mental health is well documented [16,20–22].

Previous studies have investigated the impact of RSHC experiences on adolescents' poor mental health or NSSI for one type of illness in a close relative at a time [2,3,6,23,24]. We have previously shown that adolescents with RSHC experiences have increased odds of poor mental health, particularly when reporting several RSHC experiences, regardless of the type of health problem [9]. Less is known about NSSI among adolescents with experiences of one or multiple types of various RSHC experiences [16,19,25], which we hope to shed some light on in the present study, where we use information on RSHC experiences such as physical illness, mental illness, addiction/gambling disorders, or death.

Protecting against poor mental health and depression in adolescents is seen as a major health promotion area to support normal psychosocial development [26]. This is a challenge since adolescents with poor mental health and/or who self-harm perceive that they have less support from their family [22] and that their parents use more alcohol [19,23] compared with peers without these difficulties. Previous studies have found that important protective factors for mental health among adolescents with RSHCs were positive friend relations, positive parental relationships, positive school experiences, meaningful leisure activities, and a belief in the future [2,9,23,24,27,28]. These factors have also been identified as important protective factors among adolescents who deliberately self-harm [16]. Furthermore, studies have shown that positive experiences early in life may compensate for the negative consequences of adverse childhood experiences on health outcomes later on in life [29,30].

In the present study, we aimed to investigate the association between adolescents' self-reported experiences of one or multiple types of RSHCs (such as either of physical illness, mental illness, addiction/gambling disorders, or death—alone or in combination with one of the other RSHCs) and poor mental health and NSSI compared with adolescents without RSHC experiences, considering protective factors for mental health and stratifying by gender.

## 2. Materials and Methods

We used data from The Life and Health in Youth survey performed in the county of Sörmland, Sweden, to monitor public health in youth, focusing on their lives and living conditions. The county of Sörmland has close to 300,000 inhabitants, of which one third live in Eskilstuna, followed by 58,000 in Nyköping. Half of the population lives in smaller towns or in a rural area. The proportion of non-Swedish-born inhabitants varies between 15 and 25% in the nine communities of the county of Sörmland.

The data were collected during February–March 2020 by the Department of Public Health and Welfare in the County Council of Sörmland in collaboration with the Centre of Clinical Research in Sörmland. School personnel handed out a code for accessing the electronic survey, which was answered anonymously in the classroom. The questionnaire consisted of 77 questions for those attending 9th grade (Y9) (15–16 years old) and 85 questions for those attending the 2nd year of upper-secondary school (Y2U) (17–18 years old). The students and parents were informed in writing beforehand that participation was voluntary, that participants could skip questions or leave the survey at any time, and that

the data would be used for public health monitoring and research projects. The students also received this information via film immediately before completing the questionnaire. Therefore, a completed questionnaire was regarded as the student's informed consent to participate. No parental approval is needed for participants above the age of 15 years in Sweden [31]. This study was approved by the Regional Ethical Review Board, Stockholm (Dnr 2017/709-32). The Life and Health in Youth surveys have previously been used in other research projects regarding adolescents' health [32–34].

In total, 4159 students filled out the questionnaire, with response rates of 74% for Y9 and 50% for Y2U. The question about having RSHC experiences or not was declined by 462 students, which were not included. An additional 214 students were excluded due to incomplete data (gender  $n = 85$ , economic stress  $n = 64$ , feeling happy about life  $n = 33$ , online abuse  $n = 18$ , and good sleep  $n = 14$ ). A total of 3483 students were included in this study.

### 2.1. Measurements and Definitions

The Swedish Health Care Law and the Convention on the Rights of the Child state that a child has the right to receive information, advice, and support when a close relative has a severe health condition or has died (RSHC). In clinical practice, the county of Sörmland has a broader definition of children as close relatives, stating that a child and their parents decide who is considered a close person with a severe health condition or who has died. Our definition of a close relative is described below.

The questionnaire contained four questions on RSHC experiences: "Do you have a family member or a close person that has: (1) a severe physical illness/injury/impairment, (2) a severe mental illness and/or psychiatric disorder/impairment, (3) a substance abuse/gambling disorder, or (4) died". This information was used in different approaches in the present study. Firstly, any RSHC experiences were reported, consisting of those with close relative/s belonging to one or several of the four diagnostic types. Secondly, the diagnostic types were treated as four separate groups (physical illness, mental illness, substance abuse/gambling, or death), creating the following subcategories: (1) having an experience of one of the specific types of RSHC or (2) having multiple experiences of more than this specific type of RSHC (including one or more of the other RSHCs). This was repeated for the four diagnostic types of RSHCs. Adolescents responding as not having any experiences of RSHCs constituted our control group.

Gender, background factors (age, ethnicity, and economic stress), poor mental health, and eleven factors protecting against poor mental health related to school, home, and safety in everyday life and lifestyle that we previously identified among adolescents with experiences of RSHCs were measured as described below [9].

Gender was categorised as "boy" or "girl", grade as Y9 (15–16 years old) or Y2U (17–18 years old), and ethnicity as "Swedish" (born in Sweden or having at least one Swedish parent) or "non-Swedish" (born outside of Sweden or having both parents born outside of Sweden). A proxy question for no economic stress, "Are you worried about your family's economy?", was used, and answers were categorised as "yes" ("yes, quite worried", or "yes, very worried") or "no" ("not especially worried" or "not worried at all").

Adolescents' poor mental health was measured with the question "During the last 12 months, have you been feeling down? By feeling down, we mean, that during at least two weeks in a row, you have been feeling stressed, sad, depressed, worried, lonely, bullied, anxious or have had suicidal thoughts" [35]. The answers to the question about poor mental health were "yes" or "no".

Adolescents' non-suicidal self-injury (NSSI) was measured with the question "During the last 12 months, have you deliberately injured yourself? By injuring yourself, we mean that you cut, scratched, hit yourself, banged your head against something or that you otherwise caused yourself harm." The possible responses were "no" or "yes" ("yes, one time", "yes, 2–5 times", and "more than 5 times").

The protective factors for mental health (no economic stress, not being bullied, enjoying school, feeling safe at home, living with both parents, not being violated via social media, feeling happy about life, feeling happy about leisure, having dinner daily, falling asleep well, getting good sleep, no use of alcohol) were categorised and, if needed, recoded to reflect a protective role. They are shown in the Supplementary Table S1.

## 2.2. Statistical Methods

Statistical analyses were conducted with the SPSS 29 statistical software. Pearson's chi-squared tests were used to test the associations between having RSHCs experiences (none or any) and different aspects in the adolescents' lives. These aspects are considered background factors (grade, ethnicity, and no economic stress) as well as protective factors against poor mental health (no economic stress, not being bullied, enjoying school, feeling safe at home, living with both parents, not being violated via social media, feeling happy about life, feeling happy about leisure, having dinner daily, falling asleep well, getting good sleep, and no use of alcohol). Pearson's chi-squared tests were also used to test the associations between having experiences of one specific or multiple types of RSHCs (in combinations), such as physical illness, mental illness, abuse/gambling disorders, or death, separately for adolescents' poor mental health as well as for NSSI compared with peers without these experiences.

In the next step, logistic regressions were used to examine the relationships between having experiences of one or multiple types of RSHCs and adolescents' poor mental health, compared with peers without such experiences. The logistic regressions were stratified by gender and carried out separately for each specific RSHC experience, alone or as multiple types of RSHCs (in combination with one or more of the other RSHC experiences; physical illness, mental illness, abuse/gambling disorders, or death). The logistic regressions were performed in two different steps. First, adjustments were made for background factors (grade, ethnicity, and no economic stress). In the second step, additional adjustments were made for eleven protective factors against poor mental health (no economic stress, not being bullied, enjoying school, feeling safe at home, living with both parents, not being violated via social media, feeling happy about life, feeling happy about leisure, having dinner daily, falling asleep well, getting good sleep, and no use of alcohol) [9]. The logistic regression modelling of experiences of single or multiple types of RSHCs and NSSI were carried out in the same way, separately for genders and with adjustments made in two steps. Odds ratios (ORs) were estimated in adjusted models with 95% confidence intervals (CIs). *p*-values <0.05 in the two-tailed analysis were considered statistically significant.

## 3. Results

### 3.1. Relatives with Severe Health Conditions (RSHC)

Over half of the adolescents reported having at least one RSHC experience (55% reporting one RSHC and 45% reporting multiple RSHCs), and these adolescents consistently reported a significantly more vulnerable situation in school and at home, regarding safety and healthy behaviours, compared with peers without these experiences (Table 1).

**Table 1.** Background factors and protective factors for mental health in the study population and their associations with the adolescents' reported experiences of relatives with severe health conditions (RSHC).

Included Variables	No RSHC * n (%)	Any RSHC # n (%)	<i>p</i> -Value £
Total	1636 (47)	1847 (53)	
Gender			<0.001
Boy	939 (57)	855 (46)	
Girl	697 (43)	992 (54)	

Table 1. Cont.

Included Variables	No RSHC * n (%)	Any RSHC # n (%)	p-Value £
Background variables			
Grade			0.31
Y9 (15–16 years)	883 (54)	965 (52)	
Y2U (17–18 years)	753 (46)	882 (48)	
Ethnicity			<0.001
Swedish	1164 (71)	1479 (80)	
Non-Swedish	472 (29)	368 (20)	
No economic stress \$			<0.001
Yes	1474 (90)	1518 (82)	
No	62 (10)	329 (18)	
School-related factors			
Not being bullied at school \$			<0.001
Yes	1454 (89)	1533 (83)	
No	182 (11)	314 (17)	
Enjoying school			<0.001
Yes	1266 (77)	1298 (70)	
No	370 (23)	549 (30)	
Home-related factors			
Feeling safe at home			<0.001
Yes	1525 (93)	1589 (86)	
No	111 (7)	258 (14)	
Living with both parents			<0.001
Yes	1085 (66)	1023 (55)	
No	551 (33)	824 (45)	
Safety in everyday life			
Not being violated via social media \$			<0.001
Yes	1377 (84)	1357 (74)	
No	259 (16)	490 (27)	
Feeling happy about life			<0.001
Yes	1439 (88)	1479 (80)	
No	506 (12)	368 (20)	
Feeling happy with leisure			<0.001
Yes	1314 (80)	1317 (71)	
No	242 (20)	530 (29)	
Lifestyle factors			
Having dinner daily			0.04
Yes	1390 (85)	1502 (81)	
No	246 (15)	345 (19)	
Falling asleep well \$			<0.001
Yes	1191 (73)		
No	445 (27)	458 (34)	

**Table 1.** Cont.

Included Variables	No RSHC * n (%)	Any RSHC # n (%)	p-Value £
Getting good sleep §			<0.001
Yes	1418 (87)	1441 (78)	
No	218 (13)	406 (22)	
No use of alcohol §			<0.001
Yes	794 (49)	667 (36)	
No	842 (51)	1180 (64)	

\* Control group consisting of adolescents not having any experiences of RSHC. # Group consisting of adolescents having experiences of one or more of the four diagnostic groups of RSHC. £ Pearson's chi-square test. § Recoded to reflect a protective role.

### 3.1.1. Adolescents' Mental Health

Half of the participating adolescents (n = 1911) reported poor mental health (1162 (61%) for girls and 749 (49%) for boys; *p*-value < 0.001), and nearly 1 in 5 (n = 648) reported NSSI (398 (23%) for girls and 250 (13%) for boys; *p*-value < 0.001) during the last 12 months (Tables 2 and 3). The correlation between poor mental health and NSSI was statistically significant, so they were analysed as separate outcomes.

**Table 2.** Proportions and associations between adolescents' experiences of relatives with severe health conditions (RSHC) of different specific types, alone or in combination with one or more of the other RSHC experiences, related to self-reported poor mental health, by gender.

Type of RSHC	Girls' Poor Mental Health			Boys' Poor Mental Health		
	No n (%)	Yes n (%)	p-Value *	No n (%)	Yes n (%)	p-Value *
Physical illness (PI)						
No RSHC	278 (40)	419 (60)		609 (65)	330 (35)	
PI only	17 (24)	55 (76)	<0.001	46 (57)	34 (43)	0.002
PI + ≥1 other RSHC	46 (16)	250 (85)		105 (48)	113 (52)	
Total	341 (32)	724 (68)		760 (61)	477 (39)	
Mental illness (MI)						
No RSHC	278 (40)	419 (60)		609 (65)	330 (35)	
MI only	21 (25)	64 (75)	<0.001	25 (46)	30 (55)	<0.001
MI + ≥1 other RSHC	53 (17)	269 (84)		107 (47)	119 (53)	
Total	352 (32)	752 (68)		741 (61)	479 (40)	
Substance abuse/ gambling (SAG)						
No RSHC	278 (40)	419 (60)		609 (65)	330 (35)	
SAG only	15 (32)	32 (68)	<0.001	11 (48)	12 (52)	<0.001
SAG + ≥1 other RSHC	42 (18)	200 (83)		79 (42)	108 (58)	
Total	335 (34)	651 (66)		699 (61)	450 (40)	
Died (D)						
No RSHC	378 (40)	419 (60)		609 (65)	330 (35)	
D only	111 (36)	199 (64)	<0.001	193 (56)	152 (44)	<0.001
D + ≥1 other RSHC	76 (19)	315 (81)		135 (45)	165 (55)	
Total	465 (33)	933 (67)		937 (59)	647 (41)	

\* Pearson's chi-square test.

**Table 3.** Proportions and associations between adolescents' experiences of relatives with severe health conditions (RSHC) of different specific types, alone or in combination with one or more of the other RSHC experiences, related to non-suicidal self-injury (NSSI), by gender.

Type of RSHC	Girls' NSSI			Boys NSSI		
	No n (%)	Yes n (%)	<i>p</i> -Value *	No n (%)	Yes n (%)	<i>p</i> -Value *
Physical illness (PI)						
No RSHC	579 (83)	116 (17)	<0.001	836 (88)	105 (11)	0.002
PI only	57 (80)	14 (20)		69 (86)	11 (14)	
PI + $\geq 1$ other RSHC	179 (61)	116 (40)		174 (80)	44 (20)	
Total	815 (246)	246 (23)		1079 (87)	160 (13)	
Mental illness (MI)						
No RSHC	579 (83)	116 (17)	<0.001	836 (89)	105 (11)	<0.001
MI only	65 (77)	20 (24)		43 (78)	12 (22)	
MI + $\geq 1$ other RSHC	189 (60)	132 (41)		177 (78)	49 (22)	
Total	833 (76)	268 (24)		1056 (86)	166 (14)	
Substance abuse/ gambling (SAG)						
No RSHC	579 (83)	116 (17)	<0.001	836 (89)	105 (11)	<0.001
SAG only	34 (72)	13 (28)		18 (78)	5 (22)	
SAG + $\geq 1$ other RSHC	141 (58)	101 (42)		135 (72)	53 (28)	
Total	754 (76)	230 (23)		989 (86)	163 (14)	
Died (D)						
No RSHC	579 (83)	116 (17)	<0.001	836 (89)	105 (11)	<0.001
D only	249 (80)	61 (20)		304 (88)	40 (12)	
D + $\geq 1$ other RSHC	253 (65)	137 (35)		233 (77)	68 (23)	
Total	1081 (78)	314 (23)		1373 (86)	213 (13)	

\* Pearson's chi-square test.

### 3.1.2. RSHC and Poor Mental Health

Girls reporting experiences of multiple types of RSHCs had significantly increased ORs, ranging from 2.45 to 3.07, for poor mental health compared with girls without these experiences and when adjusting for background factors (Table 4, Model 1). Girls also had increased ORs for poor mental health when reporting RSHC experiences such as either physical illness or mental illness only (Table 4, Model 1). With adjustments for mental health protective factors, the ORs for poor mental health in girls were reduced by half but remained significant when reporting experiences of multiple types of RSHCs of any type (Table 4, Model 2).

**Table 4.** Adjusted odds ratios for adolescents' self-reported poor mental health related to experiences of relatives with severe health conditions (RSHC) of different specific types, alone or in combination with one or more of the other related RSHC experiences, by gender.

RSHC	Poor Mental Health Girls		Poor Mental Health Boys	
	Model 1	Model 2	Model 1	Model 2
<b>Physical illness (PI)</b>				
No RSHC	1	1	1	1
PI only	1.99 (1.23–3.53)	1.63 (0.87–3.01)	1.42 (0.89–2.28)	1.43 (0.84–2.43)
PI + $\geq 1$ other RSHC	3.07 (2.15–4.39)	1.84 (1.23–2.74)	1.74 (1.28–2.38)	1.23 (0.86–1.76)
<b>Mental illness (MI)</b>				
No RSHC	1	1	1	1
MI only	1.70 (1.00–2.88)	1.40 (0.78–2.52)	2.17 (1.24–3.79)	1.74 (0.92–3.28)
MI + $\geq 1$ other RSHC	2.85 (2.03–4.00)	1.60 (1.09–2.35)	1.82 (1.34–2.64)	1.24 (0.87–1.76)
<b>Substance abuse/ gambling (SAG)</b>				
No RSHC	1	1	1	1
SAG only	1.21 (0.63–2.31)	0.80 (0.37–1.17)	1.48 (0.62–3.57)	1.05 (0.39–2.81)
SAG + $\geq 1$ other RSHC	2.68 (1.85–3.90)	1.67 (1.09–2.26)	2.26 (1.63–3.14)	1.35 (0.91–1.99)
<b>Died (D)</b>				
No RSHC	1	1	1	1
D only	1.16 (0.88–1.54)	0.98 (0.71–1.34)	1.48 (1.46–1.91)	1.58 (1.19–2.09)
D + $\geq 1$ other RSHC	2.45 (1.80–3.27)	1.58 (1.26–2.22)	2.01 (1.60–2.74)	1.40 (1.02–1.91)

Model 1. Adjusted for grade, ethnicity, and no economic stress (grade and ethnicity were non-significant) Model 2. Adjusted for no economic stress, not being bullied, enjoying school, feeling safe at home, living with both parents, not being violated via social media, feeling happy about life, feeling happy about leisure, having dinner daily, falling asleep well, getting good sleep, and no use of alcohol.

Correspondingly, boys reporting experiences of multiple types of RSHCs had significantly increased ORs for poor mental health, ranging from 1.74 to 2.26, compared with boys without these experiences and adjusting for background factors (Table 4, Model 1). This association with poor mental health was also seen for boys with experiences of RSHCs who had mental illness or who had died only. When adjusting for mental health protective factors, the association with poor mental health remained for boys reporting experiences of a relative who had died only or in combination with experiences of another severe health condition (Table 4, Model 2).

### 3.1.3. RSHC and Non-Suicidal Self-Injury

Among girls, the association between multiple types of RSHCs and NSSI revealed increased ORs (ranging from 2.27 to 3.02) compared with the control group when adjusting for background factors (Table 5, Model 1). With adjustments for protective factors, these ORs diminished by half; however, all associations remained statistically significant (Table 5, Model 2).

**Table 5.** Adjusted odds ratios for adolescents' self-reported non-suicidal self-injury (NSSI) related to experiences of relatives with severe health conditions (RSHC) of different specific types, alone or in combination with one or more of the other RSHC experiences, by gender.

RSHC	NSSI Girls		NSSI Boys	
	Model 1	Model 2	Model 1	Model 2
<b>Physical illness (PI)</b>				
No RSHC	1	1	1	1
PI only	1.16 (0.62–2.16)	0.88 (0.44–1.74)	1.30 (0.67–2.55)	1.45 (0.55–2.38)
PI + ≥1 other RSHC	2.89 (2.11–3.97)	1.64 (1.14–2.35)	1.83 (1.23–2.72)	1.32 (0.85–2.04)
<b>Mental illness (MI)</b>				
No RSHC	1	1	1	1
MI only	1.22 (0.70–2.13)	0.78 (0.41–1.49)	2.27 (1.14–4.50)	1.57 (0.74–3.34)
MI + ≥1 other RSHC	2.89 (2.12–3.95)	1.63 (1.14–2.32)	1.99 (1.35–2.94)	1.24 (0.80–1.92)
<b>Substance abuse/ gambling (SAG)</b>				
No RSHC	1	1	1	1
SAG only	1.68 (0.85–3.35)	0.96 (0.44–2.10)	1.86 (0.65–5.35)	1.31 (0.44–3.89)
SAG + ≥1 other RSHC	3.02 (2.16–4.23)	1.66 (1.12–2.46)	2.92 (1.98–4.31)	1.72 (1.14–2.67)
<b>Died (D)</b>				
No RSHC	1	1	1	1
D only	1.16 (0.82–1.65)	1.14 (0.78–1.67)	1.11 (0.75–1.65)	1.09 (0.72–1.66)
D + ≥1 other RSHC	2.27 (1.68–3.01)	1.45 (1.03–2.03)	2.29 (1.61–3.23)	1.40 (0.96–2.06)

Model 1. Adjusted for grade, ethnicity, and no economic stress (grade and ethnicity were non-significant) Model 2. Adjusted for no economic stress, not being bullied, enjoying school, feeling safe at home, living with both parents, not being violated via social media, feeling happy about life, feeling happy about leisure, having dinner daily, falling asleep well, getting good sleep, and no use of alcohol.

A similar pattern with somewhat weaker associations was seen among boys, where experiences of multiple types of RSHCs, as well as mental illness only, showed statistically significant ORs for NSSI when adjusted for background factors (Table 5, Model 1). With additional adjustments for protective factors, the associations with NSSI remained significant only for boys reporting multiple types of RSHC experiences including substance abuse/gambling (Table 5, Model 2).

#### 4. Discussion

The present population-based study exploring the burden of close relatives with severe health conditions (RSHCs) showed that adolescents reporting multiple types of RSHCs had significantly increased ORs for poor mental health or NSSI, compared with peers without such experiences. We also found that mental health protective factors influenced the association between RSHC experiences and poor mental health or NSSI positively in this vulnerable group of adolescents—in different ways, however—for girls and boys. Girls facing multiple types of RSHC experiences had significantly increased odds of poor mental health or NSSI, including when fully adjusting for mental health protective factors. For boys, significantly increased odds remained for poor mental health when having experiences of close relatives dying and for NSSI when having multiple types of RSHC experiences, including substance abuse/gambling.

Our study contributes to the current knowledge in several ways. To the best of our knowledge after searching the literature, this is the first study investigating poor mental health and NSSI among adolescents reporting a broad spectrum of RSHC types (physical illness, mental illness, addiction/gambling disorders, or death—one type or in

combination). We also differentiated between the mental health vulnerability of girls and boys in this challenging situation.

RSHC experiences are common, as half of the participating adolescents reported having them. Just as many reported poor mental health and nearly one in five reported NSSI during the last 12 months. These adolescents constitute a large group of young people in vulnerable situations. Our results confirm that poor mental health and NSSI are more prevalent among adolescent girls than boys [12,14]. Furthermore, our noted association between adolescents' self-reported experiences of RSHCs and poor mental health or NSSI agrees with previous studies [9,16,21]. The high prevalence found underlines the magnitude of preventive work needed to support adolescents' mental health, especially when facing the challenges of RSHC experiences [11,12,26].

Our identified associations between adolescents' poor mental health and the multiple types of RSHC experiences reported, or mental illness only (Table 3), follow previous Swedish research showing that the experiences of parents with mental illness or substance abuse were associated with increased odds for needing psychiatric care among young adults [36]. Moreover, our finding that girls had increased odds for poor mental health when reporting RSHC experiences, such as physical or mental illness only, aligns with previous results [37]. No comparable studies could be found regarding our finding of an association between adolescent NSSI and multiple types of RSHC experiences (Table 4). A Danish population-based study reported up to threefold increased odds for self-injury among adolescents with two parents with alcohol problems [19]. The Danish study, however, reported a difference in odds between genders that we did not see [19]. Furthermore, depressive feelings in caregivers [25] and a family history of psychiatric disorders [16] have been identified as single risk factors for NSSI among adolescents.

Participating adolescents with RSHC experiences reported significantly more vulnerable situations in school and at home regarding safety and when describing healthy behaviours compared with peers without these experiences (Table 1). We previously identified protective factors for mental health among adolescents facing the challenges of RSHC experiences [9], such as positive friend relations, positive parental relationships, positive school experiences, meaningful leisure activities, and belief in the future, in agreement with the findings of other studies [2,23,24,27,28].

In the present study, adjustments for our identified mental health protective factors attenuated the ORs for poor mental health and NSSI among adolescents with RSHC experiences. This was, however, manifested in different ways for different genders, producing significantly increased ORs for poor mental health and NSSI in girls reporting multiple types of RSHC experiences, while for boys, the association with poor mental health was significant only for those reporting that close relative(s) had died, solely or in combination with other RSHC experiences. This agrees with studies that have shown long-term effects on young men's poor mental health after the loss of a parent due to external causes during childhood [8]. Correspondingly, for NSSI, an association was seen only for boys reporting multiple types of RSHCs, including substance/gambling abuse, which was also reported by Pisinger et al. [19].

The stronger and increased number of associations found in girls compared to boys between adolescent experiences of RSHCs and poor mental health or NSSI indicate that girls are more vulnerable in these situations. This may be related to girls having a different role in the context of a close relative having a severe health condition, such as a given or own sense of responsibility concerning the prevailing situation.

Other studies have shown that risk factors for poor mental health, such as sleeping difficulties, negative experiences in school, difficulties with friends, and alcohol use, impact poor mental health as well as NSSI [15,27]. One study, however, concluded that the increased prevalence of NSSI could not be explained by well-known risk factors [18]. Instead, the authors suggest that factors that have changed during the last decades, such as lifestyles and the development of digital media, play an important role in the increase in self-injury [18]. In the present study, we showed that the presence of protective factors at

the individual, family, and environmental levels, such as feeling happy about life, falling asleep well, getting good sleep, living with both parents, feeling safe at home, having dinner daily, not using alcohol, enjoying school, feeling happy about leisure, and not being bullied or violated via social media, may buffer both poor mental health and self-harm in the vulnerable group of adolescents facing the challenges of multiple types of RSHC experiences.

The noted protective effects of several psychosocial factors in adolescents' everyday lives on the association between RSHC experiences and poor mental health or NSSI emphasises the importance of a holistic approach when meeting this vulnerable group in school, at leisure, and in the clinic. A structured psychosocial history developed and validated for adolescents (called HEEADSSS) may help identify strengths and weaknesses in young people's everyday lives and well-being [38]. This stepwise approach of moving from less stressful areas to more sensitive matters can help a young person to open up and provide the caregiver with valuable information. This holistic approach may be supported by spending time alone in a confidential meeting with the adolescent [39], such as in the student and primary healthcare, or social services. Taking these psychosocial aspects into account might be key to improving perceived health and, thus, self-esteem and self-empowerment during the challenges of adolescent development.

In addition, in situations where a relative with severe illness is the focus, research has shown that children and adolescents want to be involved in the care, which may increase their possibilities to manage the situation [40]. For adolescents with experiences of mental and/or addictive disorders in parents, mental health nurses and social workers play a key role in providing information and building resilience, where interventions need to focus on psychological as well as physical well-being for the whole family [2,23,24,28]. Peer support groups can promote the group members' resilience, well-being, coping skills, and mutual support [2]. Teachers and parents in schools can help adolescents resolve their problems by reducing stigma and academic stress, improving family contexts, and initiating referrals to healthcare for individual support if needed [41].

These efforts are especially important at a time when young people are searching for their place in life and should be spending much of their energy preparing for adulthood by, for instance, gaining experiences together with peers, challenging parents, and engaging in education. Adolescent psychosocial development, i.e., the training period for the transition from childhood to adulthood, requires self-esteem, self-empowerment, and peer acceptance that may be threatened by relatives' health issues that may produce a decline in a young person's mental health [11].

The most vulnerable adolescents with experiences of multiple types of RSHCs are more likely to have complex needs, requiring particularly compassionate and professional support based on interprofessional collaboration. Thus, effective health promotion interventions aimed at adolescents should be simultaneous and carried out at several societal levels (government, community, and local levels), focusing on adolescents' overall self-esteem and self-empowerment rather than single health issues [26].

### *Strengths and Limitations*

The survey used in this study was planned to be performed at the time of the outbreak of the COVID-19 pandemic. Thus, many students were absent from school, and several upper-secondary schools were closed, leading to lower response rates than a previous survey in 2017 (84% for Y9 and 82% for Y2U). Nevertheless, no systematic pattern in the non-response was found, and therefore, we may assume that the data are reliable. In agreement with a previous study [37], half of our study population stated that they had experiences with RSHCs of any of the four diagnostic types. Moreover, the observed proportions of poor mental health and NSSI agree with the Swedish national data and previous reports [17,18].

One limitation of our study was missing data, particularly on RSHC experiences. We assume that experiencing RSHCs, as well as poor mental health or NSSI, may be perceived

as sensitive topics, leading to non-response or recall bias among adolescents that otherwise would have contributed to these groups. Furthermore, considering the background factors of the adolescents that were excluded, we assume the majority represent a vulnerable group due to not answering the questions on RSHCs (67%) or ethnicity (70%). They also reported more economic stress (18%) than included study participants (11%). Over half of the excluded adolescents were boys (52%), and one in five were girls (18%), which may have led to an underestimation of gender differences. Another limitation is that our questionnaire could only be answered in Swedish, making it difficult for newcomer immigrants to participate. Altogether, we assume that these drawbacks lead to an underestimation of our results.

Another drawback with the cross-sectional nature of the research design is that it precludes the establishment of causal relationships between the studied variables.

Strengths of this study are its population-based study design and the large sample size. Another strength of the present study is that we were able to analyse the impacts of multiple types of experiences of RSHCs on adolescents' poor mental health or NSSI, while the common approach in previous studies has been to study different types of RSHCs separately [2,3,6,23,24,27,36]. A limitation, however, is our lack of information on the type of relationship between an adolescent and the RSHC. For instance, we do not know whether the relation is to a relative that is next of kin or to a friend, although the respective pathological effects of these relations are not known. Moreover, our outcome for poor mental health captures a broad range of mental illnesses, with no possibility to distinguish between different symptoms and differences between genders. However, reporting poor mental health symptoms for at least two consecutive weeks is often used to diagnose mental disorders [35]. Similarly, we measured NSSI as a broad spectrum of behaviours, so we could not distinguish between different behaviours among girls or boys. Further, the study may not account for other potential factors that could influence adolescents' mental health and NSSI tendencies. In addition, correlations between mental illness in parents and children are partly due to common genes, and the behaviour of a mentally ill parent can impact a child's mental health. The results in the fully adjusted models may be over-adjusted if the factors adjusted for are intermediate variables on a causal path from exposure to outcome.

## 5. Conclusions

The present study adds to the knowledge about the associations between experiences of multiple types of RSHCs and adolescents' poor mental health and NSSI. Girls seem to be more vulnerable in these situations. Our study further shows the importance of factors protecting against poor mental health in everyday life for adolescents with experiences of RSHCs suffering from poor mental health and/or NSSI. This knowledge is important to all professions meeting adolescents with RSHCs.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/psychiatryint4040034/s1>, Table S1. Original variables, response options, categorizations and variable names used in the manuscript.

**Author Contributions:** Both authors contributed to this study's conception and design. The data were collected by Sörmland County Council. The material preparation and analysis were performed by S.T. The first draft of the manuscript was written by Y.T. All authors have read and agreed to the published version of the manuscript.

**Funding:** YT received funding from the Centre for Clinical Research Sörmland County Council/Uppsala University (DLL-981056). ST received funding from the Centre for Clinical Research Sörmland County Council/Uppsala University [DLL-981034], Children's Welfare Foundation (Stiftelsen Allmänna Barnhuset) (2022-333), and Majblomman (2023-26).

**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of the Regional Ethical Review Board, Stockholm (protocol code Dnr 2017/709-32 and date of approval 7 April 2017).

**Informed Consent Statement:** Students and parents were informed beforehand in writing that participation was voluntary. According to the beforehand-given information, a completed questionnaire was regarded as the student's informed consent to participate. No parental approval is needed for participation above the age of 15 in Sweden.

**Data Availability Statement:** The dataset generated and analysed in the current study is available from the authors upon request but is not publicly available due to ethical guidelines.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Sieh, D.S.; Visser-Meily, J.M.A.; Meijer, A.M. Differential Outcomes of Adolescents with Chronically Ill and Healthy Parents. *J. Child Fam. Stud.* **2013**, *22*, 209–218. [CrossRef] [PubMed]
2. Radicke, A.; Barkmann, C.; Adema, B.; Daubmann, A.; Wegscheider, K.; Wiegand-Grefe, S. Children of Parents with a Mental Illness: Predictors of Health-Related Quality of Life and Determinants of Child–Parent Agreement. *Int. J. Environ. Res. Public Health* **2021**, *18*, 379. [CrossRef] [PubMed]
3. Reupert, A.E.; Maybery, D.J.; Kowalenko, N.M. Children whose parents have a mental illness: Prevalence, need and treatment. *Med. J. Aust.* **2013**, *199*, 7–9. [CrossRef] [PubMed]
4. McKenzie Smith, M.; Pinto Pereira, S.; Chan, L.; Rose, C.; Shafran, R. Impact of Well-being Interventions for Siblings of Children and Young People with a Chronic Physical or Mental Health Condition: A Systematic Review and Meta-Analysis. *Clin. Child Fam. Psychol. Rev.* **2018**, *21*, 246–265. [CrossRef] [PubMed]
5. Jernbro, C.; Tindberg, Y.; Janson, S. High risk of severe child abuse and poly-victimisation in families with parental substance misuse—Results from a Swedish school-based survey. *Child Abuse Rev.* **2022**, *31*, e2741. [CrossRef]
6. Rostila, M.; Berg, L.; Saarela, J.; Kawachi, I.; Hjern, A. Experience of sibling death in childhood and risk of psychiatric care in adulthood: A national cohort study from Sweden. *Eur. Child Adolesc. Psychiatry* **2019**, *28*, 1581–1588. [CrossRef]
7. Martikainen, P.; Korhonen, K.; Moustgaard, H.; Aaltonen, M.; Remes, H. Substance abuse in parents and subsequent risk of offspring psychiatric morbidity in late adolescence and early adulthood: A longitudinal analysis of siblings and their parents. *Soc. Sci. Med.* **2018**, *217*, 106–111. [CrossRef]
8. Berg, L.; Rostila, M.; Hjern, A. Parental death during childhood and depression in young adults—A national cohort study. *J. Child Psychol. Psychiatry* **2016**, *57*, 1092–1098. [CrossRef]
9. Tiikkaja, S.; Tindberg, Y. The association between adolescents' experiences of close relatives having severe health conditions and poor mental health—A population-based school study. *Adolescents* **2023**, *3*, 550–563. [CrossRef]
10. Dalman, C.; Bremberg, S.; Åhlén, J.; Ohlss, A.; Agardh, E.; Wicks, S.; Lundin, A. *Psykiskt Välbefinnande, Psykiska Besvär och Psykiatriska Tillstånd hos Barn och Unga—Begrepp, Mätmetoder och Förekomst*; Forte-Forskningsrådet för hälsa, arbetsliv och välfärd: Stockholm, Sweden, 2021; pp. 1–64.
11. Sawyer, S.M.; Afifi, R.A.; Bearinger, L.H.; Blakemore, S.J.; Dick, B.; Ezeh, A.C.; Patton, G.C. Adolescence: A foundation for future health. *Lancet* **2012**, *379*, 1630–1640. [CrossRef]
12. Ferrari, A.; Santomauro, F.; Mantilla Herrera, A.M.; Shadid, J.; Ashbaugh, C.; Erskine, H.; Charlson, F.J.; Degenhardt, L.; Scott, J.G.; McGrath, J.J.; et al. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet Psychiatry* **2022**, *9*, 137–150.
13. Statistik om Psykisk Hälsa i Sverige. Available online: <https://www.folkhalsomyndigheten.se/livsvillkor-levnadsvanor/psykisk-halsa-och-suicidprevention/statistik-psykisk-halsa/> (accessed on 30 August 2023).
14. Klonsky, E.D.; Muehlenkamp, J.J. Self-injury: A research review for the practitioner. *J. Clin. Psychol.* **2007**, *63*, 1045–1056. [CrossRef] [PubMed]
15. Rasmussen, S.; Hawton, K.; Philpott-Morgan, S.; O'Connor, R.C. Why Do Adolescents Self-Harm?: An Investigation of Motives in a Community Sample. *Crisis* **2016**, *37*, 176–183. [CrossRef] [PubMed]
16. Lauw, M.; How, C.H.; Loh, C. Deliberate self-harm in adolescents. *Singap. Med. J.* **2015**, *56*, 306–309. [CrossRef]
17. Lim, K.S.; Wong, C.H.; McIntyre, R.S.; Wang, J.; Zhang, Z.; Tran, B.X.; Tan, W.; Ho, C.; Ho, R. Global Lifetime and 12-Month Prevalence of Suicidal Behavior, Deliberate Self-Harm and Non-Suicidal Self-Injury in Children and Adolescents between 1989 and 2018: A Meta-Analysis. *Int. J. Environ. Res. Public Health* **2019**, *16*, 4581. [CrossRef]
18. Tørmoen, A.J.; Myhre, M.; Walby, F.A.; Grøholt, B.; Rossow, I. Change in prevalence of self-harm from 2002 to 2018 among Norwegian adolescents. *Eur. J. Public Health* **2020**, *30*, 688–692. [CrossRef]
19. Pisinger, V.; Hawton, K.; Tolstrup, J. Self-injury and suicide behavior among young people with perceived parental alcohol problems in Denmark: A school-based survey. *Eur. Child Adolesc. Psychiatry* **2018**, *27*, 201–218. [CrossRef]
20. Caine, E.D. Self-harm behaviour: Rethinking physical and mental health. *Lancet* **2012**, *380*, 1536–1538. [CrossRef]
21. Fortuna, L.R. Editorial: Disrupting Pathways to Self-Harm in Adolescence: Machine Learning as an Opportunity. *J. Am. Acad. Child Adolesc. Psychiatry* **2021**, *60*, 1459–1460. [CrossRef]
22. Tuisku, V.; Pelkonen, M.; Kiviruusu, O.; Karlsson, L.; Ruutu, T.; Marttunen, M. Factors associated with deliberate self-harm behaviour among depressed adolescent outpatients. *J. Adolesc.* **2009**, *32*, 1125–1136. [CrossRef]

23. Wlodarczyk, O.; Schwarze, M.; Rumpf, H.J.; Metzner, F.; Pawils, S. Protective mental health factors in children of parents with alcohol and drug use disorders: A systematic review. *PLoS ONE* **2017**, *12*, e0179140. [[CrossRef](#)] [[PubMed](#)]
24. Yamamoto, R.; Keogh, B. Children's experiences of living with a parent with mental illness: A systematic review of qualitative studies using thematic analysis. *J. Psychiatr. Ment. Health Nurs.* **2018**, *25*, 131–141. [[CrossRef](#)] [[PubMed](#)]
25. Uh, S.; Dalmaijer, E.S.; Siugzdaite, R.; Ford, T.J.; Astle, D.E. Two Pathways to Self-Harm in Adolescence. *J. Am. Acad. Child Adolesc. Psychiatry* **2021**, *60*, 1491–1500. [[CrossRef](#)] [[PubMed](#)]
26. Viner, R.; Macfarlane, A. Health promotion. *BMJ* **2005**, *330*, 527–529. [[CrossRef](#)] [[PubMed](#)]
27. Jørgensen, S.E.; Thygesen, L.C.; Michelsen, S.I.; Due, P.; Bidstrup, P.E.; Høeg, B.L.; Anderssen, A. Why Do Some Adolescents Manage Despite Parental Illness? Identifying Promotive Factors. *J. Adolesc. Health* **2021**, *69*, 335–341. [[CrossRef](#)] [[PubMed](#)]
28. Kallander, E.K.; Weimand, B.M.; Hanssen-Bauer, K.; Van Roy, B.; Ruud, T. Factors associated with quality of life for children affected by parental illness or substance abuse. *Scand. J. Caring Sci.* **2021**, *35*, 405–419. [[CrossRef](#)]
29. Narayan, A.J.; Rivera, L.M.; Bernstein, R.E.; Harris, W.W.; Lieberman, A.F. Positive childhood experiences predict less psychopathology and stress in pregnant women with childhood adversity: A pilot study of the benevolent childhood experiences (BCEs) scale. *Child Abuse Negl.* **2018**, *78*, 19–30. [[CrossRef](#)]
30. Almeida, T.C.; Guarda, R.; Cunha, O. Positive childhood experiences and adverse experiences: Psychometric properties of the Benevolent Childhood Experiences Scale (BCEs) among the Portuguese population. *Child Abuse Negl.* **2021**, *120*, 105179. [[CrossRef](#)]
31. Lag (2003:460) om Etikprövning av Forskning Som Avser Människor (Swedish Parliament. Ethical Review Act). Available online: [https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003460-om-etikprovning-av-forskning-som\\_sfs-2003-460/](https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/lag-2003460-om-etikprovning-av-forskning-som_sfs-2003-460/) (accessed on 30 August 2023).
32. Annerbäck, E.M.; Svedin, C.G.; Dahlstrom, Ö. Child physical abuse influencing the associations between self-reported exposure and self-reported health problems: A cross-sectional study. *Child Adolesc. Psychiatry Ment. Health* **2018**, *12*, 1–13. [[CrossRef](#)]
33. Noirrit-Esclassan, E.; Annerbäck, E.M.; Cuhna Soares, F.; Dahllöf, G.; Kvist, T. Association between self-reported dental fear and exposure to violence among adolescents—A population-based study. *Int. J. Paediatr. Dent.* **2022**, *32*, 812–818. [[CrossRef](#)]
34. Haraldsson, J.; Pingel, R.; Nordgren, L.; Tindberg, Y.; Kristiansson, P. Understanding adolescent males' poor mental health and health-compromising behaviours: A factor analysis model on Swedish school-based data. *Scand. J. Public Health* **2022**, *50*, 232–244. [[CrossRef](#)] [[PubMed](#)]
35. American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-5-TR. *Lancet* **2011**, *377*, 1162–1174.
36. Hjern, A.; Arat, A.; Vinnerljung, B. Att Växa Upp Med Föräldrar Som Har Missbruksproblem Eller Psykisk Sjukdom—Hur Ser Livet ut i Ung Vuxen Ålder? Available online: [https://anoriga.se/globalassets/media/dokument/barn-som-anorig/rapporter-och-publikationer/rapporter/bsa\\_chess-4\\_webbny.pdf](https://anoriga.se/globalassets/media/dokument/barn-som-anorig/rapporter-och-publikationer/rapporter/bsa_chess-4_webbny.pdf) (accessed on 16 February 2023).
37. Hjern, A.; Manhica, H. Barn Som Anhöriga till Patienter i Vården—Hur Många är de? Available online: [https://anoriga.se/globalassets/media/dokument/barn-som-anorig/rapporter-och-publikationer/rapporter/nka\\_rapport\\_barn\\_som\\_anoriga\\_2013-1.pdf](https://anoriga.se/globalassets/media/dokument/barn-som-anorig/rapporter-och-publikationer/rapporter/nka_rapport_barn_som_anoriga_2013-1.pdf) (accessed on 30 August 2023).
38. Smith, G.L.; McGuinness, T.M. Adolescent Psychosocial Assessment: The HEEADSSS. *J. Psychosoc. Nurs. Ment. Health Serv.* **2017**, *55*, 24–27. [[CrossRef](#)] [[PubMed](#)]
39. Haraldsson, J.; Pingel, R.; Nordgren, L.; Johnsson, L.; Kristiansson, P.; Tindberg, Y. Confidentiality matters! Adolescent males' views of primary care in relation to psychosocial health: A structural equation modelling approach. *Scand. J. Prim. Health Care* **2022**, *40*, 438–449. [[CrossRef](#)]
40. Marshall, S.; Fearnley, R.; Bristowe, K.; Harding, R. The perspectives of children and young people affected by parental life-limiting illness: An integrative review and thematic synthesis. *Palliat. Med.* **2021**, *35*, 246–260. [[CrossRef](#)]
41. Rowe, S.; French, R.; Henderson, C.; Henderson, D.; Slade, M.; Moran, P. Help-seeking behaviour and adolescent self-harm: A systematic review. *Aust. N. Z. J. Psychiatry* **2014**, *48*, 1083–1095. [[CrossRef](#)] [[PubMed](#)]

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.