Addictive Behaviors 106 (2020) 106365

Contents lists available at ScienceDirect

Addictive Behaviors

journal homepage: www.elsevier.com/locate/addictbeh

Child maltreatment and substance-use-related negative consequences: Longitudinal trajectories from early to mid adolescence

Johan Melander Hagborg*, Valgeir Thorvaldsson, Claudia Fahlke

Department of Psychology, University of Gothenburg, Box 500, 40530 Gothenburg, Sweden

HIGHLIGHTS

- Child maltreatment is associated with higher levels of substance use related negative consequences (SURNCs).
- Maltreated adolescents use more alcohol and substances compared to their peers.
- Alcohol and substance use partly mediate the relationship between maltreatment and SURNCs.

ARTICLE INFO

Keywords:
Child maltreatment
Child abuse
Alcohol
Substance use
Adolescence
Illicit drugs

ABSTRACT

Background: Child maltreatment is associated with adult substance use disorders (i.e. alcohol and/or illicit drug use). Little is known about the behavioral pathways characterizing adolescent substance users who were subjected to childhood maltreatment. Here, we investigate the longitudinal trajectories of substance-use–related negative consequences (SURNCs) in adolescence in relation to childhood maltreatment.

Method: We drew the data (N = 1515) from the longitudinal multidisciplinary research program LoRDIA (Longitudinal Research on Development In Adolescence), of which 406 reported substance use and were included in the presented analyses. The data were collected via self-report questionnaires in classroom settings at three time points (mean age: 13.5, 14.4 and 15.0). We obtained information for childhood maltreatment using the Childhood Trauma Questionnaire-Short Form (CTQ-SF) and data of frequencies of SURNC with a questionnaire scale.

Results: Estimates from zero-inflated Poisson growth curve model revealed no baseline differences in SURNCs across children reporting none, single, or multiple maltreatment before the age of twelve. However, children experiencing multiple maltreatment displayed a greater increase in the frequency of SURNCs during the transition from early to mid adolescence than did those reporting no maltreatment. These estimates were only partly influenced by the inclusion of frequency of alcohol and substance drug use to the model.

Conclusions: These findings imply that children suffering maltreatment are at a higher risk of experiencing SURNCs, a factor known to elevate the risk of substance use disorders later in life, as they transition from early to mid adolescence.

1. Introduction

According to the World Health Organization (WHO), child maltreatment can be defined as "all forms of physical and/or emotional ill-treatment, sexual abuse, neglect or negligent treatment or commercial or other exploitation, resulting in actual or potential harm to the child's health, survival, development or dignity in the context of relationship of responsibility, trust or power" (WHO, 2016). WHO further distinguishes four types of child maltreatment: physical abuse, sexual abuse, emotional or psychological abuse, and neglect (Butchart, Harvey, Mian, & Fürniss, 2006; WHO, 2016). Regardless of the type of child maltreatment, it poses significant risks for maladaptation across the biological, social, and psychological domains of development from childhood to adulthood (Cicchetti and Toth, 2005). In a recent study of ours, about 25% of Swedish adolescents reported being subjected to at least one type of maltreatment and 10% reported having experienced two or more types of maltreatment before the age of twelve years (Hagborg, Berglund, & Fahlke, 2018). One of many risk behaviors associated with child maltreatment is substance (i.e. alcohol and/or illicit drugs) use disorders later in life (American Psychiatric Association, 2013). For example, child

* Corresponding author.
E-mail addresses: johan.hagborg@psy.gu.se (J.M. Hagborg), valgeir.thorvaldsson@psy.gu.se (V. Thorvaldsson), Claudia.fahlke@psy.gu.se (C. Fahlke).

https://doi.org/10.1016/j.addbeh.2020.106365
Received 21 May 2019; Received in revised form 21 February 2020; Accepted 24 February 2020
Available online 27 February 2020

maltreatment has been robustly linked to adult substance abuse and dependence in both treatment-seeking individuals and general populations (Afifi, Henriksen, Asmundson, & Sareen, 2012; Banducci, Hoffman, Lejuez, & Koenen, 2014; Fenton et al., 2013; Potthast, Neuner, & Catani, 2014; Tonmyr, Thornton, Draca, & Wekerle, 2010). Furthermore, a study of a severely alcohol-dependent adult population in Sweden found that just over two thirds (69.1%) of the respondents reported at least one type of severe maltreatment and almost all (94.5%) had experienced some degree of maltreatment (Lundgren, Gerdner, & Lundqvist, 2002). However, the relationship between child maltreatment and substance use is complex. Earlier findings suggest that the link between child maltreatment and subsequent problematic substance use could be moderated by, for example, personality function, mental health, affect regulation, and motives for consuming alcohol and using illicit drugs (Dembo et al., 1998; Hovdestad, Tonmyr, Wekerle, Thornton, 2011; Oshri, Rogosch, Burnette, & Cicchetti, 2011; Smith, Smith, & Grekin, 2014). Furthermore, factors related to the actual maltreatment, such as timing and repetition, have also been found to influence subsequent risk of problematic use of alcohol and illicit drugs (Beal et al., 2019; Hovdestad, Tonmyr, Wekerle, & Thornton, 2011). However, it should be noted that studies of the pathways and mechanisms through which maltreatment in childhood exacerbates the risk of later substance abuse and dependence are still scarce (Dixon, Leen-Feldner, Ham, Feldner, & Lewis, 2009; Proctor et al., 2017).

Early adolescence is a period when harmful substance use patterns usually debut (Mason et al., 2011; Tarter, Vanyukov, Kirisci, Reynolds, & Clark, 2006), enabling the identification of at-risk individuals and the exploration of possible pathways and associations between childhood maltreatment and the later onset of substance use disorders. Although most adolescents cope successfully with the specific developmental tasks that occur during this period, adolescence is a period when heightened turmoil is normative (McCrory & Viding, 2010). One well-established feature of this turmoil is increased risk taking (Steinberg, 2008), so the boundaries between normal and abnormal risk taking become less clear at this age. Therefore, identifying individuals at risk of excessive alcohol and illicit drug use in adolescence requires a thorough investigation of several aspects of possible risk behaviors. Concerning alcohol, it should be noted that recent research suggests that examining only factors such as the frequency and quantity of alcohol intake, as is common today (Grigsby, Forster, Unger, & Sussman, 2016), might not be sufficient to identify youth at later risk of alcohol abuse and dependence (Topper, Castellanos-Ryan, Mackie, & Conrod, 2011). Complementing these alcohol measures could be measures of, for example, binge drinking and age of initiation to alcohol, which have been found to better predict subsequent alcohol-related problems (Dixon et al., 2009; Griffin, Bang, & Gotvin, 2010; Shin, Edwards, & Heeren, 2009). Child maltreatment has also been robustly associated with both binge drinking and earlier onset of alcohol and illicit drug use (Hamburger, Leeb, & Swahn, 2008; Proctor et al., 2017; Shin, Miller, & Teicher, 2013). Furthermore, studies of affect-regulation variables, such as impulsivity and affect lability, have shown direct associations between these variables and problems with alcohol and illicit drugs (Simons & Carey, 2002; Simons, Carey, & Gaher, 2004). Adequate regulation of affect is shaped by a range of socialization experiences during development and is one of the main developmental skills negatively affected by child maltreatment (Heleniak, Jenness, Vander Stoep, McCauley, & McLaughlin, 2016; Oshri, Sutton, Clay-Warner, & Miller, 2015). Together, these findings indicate that measuring only the quantity of substance use might not be sufficient to identify individuals at risk of subsequent substance use problems. Moreover, risk behaviors should preferably be assessed longitudinally to identify differences between normal and abnormal trajectories.

A less researched facet of risky adolescent substance use is the negative consequences of using substances, i.e. substance-use–related negative consequences (SURNCs). SURNCs are the proximal consequences of substance use, such as getting into fights with friends or family, stealing, neglecting responsibilities, and being unable to cut down on use (Dunn, Larimer, & Neighboors, 2002; Grigsby et al., 2016). Experience of SURNCs in adolescence has also been found to be predictive of substance use and dependence in early adulthood (Dick, Aliev, Viken, Kaprio, & Rose, 2011; Lessem et al., 2006).

SURNCs can be viewed as potentially harmful sequelae of risky substance use, but also as a factor that exacerbates substance use and thus increases the risk of later abuse and dependence. For example, an individual's substance use can strain family relationships, in turn causing more stress and hence a greater likelihood of risky substance use patterns, such as drinking to reduce internal negative affective states (Cooper, 1994). This means that excess SURNCs in adolescence can lead to a heightened risk of establishing risky substance use behaviors, such as drinking to cope with increased stress early in development. This in turn can be a risk factor for later maladaptation, since adolescence is a period when many social and practical skills needed to meet the demands of adult life are practiced and developed (Cicchetti & Rogosch, 2002).

Several predictors of SURNCs that earlier research has identified have also been found to be common among adolescents experiencing multiple types of maltreatment. Examples include externalizing and internalizing symptoms, drinking to cope, eating disorders, and poor self-regulation Dunn et al., 2002; Knopik, Heath, Bucholz, Madden, & Waldron, 2009; Marmorstein, 2010; Mason et al., 2011). Furthermore, earlier studies have found links between child maltreatment and substance use-related problems among young adults (e.g. Smith et al., 2014). It is therefore possible that maltreated children will report more SURNCs in adolescence than will their non-maltreated peers. It is also worth noting that even if not measured specifically as substance use related, several items in the SURNC scale, such as self-harm and problematic relationships with family members, have earlier been associated with child maltreatment (Arens, Gaher, & Simons, 2012; Hosser, Raddatz, & Windzio, 2007). Furthermore, earlier research has found that experiencing multiple types of maltreatment exacerbates the negative effect on mental health, conduct problems, and self-regulation compared with experiencing a single type of maltreatment (Anda et al., 2002; Cicchetti & Toth, 2005; Dube, Anda, Felitti, Edwards, & Croft, 2002).

The aim of this study was to examine whether maltreated adolescents report more SURNCs than do their non-maltreated peers during the transition from early to mid adolescence. Furthermore, we also examined whether experiences of single versus multiple types of maltreatment have different impacts on SURNCs and whether substance use frequency can account for this relationship.

To understand the relationship between childhood maltreatment and later onset of substance abuse or dependence, it is necessary to investigate the impact of multiple types of maltreatment on SURNCs. The present study is, to our knowledge, the first to examine the impact of multiple types of maltreatment on SURNCs. Furthermore, it is to the best of our knowledge the first study that longitudinally investigates the relationship between maltreatment and SURNCs. In this study, we examine whether maltreated adolescents report more SURNCs than do their non-maltreated peers during the transition from early to mid adolescence. We hypothesized that: (1) experiencing more types of maltreatment before age 12 would be associated with a higher frequency of SURNCs during adolescence; (2) experiencing more types of maltreatment before age 12 would be associated with a larger increase in the frequency of SURNCs during the transition from early to mid adolescence; and (3) the associations between maltreatment and SURNCs would be captured by alcohol and substance/drug use frequency.

2. Method

2.1. Participants

Data were obtained from the 1515 children and adolescents enrolled in the ongoing Longitudinal Research on Development in Adolescence (LoRDIA) program. LoRDIA is a multidisciplinary prospective and longitudinal research program studying the developmental pathways of alcohol and drug use and mental health in a non-clinical population of Swedish adolescents aged 12–18 years. Two cohorts were followed,

starting in the 6th and 7th grades from 15 schools in four municipalities with populations of 9000–36,000 in southwest and south–central Sweden. All 6th and 7th graders in the participating municipalities were invited to participate. This meant that a total of 2108 adolescents were invited to participate in the program, of whom 318 (15%) opted out (202 on parents' decision, 116 own decision) leaving a study population of 1790. At the second wave of measurements, referred to as time-point one (T1) in this study, a total of 322 students (18% of study population) were absent from school or choose to withdraw participation at the day of the data collection. General exclusion analyses have shown that the LoRDIA study population is representative of the entire group of invited participants in terms of demographics (i.e. gender and ethnicity) and school performance (i.e. grades and attendance). Finally, 1459 (82% of the study population) in T1, 1323 (74% of the study population) in T2, and 728 (77% of the study population) in T3 submitted responses to questionnaires. The presented analyses included 1282 (T1), 1277 (T2), and 728 (T3) children who completed the SURNC and child maltreatment scales. For the purpose of the present study, only those students who reported data both on the childhood trauma questionnaire and reported substance use on at least one of the waves of measurement (n = 406) were included in the analyses.

Informed consent was obtained from the caregivers (via letter) as well as from the children on the day of the survey. It was emphasized that participation was voluntary, that collected information would remain confidential, and that participants were free to withdraw from the study at any time. The research program and data collection protocols were approved by the Regional Research Review Board in Gothenburg (No. 362-13; 2013-09-25), with further approval confirmed for Wave 2 (2014-05-20), Wave 3 (2015-09-02), and Wave 4 (2017-07-06).

2.2. Procedure

Data were collected via annual surveys using paper questionnaires administered by trained research assistants in classroom settings. To ensure confidentiality, questionnaires were assigned codes instead of student names. Before each survey, the social worker or school nurse at each school was contacted and informed of the questionnaire contents. Students were informed of possible triggering questions in the questionnaire and were encouraged to contact the social worker or school nurse if they experienced negative reactions.

Items measuring SURNCs were not included in the first wave of measurements, so data from the second, third, and fourth waves of measurements were used in this study. Two cohorts were followed. In the second wave (T1 in this study), students were in 7th or 8th grade (n = 1282, mean age 13.4 years), and in the third wave (T2), they were in 8th or 9th grade (n = 1277, mean age 14.3 years). In the fourth wave (T3), only the younger of the two cohorts was examined, and students in this wave were all in the 9th grade (n = 728, mean age 15.0 years). The research program and data collection details were approved by the Regional Research Review Board in Gothenburg (No. 362-13; 2013-09-25), with further approval confirmed for Wave 2 (2014-05-20) and Wave 3 (2015-09-02). For an extensive description of the LoRDIA program design and study population, see Boson, Berglund, Wennberg, and Fahlke (2016).

3. Measures

3.1. Child maltreatment

The Swedish version of the Childhood Trauma Questionnaire—Short Form (CTQ-SF; Bernstein et al., 2003) was used to measure experiences of childhood maltreatment. CTQ-SF is a retrospective self-rating scale designed to identify childhood abuse and neglect in teenagers and adults (Bernstein & Fink, 1998). Items of the CTQ are rated on a five-point, Likert-type scale with response options ranging from (1) never true to (5) very often true. The CTQ-SF has five subscales, i.e., physical abuse (α = 79), sexual abuse (α = 0.79), emotional abuse (α = 0.69), physical neglect (α = 0.79), and emotional neglect (α = 0.85), all of which have been empirically verified (Bernstein, Ahluvalia, Pogge, & Handelsman, 1997). The Swedish version of the CTQ-SF has the same construct validity and internal consistency as the original (Gerdner & Allgulander, 2009).

For this study, an extra item was added that measured witnessing domestic violence. This item was formulated as: "When I was growing up, I witnessed violence between adults in my home". The six child maltreatment categories were dichotomized. If a respondent reported scores above the cut-off, as described by Bernstein and Fink (1998), for any level of physical abuse, sexual abuse, or witnessing domestic violence, she/he was coded as having been exposed. For emotional abuse and emotional/physical neglect, only those adolescents reporting severe levels of maltreatment were coded as being exposed.

3.2. Frequency of alcohol use and use of illicit drugs

The questionnaire in the LoRDIA program contains one item measuring the frequency of alcohol use during the past twelve months: "Have you drunk alcohol (more than just a sip) during the past year?" The response options were: (0) no, (1) once in the past year, (2) several times in the past year, (3) once a month, (4) a few times a month, and (5) once a week.

Two items were used to measure use of illicit drugs: (1) "Have you ever used hash, marijuana, spice, or other cannabis drugs?" and (2) "Have you used any other drugs?" The response options were: (1) no, (2) once in the past year, (3) several times in the past year, (4) once a month, (5) a few times a month, and (6) once a week. For the purpose of this study, an index ranging from 2 to 12 was created.

3.3. Substance-use-related negative consequences (SURNCs)

A scale containing seven items, in response to the question "Have any of the following happened when you drank alcohol or used illicit drugs during the past year?", was used to measure SURNCs. Response options were (a) I have not used any illicit drugs or alcohol during the past year; (b) got into a fight, verbally or physically; (c) harmed yourself or someone else; (d) lost money or other valuables; (e) destroyed things or clothes; (f) had problems in relationships with friends or family; and (g) had unwanted sex (that I regretted afterwards). The response options were: (1) no, (2) once, or (3) twice or more. The SURNC index was created in such a manner that those children who did not report alcohol/substance use were excluded from analyses. Students that report alcohol/substance use but no subject related negative consequences were coded 0, those that report alcohol/substance use and one negative consequence were coded 1 those that reported two negative consequence were coded 2 and so forth, the highest number of negative consequences was twelve.

3.4. Perceived family economic status

Perceived family economic status was measured via an index created using two questions. The first question was "How is your family's economic status compared with that of others where you live"? The response options were: (1) we have less money than other families; (2) we have just as much money as other families; and (3) we have more money than other families. The second question was "If you compare yourself with the others in your class, do you have less or more money to buy things with"? The response options were: (1) I have less money than other kids in my class; (2) I have just as much money as other kids in my class; and (3) I have more money than other kids in my class.

4. Data analysis

Given the hierarchical data structure with repeated measurements nested within children, and a positively skewed discrete count outcome variable with an excessive zero frequency (i.e., as many of the children

report no SURNC), we fitted two multilevel zero-inflated Poisson regression models. These models are essentially comparable to the more commonly used multilevel linear models, except for a link function in the form of a mixture distribution consisting of a Poisson part, modeling the count frequency, and a logistic part, modeling the excess zeros (for a detailed description of these models, see e.g. Lessem et al., 2006). In Model 1, as fixed effects, we included time (implied by the wave-1 data) as a level-1 covariate, child maltreatment as a level-2 factor (using no maltreatment as a reference group), and the interaction of time and maltreatment as a cross-level interaction. The model specification was identical for both the Poisson and logistic parts of the model. The random effects were modeled as intercept only. In Model 2, we added family economic status, alcohol use frequency, and substance/drug use frequency as mean-centered level-1 covariates to both parts of the models. We derived parameters using maximum likelihood estimation, as implemented using the glmTMB (Brooks et al., 2017) package in R. Missing data were handled through the estimation procedure, under the missing-at-random assumption as conventionally defined.

5. Results

The frequency distribution for the outcome SURNC variable as stratified by childhood maltreatment and data waves is presented in Table 1, and descriptive statistics for the covariates used in the analyses are presented in Table 2. Parameter estimates as derived from the two zero-inflated Poisson growth curve models are shown in Table 1A (estimates from the logistic part of the models are shown in Appendix). The childhood maltreatment groups were relatively equal in age during the investigations, but the children who reported one type or multiple types of maltreatment tended to report lower family economic status and higher frequency of alcohol and drug use. 295 students contributed with data at one point of measurement, 101 students at two points of measurement and 10 students contributed to all three points of measurement.

Parameter estimates as derived from the two zero-inflated Poisson growth curve models are shown in Table 3. Estimates reported under Model 1 imply that the expected SURNC frequency among children reporting no maltreatment was 1.97. The expected baseline value for the children reporting either a single or a multiple maltreatment diverged only minor from this value (i.e., by a factor of 1.20 and 0.99, respectively). The expected frequency of SURNC for the children reporting no maltreatment was relatively stable over time but increased among the single and multiple maltreatment groups. This increase in the frequency of SURNC over time was particularly evident among the children reporting multiple maltreatments, where the expected frequency was 1.93 at wave 1 but increased to 4.95 at wave 3. The expected frequency of SURNC across the three data waves for each of the maltreatment groups are plotted in the Figure. Accounting for family economy and frequency of alcohol and substance drug usage (see Model 2) led to only minor reduction in the associations between maltreatment and SURNC. Higher family economy was associated with lower frequency of SURNC but both frequency of alcohol and substance drug usage were associated with higher frequency of SURNC.

6. Discussion

This study is, to our knowledge, the first to examine the association between experiencing multiple types of maltreatment and changes in SURNCs from early to mid adolescence. The findings suggest that experiencing multiple types of childhood maltreatment is associated with substantially increased risk of SURNCs in adolescence. At baseline, there were only minor group differences but over the years, the students in the multiple maltreated group reported substantially higher increase in the frequency of SURNC as compared to students reporting none maltreatment (Fig. 1).

The findings were in line with our first and second hypotheses, since reporting multiple types of maltreatment was associated with both higher levels of later SURNCs and a relatively greater increase in the frequency of SURNCs over time. Our third hypothesis was not confirmed, as controlling for alcohol and substance use frequency only had minor impact on the strength of the association between child maltreatment and SURNC. Our evidence indicate, as expected, that both frequency of alcohol consumption and substance use are associated with increased frequency of SURNCs, but these variables influence the association between childhood maltreatment and SURNCs only to a small degree.

Many factors known to be overrepresented among maltreated adolescents have also been identified as risk factors for SURNCs. Examples include externalizing and internalizing problems, eating disorders, conduct problems, problems with emotion differentiation, alexithymia, and drinking to cope, all of which have been found to be predictors of SURNCs. These variables have also been found to be more common among maltreated adolescents than their non-maltreated peers (Mason et al., 2011; Marmorstein, 2010). It could therefore be possible that mental health problems, eating disorders, conduct problems, and drinking to cope are factors linking child maltreatment to SURNCs. These factors should be tested as potential moderators of the relationship between child maltreatment and SURNCs in future research.

Multiple experiences of child maltreatment have been associated with subsequent revictimization in adolescence as well as with poorer emotion regulation and stress control (Cicchetti & Toth, 2005). It is therefore likely that maltreated adolescents both suffer more stressful events and lack adequate strategies and support to resolve them adaptively. Multiple-maltreated adolescents might therefore not only drink alcohol or use illicit drugs more frequently than do others but might also adopt a

Table 1
Frequency distribution for the substance-use-related negative consequence (SURNC) variable in the LoRDIA study (n = 406).

	Childhood maltreatment								
	Time 1			Time 2			Time 3		
SURNC	None	Single	Multiple	None	Single	Multiple	None	Single	Multiple
0	69	27	19	82	29	11	45	15	7
1	14	4	4	20	7	2	18	1	1
2	14	3	3	11	2	4	9	0	1
3	2	4	1	10	3	5	1	1	1
4	3	1	1	3	2	2	2	2	2
5	5	4	1	3	2	1	1	0	0
6	1	2	0	2	3	5	3	2	2
7	2	0	1	1	0	2	0	0	0
8	3	0	0	0	0	0	1	0	2
9	1	0	0	1	2	1	0	0	1
10	0	0	0	1	0	1	0	0	0
11	0	0	0	1	0	0	0	0	0
12	0	0	0	0	0	0	0	0	1

Table 2
Descriptive statistics for the covariates used in the analyses.

Variable	No maltreatment			One maltreatment			Multiple types of maltreatment			
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Sig.diff
Age T1	11–15	13.41	0.68	12–15	13.43	0.71	12–15	13.43	0.65	
Age T2	13–17	14.44	0.62	13–16	14.50	0.68	13–16	14.51	0.60	
Age T3	14–17	14.92	0.41	14–16	14.98	0.31	14–16	14.99	0.41	
PFE T1	2–6	4.25	0.88	2–6	4.13	0.89	2–6	3.91	1.19	*
PFE T2	2–6	4.42	0.77	2–6	4.16	0.90	2–6	3.65	1.11	*
PFE T3	2–6	4.60	1.34	2–6	4.00	1.00	2–6	3.90	1.45	
ACF T1	1–6	2.38	1.22	1–6	2.36	1.12	1–6	2.90	1.47	*
ACF T2	1–6	3.21	1.14	1–6	3.36	1.25	1–6	3.72	1.53	
ACF T3	1–6	4.60	1.14	1–6	4.00	1.73	1–6	5.00	0.000	
IDUF T1	2–7	2.13	0.82	2–5	2.15	0.54	2–9	2.61	1.88	*
IDUF T2	2–12	2.13	0.98	2–8	2.68	2.16	2–12	2.83	1.34	
IDUF T3	2–12	2.60	1.34	2–11	2.67	1.15	2–12	4.00	2.83	

PFE = Perceived family economy; ACF = Alcohol consumption frequency; IDUF = Illicit drug use frequency; * = group-difference significant at $p < .01$

Table 3
Parameter estimates from zero-inflated Poisson growth curve models evaluating associations between childhood maltreatment and frequency of substance-use–related negative consequences from early to mid-adolescence.

Parameters [a]	Model 1			Model 2		
	Est.	SE	Exp.	Est.	SE	Exp.
Fixed effects						
No maltreatment [b]	0.67***	0.15	1.97	0.59***	0.15	1.81
One type of maltreatment	0.18	0.24	1.20	0.20	0.23	1.23
Multiple types of maltreatment	–0.01	0.28	0.99	–0.06	0.26	0.94
Time × no maltreatment	–0.18¯	0.11	0.83	–0.20¯	0.10	0.82
Time × one maltreatment	0.33	0.21	1.40	0.25	0.20	1.29
Time × multiple types of maltreatment	0.65**	0.21	1.92	0.54**	0.19	1.73
Economic status				–0.17**	0.06	0.84
Alcohol consumption				0.09*	0.04	1.10
Substance use				0.09*	0.03	1.09
Random intercept	0.38			0.30		

Notes. [a] Reported estimates are from the Poisson part of the model; estimates from the logistic part of the model are shown in the Appendix. [b] No maltreatment is the reference group.
***$p < .001$; **$p < .01$; *$p < .05$; ¯$p < .10$.

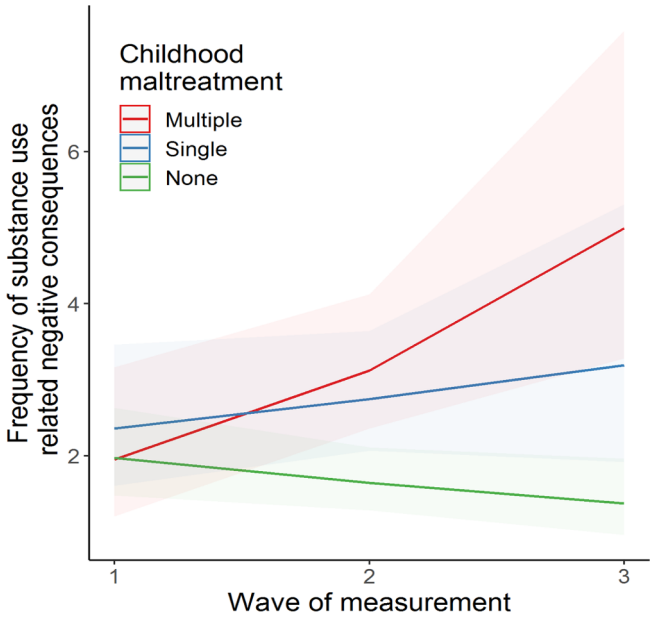

Fig. 1. Expected frequency of SURNCs over time for three groups of children differing in the frequency of reported maltreatment. The mean ages were 13.5, 14.4, and 15.0 at waves 1 to 3, respectively. Shaded areas refer to 95% confident intervals.

risky behavioral style (e.g. consumption pattern) when they use substances. Given that SURNCs pose both an immediate threat of harm to the adolescent and enhance the risk of later substance use and abuse problems, identifying variables linking maltreatment with SURNCs should be a priority for future research. Furthermore, service systems targeting substance abuse and mental health problems have traditionally been fragmented. This may lead to few teenagers with both traumatic stress and substance abuse problems receiving integrated care. It is an old myth that one should treat trauma and substance use separately, and the ideal treatment approach is to address both conditions (e.g. Giaconia, Reinherz, Paradis and Stashwick, 2003). Therefore, more training programs (e.g. Seeking Safety, see Najavits, 2003) that integrate both substance use and trauma treatment should be made available for professionals in both mental health and substance use treatment.

7. Limitations

Despite a number of strengths, including population-based representative sample and the use of prospective data, some limitations of this study are worth noting. First, the measurement of both substance use and child maltreatment relied on self-reports. Self-reports of substance use have previously been shown to be sensitive to under-reporting due to social desirability bias (Davis, Thake, & Vilhena, 2010). Self-report measures of child maltreatment generally yield higher prevalence rates compared to other sources such as community records. However, some studies has found that many substantiated cases of child maltreatment are not disclosed via self-report (Mills, Kisely, Alati, Strathearn, & Najman, 2016). Hence, both substance use and child maltreatment could be under-reported in the present study. Second, only the frequency, but not the quantity, of alcohol and illicit drug use was assessed. Quantity measures would have been valuable in order to examine possible episodes of binge drinking among adolescents. Fourth, the wordings of the items concerning economic status (SES), such as "How is your family's economic status compared with that of others where you live?" might not be optimal, since students in the same school district might have a similar economic status. Fifth, even though attrition analyses showed no differences between the LORDiA study population and those who did not participate concerning demographic variables and school performance, we cannot rule out that there were systematic differences between those who participated and those who did not concerning alcohol/substance use variables. Last, the age span examined was limited and we do not currently know which of the adolescents participating in this study will develop substance use disorders. Therefore, follow up studies are important in order to examine

whether higher levels of SURNCs among maltreated adolescents are related to subsequent substance abuse and dependence.

8. Conclusion

Our findings indicate that adolescents experiencing multiple types of maltreatment suffer more frequent SURNCs than do their less-maltreated peers. There were no differences concerning the frequency of SURNC across groups of children reporting none, single, or multiple occurrence of maltreatment at baseline (average age = 13.4). Both the single and the multiple maltreated children, on average, increased the frequency of SURNC across time. This increase in the SURNC frequency was particularly high among those children that experienced multiple maltreatment. This confirms earlier research in the maltreatment field that highlights the impact of cumulative maltreatment on negative outcomes (Anda et al., 2002; Cicchetti & Toth, 2005; Finkelhor, Ormrod & Turner, 2007).

Professionals working with maltreated adolescents should be aware of the potential increased stress of SURNCs that might be present in the adolescents' lives. Since SURNCs can be expected to increase the risk of both immediate harm and subsequent alcohol and substance use disorders, these issues should optimally be addressed in both treatment and supportive interventions. Preventive interventions need to be informative about the specific ways in which maltreatment and trauma can exacerbate the risk of destructive substance use in adolescence. Also, when intervening in an adolescent's life because of risky alcohol or illicit drug use, possible maltreatment should be assessed. Furthermore, service systems providing help for mental health and substance use have traditionally been separated and few adolescents receive integrated treatment. This may lead to few teenagers with both traumatic stress and substance abuse problems receiving integrated care. It is an old myth that one must treat trauma and substance use separately; rather, the ideal treatment approach is to address both conditions simultaneously (e.g., Giaconia, Reinherz, Paradis, & Stashwick, 2003). More training programs that integrate both substance use and trauma treatments should therefore be made available for professionals in both mental health and substance use therapy. Another way to reach out and offer support to adolescents affected by child maltreatment is by integrating knowledge of maltreatment and trauma in regular services (e.g., school, healthcare, and social services). This way of working is often called trauma-informed care. Trauma-informed care has been implemented in schools with promising results in terms of both reduced trauma symptoms among children and greater staff confidence in addressing trauma (e.g., Dorado, Martinez, McArthur, & Leibovitz, 2016). Implementing Trauma-informed care within service systems might therefor help prevent the development of negative outcomes such as problematic substance use among adolescents affected by child maltreatment.

9. Author statement

Johan Melander Hagborg designed the current study. Johan Melander Hagborg conducted the statistical analyses and wrote the manuscript. Dr. Thorvaldsson helped with the statistical analyses and editing the manuscript. Professor Fahlke is the principal investigator for the Lordia program and helped with editing the manuscript. All authors contributed to and have approved the final manuscript.

10. Specific contributions

The current study is, to our knowledge, the first to examine the impact of multiple maltreatment experiences on changes in Alcohol Related Negative Consequences (ARNCs) from early to mid-adolescence. The findings suggest that multiple types of childhood maltreatment is associated with substantially increased risk of ARNC in adolescence.

11. Role of funding sources

A major financial contribution was granted in a combined decision (No. 259–2012-25) from four Swedish research foundations: Swedish Research Council (VR); Swedish Research Council for Health, Working Life and Welfare (FORTE); Sweden's Innovation Agency (VINNOVA); and The Swedish Research Council Formas. Additional contributions were granted from Säfstaholm Foundation (No. ST-2014-023), Sunnerdahl Disability Foundation (No. 40-14), Futurum, Jönköping County (No. 2014/3821-271) and FORTE (No. 2015-0058). None of the funding bodies had any further role in: study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Table 1A
Parameter estimates from the logistic part of zero-inflated Poisson growth curve models evaluating associations of childhood maltreatment and frequency of substance use related negative consequences from early to mid-adolescence.

Parameters	Model 1			Model 2		
	Est.	SE	Exp.	Est.	SE	Exp.
No maltreatment [a]	0.13	0.21	1.13	0.47	0.24	1.59
One type of maltreatment	−0.11	0.38	0.90	−0.07	0.41	0.94
Multiple types of maltreatment	−0.13	0.46	0.88	0.01	0.48	1.01
Time × no maltreatment	−0.21	0.20	0.81	0.03	0.21	1.03
Time × one maltreatment	0.48	0.36	1.61	0.53	0.38	1.71
Time × multiple types of maltreatment	−0.34	0.46	0.71	−0.22	0.41	0.80
Economic status				–0.23~	0.13	0.79
Alcohol consumption				−0.46***	0.10	0.63
Substance use				−0.18	0.37	0.83

Notes. [a]Reported estimates are from the logisitc part of the model. Estimates form the Poisson part of the model are shown in Table 3. [b]No maltreatment is the reference group. Notes. No maltreatment is the reference group
*** p < .001; ** p < .01; *p < .05; ~ p < .10.

References

Afifi, T. O., Henriksen, C. A., Asmundson, G. J. G., & Sareen, J. (2012). Childhood maltreatment and substance use disorders among men and women in a nationally representative sample. *The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie, 57*(11), 677–686.

Anda, R. F., Whitfield, C. L., Felitti, V. J., Chapman, D., Edwards, V. J., Dube, S. R., & Williamson, D. F. (2002). Adverse childhood experiences, alcoholic parents, and later risk of alcoholism and depression. *Psychiatric Services, 53*(8), 1001–1009.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). VA: Arlington.

Arens, A. M., Gaher, R. M., & Simons, J. S. (2012). Child maltreatment and deliberate self-harm among college students: Testing mediation and moderation models for impulsivity. *American Journal of Orthopsychiatry, 82*(3), 328–337. https://doi.org/10.1111/j.1939-0025.2012.01165.x.

Banducci, A. N., Hoffman, E., Lejuez, C. W., & Koenen, K. C. (2014). The relationship between child abuse and negative outcomes among substance users: Psychopathology, health, and comorbidities. *Addictive Behaviors, 39*(10), 1522–1527. https://doi.org/10.1016/j.addbeh.2014.05.023.

Beal, S. J., Wingrove, T., Mara, C. A., Lutz, N., Noll, J. G., & Greiner, M. V. (2019). Childhood adversity and associated psychosocial function in adolescents with complex trauma. *Child & Youth Care Forum, 48*(3), 305–322. https://doi.org/10.1007/s10566-018-9479-5.

Bernstein, D. P., Ahluvalia, T., Pogge, D., & Handelsman, L. (1997). Validity of the Childhood Trauma Questionnaire in an adolescent psychiatric population. *Journal of the American Academy of Child & Adolescent Psychiatry, 36*(3), 340–348.

Bernstein, D. P., & Fink, L. (1998). *Childhood trauma questionnaire: A retrospective self-report.* Manual: Psychological Corporation.

Bernstein, D. P., Stein, J. A., Newcomb, M. D., Walker, E., Pogge, D., Ahluvalia, T., Stokes, J., Handelsman, L., Medrano, M., Desmond, D., & Zule, W. (2003). Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child Abuse & Neglect, 27*(2), 169–190.

Boson, K., Berglund, K., Wennberg, P., & Fahlke, C. (2016). Well-being, mental health problems, and alcohol experiences among young swedish adolescents: A general population study. *Journal for Person-Oriented Research, 2*, 123–134.

Brooks, M. E., Kristensen, K., van Benthem, K. J., Magnusson, A., Berg, C. W., Nielsen, A., ... Bolker, B. M. (2017). *The R Journal, 9*(2), 378–400.

Butchart, A., Harvey, H. P., Mian, M., & Fürniss, T. (2006). Preventing child maltreatment: A guide to taking action and generating evidence. Geneva, Switzerland:: World Health Organization and the International Society for Prevention of Child Abuse and Neglect.

Cicchetti, D., & Rogosch, F. A. (2002). A developmental psychopathology perspective on adolescence. *Jourand of Consulting and Clinical Psychology, 70*(1), 6–20.

Cicchetti, D., & Toth, S. L. (2005). Child maltreatment. *Annual Review of Clinical. Psychology. 1*, 409–438.

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment, 6*(2), 117.

Davis, C. G., Thake, J., & Vilhena, N. (2010). Social desirability biases in self-reported alcohol consumption and harms. *Addictive Behaviors, 35*(4), 302–311. https://doi.org/10.1016/j.addbeh.2009.11.001.

Dembo, R., Schmeidler, J., Chin Sue, C., Borden, P., Manning, D., & Rollie, M. (1998). Psychosocial, substance use, and delinquency differences among anglo, hispanic white, and african-american male youths entering a juvenile assessment center. *Substance use & Misuse, 33*(7), 1481–1510. https://doi.org/10.3109/10826089809069810.

Dick, D. M., Aliev, F., Viken, R., Kaprio, J., & Rose, R. J. (2011). Rutgers Alcohol Problem Index scores at age 18 predict alcohol dependence diagnoses 7 years later. *Alcoholism: Clinical and Experimental Research, 35*(5), 1011–1014. https://doi.org/10.1111/j.1530-0277.2010.01432.x.

Dixon, L. J., Leen-Feldner, E. W., Ham, L. S., Feldner, M. T., & Lewis, S. F. (2009). Alcohol use motives among traumatic event-exposed, treatment-seeking adolescents: Associations with posttraumatic stress. *Addictive Behaviors, 34*(12), 1065–1068. https://doi.org/10.1016/j.addbeh.2009.06.008.

Dorado, J. S., Martinez, M., McArthur, L. E., & Leibovitz, T. (2016). Healthy Environments and Response to Trauma in Schools (HEARTS): A Whole-School, Multi-level, Prevention and Intervention Program for Creating Trauma-Informed, Safe and Supportive Schools. *School Mental Health, 8*(1), 163–176.

Dube, S. R., Anda, R. F., Felitti, V. J., Edwards, V. J., & Croft, J. B. (2002). Adverse childhood experiences and personal alcohol abuse as an adult. *Addictive Behaviors, 27*(5), 713–725.

Dunn, E. C., Larimer, M. E., & Neighbors, C. (2002). Alcohol and drug-related negative consequences in college students with bulimia nervosa and binge eating disorder. *International Journal of Eating Disorders, 32*(2), 171–178. https://doi.org/10.1002/eat.10075.

Fenton, M. C., Geier, T., Keyes, K., Skodol, A. E., Grant, B. F., & Hasin, D. S. (2013). Combined role of childhood maltreatment, family history, and gender in the risk for alcohol dependence. *Psychological Medicine, 43*(5), 1045–1057. https://doi.org/10.1017/S0033291712001729.

Finkelhor, D., Ormrod, R. K., & Turner, H. A. (2007). Poly-victimization: A neglected component in child victimization. *Child Abuse & Neglect, 31*(1), 7–26. https://doi.org/10.1016/j.chiabu.2006.06.008.

Gerdner, A., & Allgulander, C. (2009). Psychometric properties of the swedish version of the childhood trauma Questionnaire—Short form (CTQ-SF). *Nordic Journal of Psychiatry, 63*(2), 160–170.

Giaconia, R. M., Reinherz, H. Z., Paradis, A. D., & Stashwick, C. K. (2003). Comorbidity of substance use disorders and posttraumatic stress disorder in adolescents. In P. Ouimette, & P. J. Brown (Eds.), Trauma and substance abuse: Causes, consequences, and treatment of comorbid disorders; trauma and substance abuse: Causes, consequences, and treatment of comorbid disorders (pp. 227-242, Chapter xiii, 315 Pages) American Psychological Association, Washington, DC.

Griffin, K. W., Bang, H., & Botvin, G. J. (2010). Age of alcohol and marijuana use onset predicts weekly substance use and related psychosocial problems during young adulthood. *Journal of Substance use, 15*(3), 174–183. https://doi.org/10.3109/14659890903013109.

Grigsby, T. J., Forster, M., Unger, J. B., & Sussman, S. (2016). Predictors of alcohol-related negative consequences in adolescents: A systematic review of the literature and implications for future research. *Journal of Adolescence, 48*, 18–35. https://doi.org/10.1016/j.adolescence.2016.01.006.

Hagborg, J. M., Berglund, K., & Fahlke, C. (2018). Evidence for a relationship between child maltreatment and absenteeism among high-school students in Sweden. *Child Abuse & Neglect, 75*, 41–49.

Hamburger, M. E., Leeb, R. T., & Swahn, M. H. (2008). Childhood maltreatment and early alcohol use among high-risk adolescents. *Journal of Studies on Alcohol and Drugs, 69*(2), 291–295. https://doi.org/10.15288/jsad.2008.69.291.

Heleniak, C., Jenness, J. L., Vander Stoep, A., McCauley, E., & McLaughlin, K. A. (2016). Childhood maltreatment exposure and disruptions in emotion regulation: A transdiagnostic pathway to adolescent internalizing and externalizing psychopathology. *Cognitive Therapy and Research, 40*(3), 394–415. https://doi.org/10.1007/s10608-015-9735-z.

Hosser, D., Raddatz, S., & Windzio, M. (2007). Child maltreatment, revictimization, and violent behavior. *Violence and Victims, 22*(3), 318–333. https://doi.org/10.1891/088667007780842829.

Hovdestad, W. E., Tonmyr, L., Wekerle, C., & Thornton, T. (2011). Why is childhood maltreatment associated with adolescent substance abuse? A critical review of explanatory models. *International Journal of Mental Health and Addiction, 9*(5), 525–542. https://doi.org/10.1007/s11469-011-9322-9.

Knopik, V., Heath, A., Bucholz, K., Madden, P., & Waldron, M. (2009). Genetic and environmental influences on externalizing behavior and alcohol problems in adolescence: A Female Twin Study: 019. *Alcoholism: Clinical & Experimental Research, 33*, 15A.

Lessem, J. M., Hopfer, C. J., Haberstick, B. C., Timberlake, D., Ehringer, M. A., Smolen, A., & Hewitt, J. K. (2006). Relationship between adolescent marijuana use and young adult illicit drug use. *Behavior Genetics, 36*(4), 498–506. https://doi.org/10.1007/s10519-006-9064-9.

Lundgren, K., Gerdner, A., & Lundqvist, L.-O. (2002). Childhood abuse and neglect in severely dependent female addicts: Homogeneity and reliability of a Swedish version of the Childhood Trauma Questionnaire. *International Journal of Social Welfare, 11*(3), 219–227. https://doi.org/10.1111/1468-2397.00219.

Marmorstein, N. R. (2010). Longitudinal associations between depressive symptoms and alcohol problems: The influence of comorbid delinquent behavior. *Addictive Behaviors, 35*(6), 564–571.

Mason, W. A., Toumbourou, J. W., Herrenkohl, T. I., Hemphill, S. A., Catalano, R. F., & Patton, G. C. (2011). Early-Age Alcohol Use and Later Alcohol Problems in Adolescents: Individual and Peer Mediators in a Bi-National Study. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors, 25*(4), 625–633. https://doi.org/10.1037/a0023320.

McCrory, E., & Viding, E. (2010). The neurobiology of maltreatment and adolescent violence. *The Lancet, 375*(9729), 1856–1857. https://doi.org/10.1016/S0140-6736(10)60842-2.

Mills, R., Kisely, S., Alati, R., Strathearn, L., & Najman, J. (2016). Self-reported and agency-notified child sexual abuse in a population-based birth cohort. *Journal of Psychiatric Research, 74*, 87–93. https://doi.org/10.1016/j.jpsychires.2015.12.021.

Najavits, L. M. (2003). Seeking safety: A new psychotherapy for posttraumatic stress disorder and substance use disorder. In P. Ouimette, & P. J. Brown (Eds.), Trauma and substance abuse: Causes, consequences, and treatment of comorbid disorders; trauma and substance abuse: Causes, consequences, and treatment of comorbid disorders (pp. 147-169, Chapter xiii, 315 Pages) American Psychological Association, Washington, DC.

Oshri, A., Rogosch, F. A., Burnette, M. L., & Cicchetti, D. (2011). Developmental pathways to adolescent cannabis abuse and dependence: Child maltreatment, emerging personality, and internalizing versus externalizing psychopathology. *Psychology of Addictive Behaviors, 25*(4), 634–644. https://doi.org/10.1037/a0023151.

Oshri, A., Sutton, T. E., Clay-Warner, J., & Miller, J. D. (2015). Child maltreatment types and risk behaviors: Associations with attachment style and emotion regulation dimensions. *Personality and Individual Differences, 73*, 127–133. https://doi.org/10.1016/j.paid.2014.09.015.

Potthast, N., Neuner, F., & Catani, C. (2014). The contribution of emotional maltreatment to alcohol dependence in a treatment-seeking sample. *Addictive Behaviors, 39*(5), 949–958. https://doi.org/10.1016/j.addbeh.2014.01.015.

Proctor, L. J., Lewis, T., Roesch, S., Thompson, R., Litrownik, A. J., English, D., & Dubowitz, H. (2017). Child maltreatment and age of alcohol and marijuana initiation in high-risk youth. *Addictive Behaviors, 75*, 64–69. https://doi.org/10.1016/j.addbeh.2017.06.021.

Shin, S. H., Edwards, E. M., & Heeren, T. (2009). Child abuse and neglect: Relations to adolescent binge drinking in the national longitudinal study of Adolescent Health (AddHealth) Study. *Addictive Behaviors, 34*(3), 277–280. https://doi.org/10.1016/j.addbeh.2008.10.023.

Shin, S. H., Miller, D. P., & Teicher, M. H. (2013). Exposure to childhood neglect and physical abuse and developmental trajectories of heavy episodic drinking from early adolescence into young adulthood. *Drug and Alcohol Dependence, 127*(1–3), 31–38. https://doi.org/10.1016/j.drugalcdep.2012.06.005.

Simons, J. S., & Carey, K. B. (2002). Risk and vulnerability for marijuana use problems: The role of affect dysregulation. *Psychology of Addictive Behaviors, 16*(1), 72–75. https://doi.org/10.1037/0893-164X.16.1.72.

Simons, J. S., Carey, K. B., & Gaher, R. M. (2004). Lability and impulsivity synergistically increase risk for alcohol-related problems. *The American Journal of Drug and Alcohol Abuse, 30*(3), 685–694. https://doi.org/10.1081/ADA-200032338.

Smith, K. Z., Smith, P. H., & Grekin, E. R. (2014). Childhood sexual abuse, distress, and alcohol-related problems: Moderation by drinking to cope. *Psychology of Addictive Behaviors, 28*(2), 532–537. https://doi.org/10.1037/a0035381.

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review, 28*(1), 78–106.

Tarter RE, (2006). Vanyukov M, Kirisci L, Reynolds M, Clark DB. Predictors of marijuana use in adolescents before and after licit drug use: Examination of the gateway hypothesis. Am J Psychiatry 2006; 163: 2134-40.

Tonmyr, L., Thornton, T., Draca, J., & Wekerle, C. (2010). A review of childhood maltreatment and adolescent substance abuse relationship. *Current Psychiatry Review, 6*, 223–234.

Topper, L. R., Castellanos-Ryan, N., Mackie, C., & Conrod, P. J. (2011). Adolescent bullying victimisation and alcohol-related problem behaviour mediated by coping drinking motives over a 12month period. *Addictive Behaviors, 36*(1), 6–13. https://doi.org/10.1016/j.addbeh.2010.08.016.

WHO. (2016). Child Maltreatment. Retrieved 2017 November 11 from http://www.who.int/mediacentre/factsheets/fs150/en/.