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Risk factors for deliberate self-harm in young people in rural Sri Lanka: a prospective cohort study of 22,000 individuals

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(Index words: deliberate self-harm, Sri Lanka, youth, adolescent, self-harm, risk)

Abstract

Background: Over 90% of youth suicide deaths occur in low- and middle-income countries. Despite this relatively little is known about risk factors in this context.

Aims: Investigate risk factors for deliberate self-harm (non-fatal) in young people in rural Sri Lanka.

Methods: A prospective cohort study of 22,401 individuals aged 12-18 years with complete data on sex, student status, household asset score, household access to pesticides and household problematic alcohol use. Deliberate self-harm was measured prospectively by reviewing hospital records. Poisson regression estimated incidence rate ratios (IRRs) for the association of risk factors with deliberate self-harm.

Results: Females were at higher risk of deliberate self-harm compared to males (IRR 2.05; 95% CI 1.75-2.40). Lower asset scores (low compared to high: IRR 1.46, 95% CI 1.12-2.00) and having left education (IRR 1.61 95% CI 1.31-1.98) were associated with higher risks of deliberate self-harm, with evidence that the effect of not being in school was more pronounced in males (IRR 1.94; 95% CI 1.40-2.70) than females. There was no evidence of an association between household pesticide access and deliberate self-harm risk, but problematic household alcohol use was associated with increased risk (IRR 1.23; 95% CI 1.04-1.45), with evidence that this was more pronounced in females than males (IRR for

females 1.42; 95% CI 1.17-1.72). There was no evidence of deliberate self-harm risk being higher at times of school exam stress.

Conclusion: Indicators of lower socioeconomic status, not being in school, and problematic alcohol use in households, were associated with increased deliberate self-harm risk in young people.

Background

Suicide is the second and third leading cause of deaths globally in young (aged 10-24 years) females and males respectively [1]. Most adolescents who die by suicide (90%) are from low and middle income countries (LMICs) – these countries are also where 90% of all adolescents live [2]. Despite this burden, relatively little is known about deliberate self-harm amongst youth in LMICs.

Sri Lanka historically had one of the highest suicide rates in the world- with particularly high rates in young people [3,4]. High rates of deliberate self-harm among adolescents in Sri Lanka may be attributed to a combination of social issues including family problems, financial hardships interpersonal difficulties [4], and a widespread view that self-harm is a socially acceptable means of dealing with difficulty [4].

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With the introduction of national pesticide regulations, the pattern of deliberate self-harm in Sri Lanka has changed, with a significant reduction in both overall and youth deliberate self-harm. However, while case fatality of pesticide self-poisoning has reduced, there has been a concurrent rise in the number of adolescents and young people engaging in deliberate self-harm [5,6].

Using a cohort study design, we aimed to investigate the association between different socioeconomic and household factors with deliberate self-harm in young people (12-18 years old) in rural Sri Lanka. We also explored whether any associations observed differed by sex, and whether there was any evidence that deliberate self-harm was higher in young people around school exam periods.

Method

Setting

Sri Lanka is a middle-income country neighbouring India. Of 21.4 million inhabitants [7], 77% live in rural areas and 33% are below age 19 years old [8].

Participants

Individuals aged 12-18 years at the initial baseline survey were included in this prospective cohort study; young people reporting a history of attempted suicide in the baseline survey were excluded (n=223; 1%) to allow incidence rates to be estimated. This age range represents high-school aged young people in Sri Lanka and captures the ages at which national exams are taken, the pubertal developmental phase – a time of social, emotional and physical transition, and includes mid-adolescence - a period of vulnerability and higher prevalence of suicidal behavior and self-harm [9,10].

Data collection

This prospective cohort study used data from a large community-based cluster randomized controlled trial (RCT) investigating effectiveness of lockable pesticide storage boxes in reducing pesticide-related self-poisoning in Sri Lanka [3,11]. The trial was carried out in the Anuradhapura district between 2010 and 2016 [3]. Baseline demographic data and household characteristics [3] were collected via a questionnaire-based census. Data were collected on all incident cases of deliberate self-harm occurring in the study area and presenting to hospital (11 small peripheral hospitals and 2 larger referral hospitals) [11]. We linked records of patients who presented at the peripheral hospital and were transferred to a referral hospital. For this analysis, the outcome was intentional self-poisoning or self-injury, regardless of suicidal intent. Only deliberate self-harm cases from residents within the study boundary of the cluster randomized trial were included in this analysis. Follow up of study participants was carried out for a minimum of 3 and maximum of 5 years [12]. We only included deliberate self-harm that could be

matched back to an individual in the baseline dataset (82% of all cases identified in hospital were linked). Details of the baseline survey and surveillance system have been previously described [3,11].

Dataset

Information on sex, student status, asset score, household access to pesticides, household problem alcohol use and a history of attempted suicide for baseline study participants was obtained at study enrolment. Data were collected on household characteristics and members.

Household problem alcohol use was elicited in the baseline survey by asking participants if a household occupant consumed alcohol and if consumption was 'problematic'. If respondents reported yes to both questions, households were considered to have 'problem' alcohol use [12]. Composite household asset score is a measure of socioeconomic position and was derived by combining data on household construction and household ownership of a motorized vehicle. Factors were combined to obtain three levels; high, middle and low, using methods previously described [12]. Household access to pesticides was defined as either storing pesticides within the home, home compound or using pesticides, a factor found in other studies to increase the likelihood of deliberate self-harm [13,14].

Data analysis

Stata 16 was used for statistical analyses (StataCorp, College Station, Texas, US). When there were repeat attempts, only the earliest attempt was retained in the dataset and the individual's follow-up censored at that time point. We fitted mixed-effects Poisson regression models accounting for clustering at the household level. The variable amount of time individuals spent in the residential address in the study area was incorporated into the regression model [11]. In this model, reference categories were those anticipated to be the lowest risk groups: high asset score and being a student. Associations were estimated as incidence rate ratios (IRRs) and sex-stratified IRRs, adjusted for age at baseline survey, intervention group and sex. Evidence of a difference in the strength of association between deliberate self-harm and a risk factor, for males and females, was quantified by an interaction test p-value. All p-values were calculated using likelihood ratio tests.

Exam stress has been indicated as a potential trigger for deliberate self-harm in young people in Sri Lanka [15]. Given the local concern, we graphically explored the monthly variation in deliberate self-harm for students in different school years. For each student incident of deliberate self-harm, we determined the school year from their date of birth. We present the number of student deliberate self-harm incidents by the 12 months corresponding to each academic year in Sri Lanka (year

10-13) and additionally the interim 6-month period when students are either sitting or awaiting results. We have attempted to highlight when examinations are taken, time awaiting results and finally when schools restart for the academic year.

Results

The study population consisted of 22,689 individuals aged 12-18 years at enrolment, and a further 65 individuals (0.29%) were excluded due to missing data on at least one of the variables analyzed. Of the remaining 22,401 individuals, 752 young people engaged in deliberate self-harm over an average follow-up period of four years, with a rate of 9.2 per 1000 person-years (95% CI 8.5 - 9.9). The deliberate self-harm rate was higher in females (12.4 per 1000 person-years (95% CI 11.2 -13.5) than males (6.2 per 1000 person-years (95% CI 5.5-7.0). Rate of deliberate self-harm increased with age at enrolment in males, whereas female rates were highest in those aged 14 years at baseline (Figure 1).

Table 1 presents the deliberate self-harm risks for each level of the risk factors investigated. In this cohort of 12 to 18-year olds, females and those who had left school at any stage prior to study enrolment were at increased risk of deliberate self-harm. Of the household characteristics, lower asset score (IRR low compared to

high asset score 1.50; 95% CI 1.12 - 2.00) and living in a household with problematic alcohol use (IRR 1.22; 95% CI 1.02 - 1.45) were associated with increased risk. There was no statistical evidence of an association between household pesticide access and risk of deliberate self-harm (IRR 0.98; 95% CI 0.80-1.20).

Table 2 presents deliberate self-harm risks for each level of the risk factors, stratified by male and female cohort members. While increased risk of deliberate self-harm was found for both males and females no longer at school, this association was stronger for males than females (p-value for interaction = 0.01). We found no convincing evidence of a difference between males and females in the associations between the rate of deliberate self-harm and household asset score (p-value for interaction = 0.30), and access to pesticides (p-value for interaction = 0.76). There was evidence that living in a household with problematic alcohol use was a risk factor for deliberate self-harm in females (IRR 1.42; 95% CI 1.17 - 1.72) but not males (IRR 0.92; 95% CI 0.68 - 1.23; p-value for interaction =0.01).

Figure 2 presents deliberate self-harm recorded during the three-year follow-up of the trial for students by grade. There was no clear evidence that the O-level and A-level exam timetable was associated with deliberate self-harm in young people.

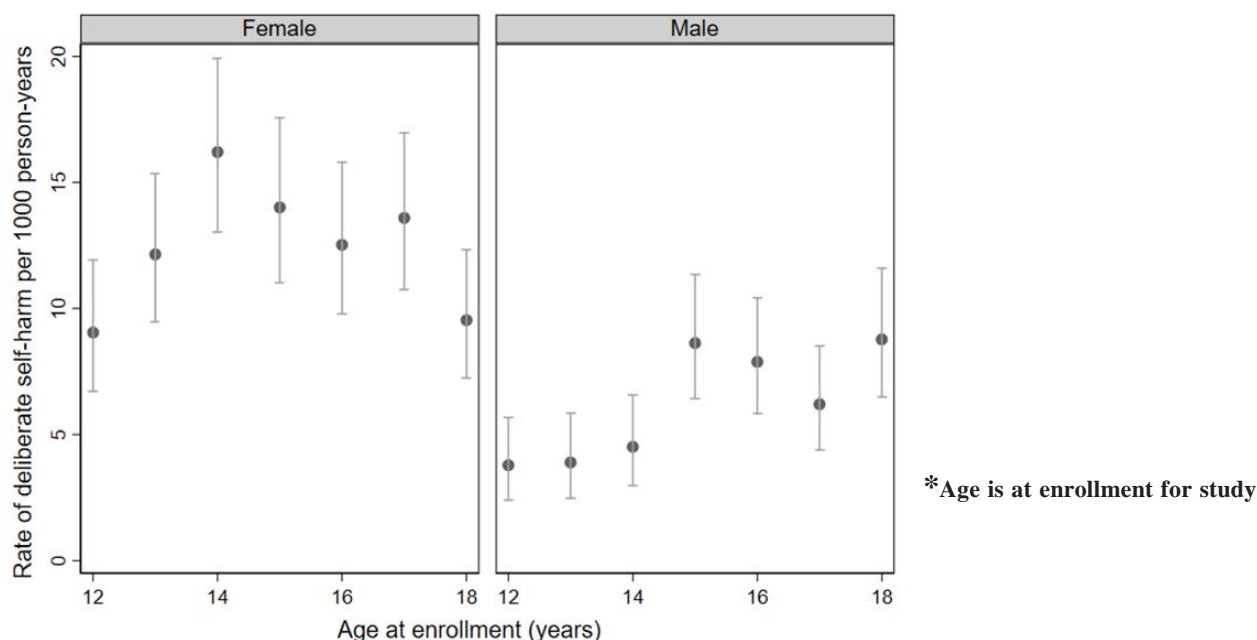


Figure 1. Rate of deliberate self-harm in females and males.

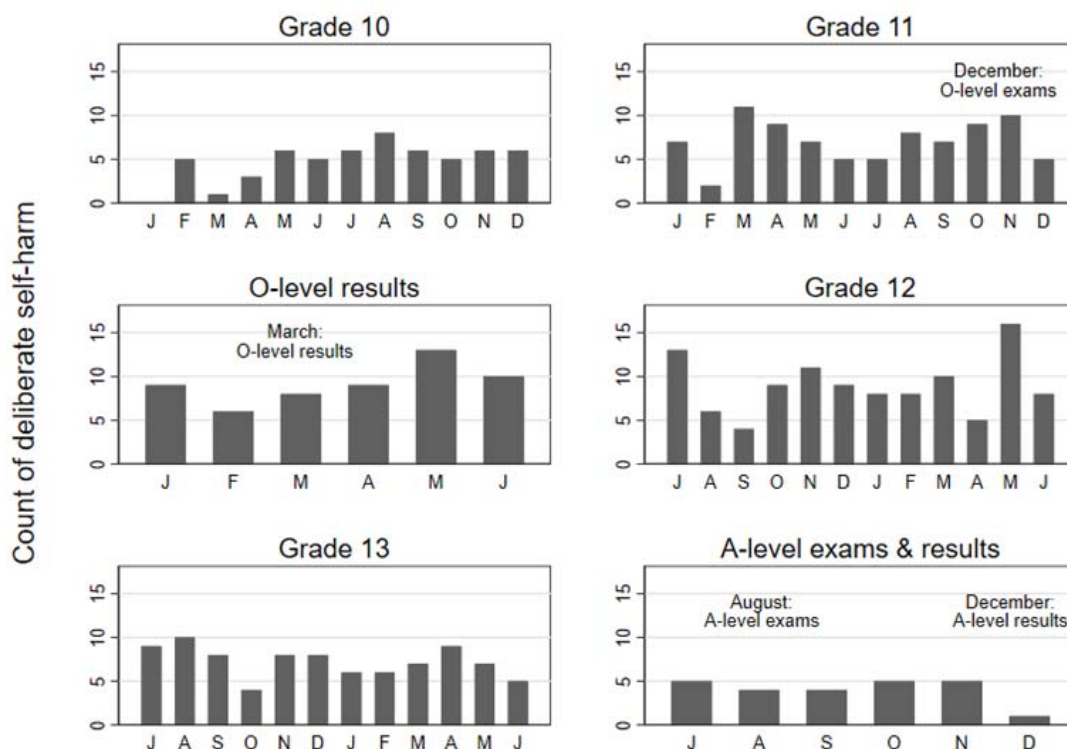


Figure 2. 417 deliberate self-harm episodes in 16,299 students
 * by grade and month (determined by date of episode)

* 45 deliberate self-harm incidents amongst were excluded for 1555 students with missing date of birth

Figure 2 is structured according to school years and the intervals in between examinations

Table 1. Overall associations of individual risk factors with hospital admissions for deliberate self-harm

Individual-level risk factors	Deliberate self-harm n/N (%)	IRR1 (95% CI)	p value
Overall	752/22401 (3.36)		
Male	260/11494 (2.26)		
Female	492/10907 (4.51)	2.05 (1.75, 2.40)	p < 0.001
Student status			
Student	570/17854 (3.19)	1.00	
Left school	182/4547 (4.00)	1.61 (1.31 - 1.98)	p < 0.001
Household-level risk factors			
Asset score			
High	394/13637 (2.89)	1.00	
Middle	296/7225 (4.10)	1.47 (1.25 - 1.72)	
Low	62/1539 (4.03)	1.50 (1.12 - 2.00)	p < 0.001
No access to pesticides	152/4354 (3.49)	1.00	
Access to pesticides	600/18047 (3.32)	0.96 (0.79 - 1.16)	p = 0.64
No alcohol problem	514/16201 (3.17)	1.00	
Alcohol problem	238/6200 (3.84)	1.23 (1.04 - 1.45)	p = 0.01

1. Incidence rate ratio (95% confidence interval) adjusted for age, sex and study intervention. P-values test the null hypothesis of equal population incidence of deliberate self-harm across levels of the risk factor.

Table 2. Sex-stratified associations of individual risk factors with hospital admissions for deliberate self-harm

Individual-level risk factors	Female		Male		p value for interaction ²
	Deliberate self-harm	IRR ¹ (95% CI)	Attempted n/N (%)	IRR ¹ (95% CI) suicide n/N (%)	
Overall	492/10907 (4.51)		260/11494 (2.26)		
Student status					
Student	396/8852 (4.72)	1.00	174/9002 (1.93)	1.00	
Left school	96/2055 (4.67)	1.40 (1.07-1.82)	86/2492 (3.45)	1.94 (1.40-2.70)	p < 0.001
Household-level risk factors					
Asset score					
High	247/6546 (3.77)	1.00	147/7091 (2.07)	1.00	
Middle	199/3600 (5.53)	1.53 (1.26-1.86)	97/3625 (2.68)	1.34 (1.02-1.76)	
Low	46/761 (6.04)	1.75 (1.26-2.44)	16/778 (2.06)	1.11 (0.64-1.90)	p=0.11
No access to pesticides	102/2165 (4.71)	1.00	50/2189 (2.28)		
Access to pesticides	390/8742 (4.46)	0.93 (0.74-1.17)	210/9305 (2.26)	0.98 (0.71-1.36)	p=0.91
No alcohol problem	321/7867 (4.08)	1.00	193/8334 (2.32)		
Alcohol problem	171/3040 (5.63)	1.42 (1.17-1.72)	67/3160 (2.12)	0.92 (0.68-1.23)	p=0.55

¹ Incidence rate ratio (95% confidence interval) adjusted for age, sex and study intervention. P-values test the null hypothesis of equal population incidence of **deliberate self-harm** across levels of the risk factor.

² P-values for interaction test the null hypothesis of equal association of the risk factor and incidence of deliberate self-harm between males and females in the population.

Discussion

Main findings

We have studied risk factors for deliberate self-harm in a large cohort of 12 to 18-year olds living in rural north central Sri Lanka. In this age group, factors associated with a higher rate of deliberate self-harm were being female, no longer being in education, living in a household with fewer assets, and sharing a household with an individual with problematic alcohol consumption. There was evidence that the association between no longer being in school and higher risk of deliberate self-harm was stronger in males, whilst there was a stronger association between living in a household where at least one resident was perceived as having problem alcohol use and a higher risk of deliberate self-harm in females. We found no clear correlation between deliberate self-harm and exam related stress in Sri Lankan students, though we appreciate that a study focused on school pupils with a history of mental illness may have different findings.

Comparison to other studies

Higher prevalence of deliberate self-harm amongst young females compared to males was observed, similar to findings from cross-sectional surveys of school children in China, Malaysia and India, [16,17,18]. Exploring female suicidal behavior in Sri Lanka, Marecek [19] describes specific crises involving interpersonal relationships, school failures and family conflicts as propagating self-harming behaviour in young girls. Parental control, restriction and surveillance concerning privacy, self-determination and freedom of movement affect young girls in Sri Lanka [20]. Often these struggles were linked to parents' standards of female sexual propriety, and cultural standards for women [19]. With stereotypical gender roles, younger females have fewer socially acceptable ways of expressing their emotions of unhappiness or anger, in a largely hierarchical culture where overt confrontation is disapproved of and stigmatized [21]. Higher rates amongst young females may be explained by Marecek and Senadheera [20] finding young women using self-harm (regardless of suicidal intent) to communicate what they find difficult to verbalise. Termed "dialogue suicides" these acts were expressive, directed and intended as communication. Though the rate of attempted suicide is also high amongst young women in high-income countries, Marecek and Senadheera found that the nature of attempted suicide as "dialogue", communicative acts often with limited association with mental illness.

Lower socioeconomic status is associated with increased risk of suicidal behaviours in young people [22,23]. Similar to findings in this study, a study of youth in Vietnam, China and Taiwan used an equivalent composite measurement of assets to determine that in some regions, lower wealth quintiles were associated with higher risk of suicide attempts [24]. A Bangladeshi study, although not exclusively investigating youth, also used a composite

asset measurement to show that those in lower socioeconomic groups were at a higher risk of attempted suicide [25].

The association between education and deliberate self-harm is a widely documented phenomenon. The strength of association between the level of education and risk of deliberate self-harm was stronger for males than females in our study (p-value for interaction = 0.01). Lower education levels associated with higher risk of attempted suicide was identified in another study based in Sri Lanka [26]. In the present study, we compared those enrolled in school at any stage at the time of the survey with those who were not. Although we are unaware of the final educational level of our participants, non-student participants, especially males, were at higher risk of attempted suicide than current students. School is central to most young people, providing a sense of community and connectedness [27,28]. A descriptive study of routinely collected data in Brazil [29] found young people with limited or no schooling had a higher risk of suicide. In Sri Lanka, it may be that intergenerational cycling of poverty and limited household assets limits incentive and capacity to invest in education [30]. Young people considered to be "drifting", neither attending school nor work, have a higher risk of suicide due to poor structure and instability [31].

Lack of association between household pesticide access and deliberate self-harm is contrary to previous evidence, e.g. a case-control study which identified pesticide access as a statistically significant risk factor for suicide [32]. This may be an artefact of most participants (80%) living in households with access to pesticides, such that there were inadequate numbers of unexposed individuals to find a difference.

Problematic alcohol use in the household was associated with increased risk of deliberate self-harm in this study, with this relationship more pronounced in females. Gupta and colleagues in a cross-sectional study found hazardous drinking in male household residents increased the proportion of co-habiting women responding "yes" to the question "Did you ever attempt to commit suicide in the past 1 year?" [33]. Father or husband alcohol misuse is a predisposing factor for attempted suicide in co-habiting women in Sri Lanka [34,35], and is often associated with intimate partner violence [14]. A 2018 United Nations Population Fund (UNFPA) report in Sri Lanka reported more than one-third of female deaths, including suicides, were attributed to intimate partner violence [36].

Strengths and limitations

To the best of our knowledge, this is the first prospective study of the general population in Sri Lanka focusing on the extent and risk factors for deliberate self-harm in young people. The study is representative, with 95% of approached households consenting to partici-

pation. An average three years' follow up was carried out at all hospitals (peripheral, secondary and tertiary level) in the Anuradhapura district.

There are, however, limitations to this study that need to be considered. Firstly, only episodes of deliberate self-harm resulting in admission to hospital were included. It is noteworthy that some instances of deliberate self-harm may not result in hospital presentation; however, an end-of-study audit found very few cases of self-poisoning (the most common method of self-harm) not requiring presentation to hospital reported by participants [37]. Secondly, we were restricted in our analysis to risk factors measured by the baseline survey. As this survey did not contain information on factors such as mental illness and intimate partner violence (not a primary focus of the original study), we were unable to explore whether these factors were associated with risk of deliberate self-harm in young people. Thirdly, limited data were collected regarding the details of the deliberate self-harm admission to hospital. We were, therefore, unable to assess the prevalence of psychiatric morbidity in presenting cases, and whether the demographic measures differed by suicidal intent. Finally, problematic alcohol use was assessed using a single question and not a validated questionnaire. It was also recorded at the household level and relied on the household respondent to both recognize and report the problematic alcohol use.

Conclusion and recommendations

The study showed that being female, having left school at any stage, prior to age 18, lower household asset score and household problem alcohol use were associated with an elevated risk of deliberate self-harm in young people. Key prevention strategies can be population based (e.g. media coverage, limiting access to means of suicide), while targeting high risk subgroups through specific programmes to keep children in school (e.g. a modest grant for those studying for A-Levels) or apprenticeship programmes for those keen to start earning, and providing crisis hotlines and online help [32]. Some of these strategies are in the process of being established and evaluation will be important to ensure they are effective. Problem alcohol use [38], more prevalent in male household members, affects both males and females and needs to be addressed by national suicide and violence prevention policies. These findings shed light on context-specific risk to young people in Sri Lanka and may have implications on the current national suicide-prevention policy and could potentially assist policy development elsewhere in South Asia.

Author contributions

KF, CM and DK designed the study and planned the analysis. DK, MP, SJ, KH, DG, CM, FK, CP, MW and ME were involved in acquisition of data. KF conducted the analysis under the supervision of DK and CM. KF, CM

and DK drafted the manuscript and all authors were involved in critical revision.

Conflicts of interest

The authors declare no relevant conflicts of interests. Authors DK and KF had full access to all data in this study and take complete responsibility for the integrity of the data and the accuracy of the data analysis.

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Ethics approval

Ethical approval was received from the research ethics committees of the University of Peradeniya and Rajarata University of Sri Lanka. This trial was registered with ClinicalTrials.gov, number NCT1146496.

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Data sharing

Data are available upon request.

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