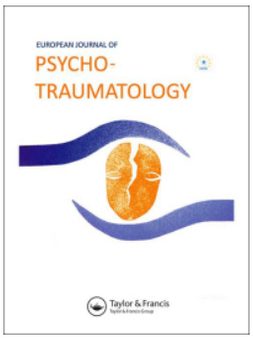

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# Associations between stressful life events in childhood/adolescence and adulthood: results from the 7th Tromsø survey

Jens C. Thimm[a,b], Kamilla Rognmo[a], Hege Nermo[c,d], Jan-Are Kolset Johnsen[c], Ingunn Skre[a] and Catharina E. A. Wang[a]

[a]Department of Psychology, UiT The Arctic University of Norway, Tromsø, Norway; [b]Centre for Crisis Psychology, University of Bergen, Bergen, Norway; [c]Department of Clinical Dentistry, UiT The Arctic University of Norway, Tromsø, Norway; [d]The Public Dental Health Service Competence Center of Northern Norway, Tromsø, Norway

## ABSTRACT

**Background:** Exposure to highly stressful life events (SLEs), such as accidents, violence, or serious illness, is common. With the accumulation of SLEs, the risk of detrimental somatic and mental health outcomes increases. To understand patterns of SLE exposure, research into the associations between SLEs is needed.

**Method:** The sample comprised 21,069 participants of the population-based Tromsø7 (2015/2016) study (52.7% female, mean age = 57.3 years, *SD* = 11.4 years). Participants were asked whether they had experienced eleven SLEs in childhood/adolescence and adulthood. Correlations, network analysis, and logistic regression analysis were used to examine the associations between SLEs.

**Results:** Medium-sized to large correlations between SLEs in childhood/adolescence and SLEs in adulthood were found. Two clusters of SLEs emerged in the network analysis in childhood/adolescence and in adulthood, respectively, interpreted as interpersonal (e.g. violence and sexual abuse) and impersonal SLEs (e.g. a life-threatening illness or serious accident). SLEs in childhood/adolescence predicted the number of SLEs in adulthood as well as exposure to the specific SLE categories in adulthood. Childhood neglect was an important predictor of SLE exposure in adulthood.

**Conclusions:** Public health policies should focus on the prevention of SLEs and the early intervention after SLE exposure, especially childhood neglect.

## Asociaciones entre eventos vitales estresantes en la niñez/adolescencia y en la edad adulta: resultados de la 7.ª encuesta de Troms

**Antecedentes:** Es común la exposición a eventos vitales altamente estresantes (SLEs, por su sigla en inglés), como accidentes, violencia o enfermedades graves. Con la acumulación de SLEs, aumenta el riesgo de resultados adversos para la salud somática y mental. Para comprender los patrones de exposición a SLEs, se necesita investigar las asociaciones entre los SLEs.

**Método:** La muestra estuvo compuesta por 21.069 participantes del 7mo estudio de base poblacional Troms (2015/2016) (52,7 % mujeres, edad media = 57,3 años, *DE* = 11,4 años). Se preguntó a los participantes si habían experimentado alguno de los once SLEs, en la infancia/adolescencia y la edad adulta. Se utilizaron correlaciones, análisis de red y análisis de regresión logística para examinar las asociaciones entre SLEs.

**Resultados:** Se encontraron correlaciones medianas a grandes entre SLEs en la niñez/adolescencia y en la edad adulta. Dos grupos de SLEs surgieron en el análisis de red en la niñez/adolescencia y en la edad adulta, interpretados como SLEs interpersonales (p. ej., violencia y abuso sexual) e impersonales (p. ej., una enfermedad potencialmente mortal o un accidente grave) respectivamente. Los SLEs en la niñez/adolescencia predijeron tanto el número de SLEs como la exposición a las categorías específicas de SLEs en la edad adulta. El abandono infantil fue un predictor importante de la exposición a SLEs en la edad adulta.

**Conclusiones:** Las políticas de salud pública deben centrarse tanto en la prevención de los SLEs como en la intervención temprana tras la exposición a los SLEs, especialmente el abandono infantil.

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Stressful life events; trauma; childhood; adolescence; adulthood; reexposure; network analysis

## PALABRAS CLAVE
Eventos vitales estresantes; trauma; infancia; adolescencia; adultez; reexposición; análisis de red

## 关键词
压力生活事件、创伤、童年期、青春期、成年期、再暴露、网络分析

## HIGHLIGHTS

- Highly stressful life events (SLEs) are systematically interconnected.
- SLEs in childhood and adolescence are associated with exposure to SLEs in adulthood.
- Childhood physical and emotional neglect is strongly related to other SLEs in childhood/adolescence and adulthood.

**CONTACT** Jens C. Thimm jens.thimm@uit.no Department of Psychology, UiT The Arctic University of Norway, 9037 Tromsø, Norway
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## 童年期/青春期和成年期压力生活事件之间的关联：第七次特罗姆瑟调查的结果

**背景**：遭遇事故、暴力或严重疾病等高压力生活事件 (SLE) 是很常见的。随着 SLE 的累积，有害的躯体和心理健康结果的风险也会增加。为了解 SLE 暴露模式，需要研究 SLE 之间的关联。
**方法**：样本包括基于人群的特罗姆瑟7研究(2015/2016)的 21,069 名参与者（52.7% 为女性，平均年龄 = 57.3 岁，*SD* = 11.4 岁）。参与者被问及他们是否在童年期/青春期和成年时期经历过 11 种SLE。使用相关性、网络分析和逻辑回归分析来考查 SLE 之间的关联。
**结果**：发现童年期/青春期的 SLE 与成年期的 SLE 之间存在中等至较大的相关性。在童年期/青春期和成年期的网络分析中出现了两组 SLE，分别被解释为人际 SLE （例如暴力和性虐待）和非人际 SLE （例如危及生命的疾病或严重事故）。童年期/青春期的 SLE 预测了成年期 SLE 的数量以及成年期特定 SLE 类别的暴露情况。 童年期的忽视是成年后遭遇 SLE 的一个重要预测因素。
**结论**：公共卫生政策应侧重于 SLE 的预防和 SLE 暴露后的早期干预，特别是童年期忽视。


## 1. Introduction

During a lifetime, many people will experience adverse and highly stressful life events, such as accidents, natural disasters, serious illness, violence, sexual abuse, or the loss of a loved one (SLEs). SLEs have in common that they involve actual physical harm or threat to one's (or a loved one's) physical integrity or social, cognitive, or emotional deprivation (McLaughlin et al., 2014). International studies report a lifetime prevalence of approximately 70–80% for SLE exposure (e.g. Benjet et al., 2016; Kessler et al., 2017).

Several prospective and retrospective studies have found a relationship between SLEs and an increased risk of developing a broad range of mental and somatic disorders (for recent reviews see Baldwin et al., 2023; Hogg et al., 2022; Petruccelli et al., 2019), mortality (e.g. Elliot et al., 2018), and adverse functional outcomes, such as education and social relationships (e.g. Copeland et al., 2018). Neurobiological changes and inflammatory processes are possible biological links between SLEs and somatic diseases (e.g. Chen et al., 2023; Sherin & Nemeroff, 2011). Moreover, it has been recognized that SLEs have a cumulative effect (Lacey & Minnis, 2020), i.e. with more SLEs, the risk of adverse mental and physical health effects increases (Felitti et al., 1998; Hughes et al., 2017; Lin et al., 2021). Therefore, summing the different types of adversity has been used to determine an individual's risk of difficulties in a wide range of health and psychosocial outcomes (Lacey & Minnis, 2020). However, despite being widely used in research and practice, shortcomings of this approach have been noted, including the unlikely assumption that all SLEs contribute equally to different outcomes, the disregard of the timing and patterns and interactions of adversity, and the role of resilience (Briggs et al., 2021; Goldenson et al., 2021; Lacey & Minnis, 2020; Schalinski et al., 2016). Further, for theory building and in order to develop policies and interventions, insight into the interconnectedness of SLEs is needed (Lacey & Minnis, 2020; Lian et al., 2022). The purpose of the present study was therefore to examine the associations between a wide range of SLEs.

It has long been observed that certain SLEs tend to co-occur (Dong et al., 2004). Existing investigations into the associations between SLEs have most often employed factor analysis based on the assumption of latent variables that explain correlations between SLEs (Benjet et al., 2016; Ford et al., 2014) or latent class analysis focusing on mutually exclusive groups of individuals that share the same pattern of responses on a set of items (e.g. Haahr-Pedersen et al., 2020; Lian et al., 2022). It has been argued, however, that factor analysis and latent class analysis provide limited information about the associations between specific SLEs (de Vries et al., 2022), which is necessary to examine and understand possible causal connections between SLEs. de Vries et al. (2022) proposed network analysis as a statistical approach to model associations between SLEs. Network analysis has relatively recently been introduced to the field of psychopathology to overcome the limitations of latent variable approaches (Borsboom, 2017). In network analysis terminology, the variables of interest and elements of the network are called nodes, and the relations between the elements, which are controlled for the remaining elements, are termed edges (Borsboom et al., 2021; de Vries et al., 2022). Weighted edges represent the strength of the association between two nodes (Epskamp et al., 2018). Several measures have been proposed to quantify the relative importance of a given element for the network's structure. The most often used indices of centrality include strength, closeness, and betweenness (Epskamp et al., 2018). An element's strength refers to the sum of its edge weights. Closeness is defined as the inverse of total lengths of one element to all other elements in the network, and betweenness indicates how often an element is on the shortest path between two other elements (Opsahl et al., 2010). De Vries et al. (2022) argue that network analysis of life events expands the knowledge about

the relationships between these events beyond correlation analysis by considering conditional dependency.

Many studies on the SLE interrelationships have not assessed age at exposure for the different SLEs and were therefore unable to investigate temporal associations between SLEs. However, several studies have examined the role of SLEs in subsequent exposure to SLEs. For example, studies have shown that childhood abuse is associated with exposure to violence and sexual victimization in adulthood (Fanslow et al., 2021; Li et al., 2019; Ports et al., 2016). However, only a few studies have investigated a wider range of SLEs than childhood maltreatment and subsequent exposure to sexual abuse and violence. For example, childhood maltreatment has been found to be related to exposure to accidents and natural disasters in adulthood (Dias et al., 2017) and the murder or suicide of a loved one (Widom et al., 2008). Moreover, SLEs other than child abuse or neglect have been shown to predict later SLE exposure. For example, in the Benjet et al. (2016) study, accidents and injuries were associated with later exposure to intimate partner and sexual violence.

Thus, the aim of the present study was to explore the associations between a broad range of SLEs, including SLEs that are not commonly assessed in the field, such as bullying and painful or frightening medical treatment at the hospital or the dentist (Thimm et al., 2021). These events represent actual or perceived threats to the person's physical and mental health (e.g. Beaton et al., 2014; Wolke & Lereya, 2015), which justifies their inclusion as SLEs. The current study also aimed to investigate the prediction of SLE exposure in adulthood from SLEs in childhood/adolescence.

## 2. Methods

### 2.1. Participants

The sample consisted of participants of the seventh wave of the population based Tromsø study (Tromsø7), in which all residents of the Tromsø municipality in Northern Norway who were 40 years or older were invited to participate in 2015–2016. At the time of the current study, 21,069 participants (52.5% female, mean age = 57.3 years, *SD* = 11.4 years, range 40–99 years) consented that their data could be used for research (response rate 64.6%). Approximately three-quarter of the participants (76.8%) cohabitated with a spouse or a partner. In total, 23.2% of the participants had primary/partly secondary education, 27.8% had upper secondary education, 19.4% had tertiary education of less than four years, and 29.7% had tertiary education of four years or more. In total, 58.1% of the participants were working full-time, 23.1% were retired, 9.2% received disability benefits or work assessment allowance, 8.0% were working part-time, 0.7% were unemployed, 0.6% were housekeeping, 0.3% were a student or in military service, and 0.1% received family income supplement. Most participants (94.1%) identified themselves as Norwegian, 2.7% as Sami, 1.9% as Kven/Finnish, and 4.2% as other than Norwegian, Sami, or Kven/Finnish.

The present study was approved by the Regional Committee of Medical and Health Research Ethics (ref. 477677). The Norwegian Data Protection Service (NSD) was notified about the study (ref. 755549).

### 2.2. Measures

The data that were used in the present study were collected with a paper-pencil questionnaire (demographics) and an online survey (SLEs). The following SLEs were assessed: 1) a life-threatening illness or a serious accident; 2) violence; 3) sexual abuse; 4) bullying; 5) witnessing a loved one being exposed to violence or sexual abuse; 6) something else frightening, dangerous, or violent (e.g. natural disaster, war, terror attack); 7) the loss of a loved one and severe grief (difficulty accepting the loss, yearning for the deceased, and intense emotional pain related to the loss); 8) painful or frightening medical treatment in hospital; 9) painful or frightening dental treatment; 10) a life-threatening illness or serious accident of a loved one; 11) physical and emotional neglect in childhood. Participants were asked whether they have experienced no SLE exposure ('No'), SLEs in childhood/adolescence ('Yes, before age 18'), SLEs in adulthood ('Yes, after age 18'), and SLEs in the previous year ('Yes, the previous year'), except for childhood neglect, which could be answered with 'Yes' or 'No'. The list of SLEs was followed by the question 'If «yes» to at least one of the ten questions above: Do you still think a lot about what happened?' with the response options 'Yes' and 'No'.

### 2.3. Statistical analyses

All statistical analyses were performed in R 4.2.2 (R Core Team, 2022). Prior to analyses, SLE exposure after age 18 and SLE exposure in the previous year were combined into one binary variable (SLE exposure in adulthood). Descriptive statistics were obtained and tests of group differences were conducted using the misty package (version 0.4.8; Yanagida, 2023). To examine the bivariate associations between SLEs in childhood/adolescence and adulthood, tetrachoric correlations were calculated with the psych package (version 2.2.9; Revelle, 2022). Correlation coefficients of .10., 30., and .50 were interpreted as small, medium, and large, respectively (cf. Cohen, 1988). To further

investigate and to visualize the associations between SLEs in the current sample, a network analysis was conducted using the IsingFit package (version 0.3.1; van Borkulo & Epskamp, 2022), which can handle binary variables but requires a complete data set without missing data points. Participants with missing data ($n$ = 1,283) were therefore excluded from this analysis. Participants who had missing data were statistically significantly ($p < .05$) more likely to be older, female, having lower education, not living with a spouse, having non-Norwegian ethnicity, and having experienced childhood neglect, a life-threatening illness or a serious accident (before and after age 18), violence (before age 18), sexual abuse (before age 18), bullying (after age 18), witnessing violence or sexual abuse (before and after age 18), something else frightening (before and after age 18), the loss of a loved one and severe grief (after age 18), painful/frightening hospital and painful/frightening dental treatment (after age 18), a life-threatening illness or a serious accident of a loved one (before and after age 18), and thinking a lot about what happened when having experienced one or more SLEs. The default hyperparameter of $\gamma$ = .25 was used. Further, the AND-rule was applied, meaning that both nodes had to predict each other. To identify clusters of SLEs in the network, the walktrap algorithm in the igraph package (version 1.4.1; Csardi & Nepusz, 2006) was used. The network was plotted using the Fruchterman-Reingold algorithm in the qgraph package (version 1.9.3; Epskamp et al., 2012). The centrality of the nodes (strength, closeness, and betweenness) was also obtained using the qgraph package. Confidence intervals for edge weights, the stability of centrality indices, and difference tests for edge weights and centrality indices were calculated using the bootnet package (version 1.5; Epskamp et al., 2018). The centrality stability coefficient should be at least .25 and preferably above .50 (Epskamp et al., 2018). To examine the connection of exposure to SLEs in childhood/adolescence with SLEs in adulthood, the nodes' bridge strength (sum of edge weights with nodes in the other group), bridge betweenness (importance of the node for the shortest path between two nodes in the other group), and bridge closeness (average distance of the node to the nodes in the other group) was calculated using the networktools package (version 1.5.0; Jones et al., 2017). The global structure (associations between SLEs) and the global strength (sum of weighted edges) of the networks of female and male participants were compared using the NetworkComparisonTest package (version 2.2.1; van Borkulo et al., 2022).

In addition to network analysis, a series of regression analyses was performed to further examine the associations of SLE exposure in childhood/adolescence with SLE exposure in adulthood. The sum of all SLEs in childhood/adolescence, the presence of any SLEs in childhood/adolescence, and the specific SLEs in childhood/adolescence were used as independent variables in separate analyses to predict the sum of SLEs in adulthood and the specific SLEs in adulthood as dependent variables, respectively. In calculating the sum of childhood/adolescence SLEs, only participants who had answered at least eight events were included in the analyses ($n$ = 20,500). Four categories were formed: no SLE exposure, one SLE, two SLEs, and three or more SLEs in childhood/adolescence. The variable was dummy coded with no exposure as reference category. A sum score for SLEs in adulthood was calculated when at least 80% of the SLEs had been answered ($n$ = 20,463). Because the Thimm et al. (2021) study on the prevalence of SLEs in the Tromsø7 population found that reporting SLEs was positively associated with being female, younger age, having higher education, and belonging to a minority population (immigrant or indigenous), it was controlled for these demographics in all analyses. Education was dummy coded with primary/partly secondary education as the reference category. The variable ethnicity was dichotomized into Norwegian vs. non-Norwegian (including dual ethnicity with Norwegian ethnicity). In all regression analyses, the predictors were entered simultaneously. The prediction of the sum of SLEs in adulthood from the number of SLEs in childhood/adolescence and from the specific SLEs in childhood/adolescence was examined using negative binomial regression analysis performed in the MASS package (version 7.3–58.1; Venables & Ripley, 2002). Finally, a series of logistic regression analyses was conducted, in which the ten SLEs in adulthood were regressed on the presence of any SLE in childhood/adolescence, the sum of childhood/adolescence SLEs, and all eleven specific SLEs in childhood/adolescence.

## 3. Results

Overall, 76% of the participants reported at least one lifetime SLE, and 45.1% and 65.2% experienced at least one SLE in childhood/adolescence and in adulthood, respectively. At least one SLE in both childhood/adolescence and adulthood was reported by 33.5% of the participants. The frequencies of the specific SLEs ranged from 2.9% (sexual abuse in adulthood) to 34.2% (serious illness or accident of a loved one in adulthood) (see Table 1). The mean sum of SLEs experienced across childhood/adolescence and adulthood was 2.09 ($SD$ = 1.99). In total, 7.3% of the participants reported that they were still thinking a lot about what happened (Table 1).

The correlations between SLEs in childhood/adolescence and adulthood are presented in Table 1. In childhood/adolescence, medium-sized to large correlations were found between childhood neglect,

**Table 1.** Frequencies and tetrachoric correlations between SLEs in childhood and adulthood.

| | | | SLEs before age 18 | | | | | | | | | | | SLEs after age 18 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *N* (valid %) | Miss. (%) | Illness/ acci-dent | Vio-lence | Sexual abuse | Bully-ing | Witn. viol./ sex. abuse | Sth. else fright-ening | Loss and severe grief | Painful hospital treat-ment | Painful dental treat-ment | Illn./ acc. of a loved one | Ne-glect | Illness/ acci-dent | Vio-lence | Sexual abuse | Bully-ing | Witn. viol./ sex. abuse | Sth. else fright-ening | Loss and severe grief | Painful hospital treat-ment | Painful dental treat-ment | Illness/ acc. of a loved one |
| *SLEs before age 18* | | | | | | | | | | | | | | | | | | | | | | | |
| Serious illness/ accident | 1,095 (5.3) | 572 (2.7) | – | | | | | | | | | | | | | | | | | | | | |
| Violence | 1,213 (5.9) | 576 (2.7) | .30 | – | | | | | | | | | | | | | | | | | | | |
| Sexual abuse | 1,500 (7.3) | 609 (2.9) | .19 | .36 | – | | | | | | | | | | | | | | | | | | |
| Bullying | 3,314 (16.2) | 587 (2.8) | .15 | .44 | .34 | – | | | | | | | | | | | | | | | | | |
| Witnessed viol. or sexual abuse | 901 (4.4) | 593 (2.8) | .25 | .59 | .42 | .40 | – | | | | | | | | | | | | | | | | |
| Something else frightening | 612 (3.0) | 603 (2.9) | .19 | .25 | .17 | .13 | .29 | – | | | | | | | | | | | | | | | |
| Loss and severe grief | 1,064 (5.2) | 628 (3.0) | .23 | .17 | .17 | .19 | .25 | .28 | – | | | | | | | | | | | | | | |
| Painful/frightening hospital treatment | 713 (3.5) | 652 (3.1) | .43 | .23 | .20 | .24 | .25 | .11 | .19 | – | | | | | | | | | | | | | |
| Painful/frightening dental treatment | 3,833 (18.8) | 693 (3.3) | .14 | .23 | .24 | .31 | .22 | .12 | .18 | .37 | – | | | | | | | | | | | | |
| Illness/accident of a loved one | 889 (4.4) | 718 (3.4) | .30 | .27 | .22 | .24 | .28 | .25 | .54 | .29 | .28 | – | | | | | | | | | | | |
| Physical and emotional neglect | 1,415 (6.9) | 450 (2.1) | .16 | .47 | .44 | .33 | .55 | .28 | .24 | .23 | .20 | .24 | – | | | | | | | | | | |
| *SLEs after age 18* | | | | | | | | | | | | | | | | | | | | | | | |
| Serious illness/ accident | 3,997 (19.5) | 572 (2.7) | −.07 | .17 | .09 | .05 | .12 | .17 | .07 | .07 | .10 | .08 | .14 | – | | | | | | | | | |
| Violence | 2,196 (10.7) | 576 (2.7) | .16 | .15 | .26 | .21 | .31 | .03 | .08 | .10 | .14 | .11 | .29 | .24 | – | | | | | | | | |
| Sexual abuse | 597 (2.9) | 609 (2.9) | .11 | .24 | .26 | .16 | .24 | .13 | .19 | .18 | .16 | .17 | .37 | .11 | .46 | – | | | | | | | |
| Bullying | 1,399 (6.8) | 587 (2.8) | .10 | .25 | .23 | .11 | .19 | .03 | .12 | .16 | .13 | .14 | .35 | .18 | .33 | .38 | – | | | | | | |
| Witnessed viol. or sexual abuse | 1,136 (5.5) | 593 (2.8) | .14 | .25 | .21 | .18 | .23 | .08 | .07 | .11 | .15 | .15 | .25 | .21 | .41 | .25 | .33 | – | | | | | |
| Something else frightening | 1,139 (5.6) | 603 (2.9) | .09 | .19 | .16 | .15 | .22 | .02 | .10 | .14 | .06 | .12 | .25 | .25 | .41 | .23 | .24 | .39 | – | | | | |
| Loss and severe grief | 6,039 (29.5) | 628 (3.0) | .06 | .03 | .12 | .07 | .08 | .21 | −.04 | .07 | .15 | .03 | .10 | .14 | .09 | .12 | .14 | .20 | .15 | – | | | |
| Painful/frightening hospital treatment | 1,572 (7.7) | 652 (3.1) | .07 | .20 | .18 | .14 | .16 | .14 | .14 | −.02 | .16 | .08 | .23 | .45 | .19 | .22 | .21 | .24 | .23 | .22 | – | | |

(*Continued*)

**Table 1.** Continued.

| | *N* (valid %) | Miss. (%) | SLEs before age 18 | | | | | | | | | | SLEs after age 18 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Illness/ accident | Violence | Sexual abuse | Bullying | Witn. viol./ sex. abuse | Sth. else frightening | Loss and severe grief | Painful hospital treatment | Painful dental treatment | Illn./ acc. of a loved one | Neglect | Illness/ accident | Violence | Sexual abuse | Bullying | Witn. viol./ sex. abuse | Sth. else frightening | Loss and severe grief | Painful hospital treatment | Painful dental treatment | Illness/ acc. of a loved one |
| Painful/frightening dental treatment | 1,329 (6.5) | 693 (3.3) | .09 | .19 | .13 | .15 | .15 | .11 | .13 | .15 | −.06 | .14 | .18 | .17 | .16 | .13 | .23 | .24 | .17 | .18 | .37 | – | |
| Illness/accident of a loved one | 6,951 (34.2) | 718 (3.4) | .12 | .14 | .18 | .15 | .21 | .15 | .11 | .12 | .21 | .06 | .12 | .23 | .17 | .19 | .17 | .25 | .20 | .37 | .21 | .21 | – |
| Thinking a lot about SLE(s) | 886 (7.3) | 8,931 (42.4) | .11 | .32 | .35 | .22 | .34 | .19 | .19 | .18 | .03 | .18 | .78 | .03 | .18 | .33 | .28 | .16 | .19 | .08 | .17 | .12 | .02 |

Note. Miss. = missing data points. Correlation coefficients ≥ .30 are underlined.

violence, sexual abuse, bullying, and witnessing violence or sexual abuse, ranging from .33 (sexual abuse with bullying) to .59 (violence with witnessing violence or sexual abuse). Further, the correlation between a life-threatening illness or serious accident of a loved one and severe grief after the loss of a loved one ($r = .54$) and the correlation between a life-threatening illness or serious accident and painful/frightening hospital treatment ($r = .43$) were among the highest in childhood/adolescence. Similarly, in adulthood, violence, sexual abuse, bullying, witnessing violence or sexual abuse, and experiencing something else frightening were intercorrelated with medium to high effect sizes, ranging from .23 (sexual abuse with something else frightening) to .46 (violence with sexual abuse). In addition, the correlations between a life-threatening illness or serious accident and painful/frightening hospital treatment ($r = .45$) and between a life-threatening illness and severe grief after the loss of a loved one ($r = .37$) were medium to large. Across childhood/adolescence and adulthood, the largest correlations were found between neglect in childhood and sexual abuse ($r = .37$), bullying ($r = .35$), and violence ($r = .29$) in adulthood, and between witnessing violence or sexual abuse in childhood/adolescence and experiencing violence in adulthood ($r = .31$) with medium-sized to large effect sizes. There were small negative correlations between illness/accident in childhood/adolescence and adulthood ($r = -.07$), between painful/frightening dental treatment in childhood/adolescence and adulthood ($r = -.06$), and between loss of a loved one and severe grief in childhood/adolescence and adulthood ($r = -.04$), and a near-zero correlation between painful/frightening hospital treatment in childhood/adolescence and adulthood ($r = -.02$). Thinking a lot about what happened was strongly correlated with childhood neglect ($r = .78$).

The network of SLEs in childhood/adolescence and adulthood is depicted in Figure 1 (bootstrapped confidence intervals of edge weights and difference tests can be found in Table S1 and Figure S1 in the supplementary online material, respectively). The results of the analysis on the clustering of SLEs in the network using the walktrap algorithm indicated four major groups (shown in different colours in Figure 1): 1) violence, bullying, sexual abuse, witnessing violence or sexual abuse of a close one, and childhood neglect before age 18; 2) violence, bullying, sexual abuse, witnessing violence or sexual abuse of a close one, and having experienced something else frightening, dangerous, or violent after age 18; 3) a life-threatening illness or serious accident, painful/frightening hospital treatment, painful/frightening dental treatment, a life-threatening illness or serious accident of a loved one, the loss of a loved one and severe grief, and having experienced something else frightening,

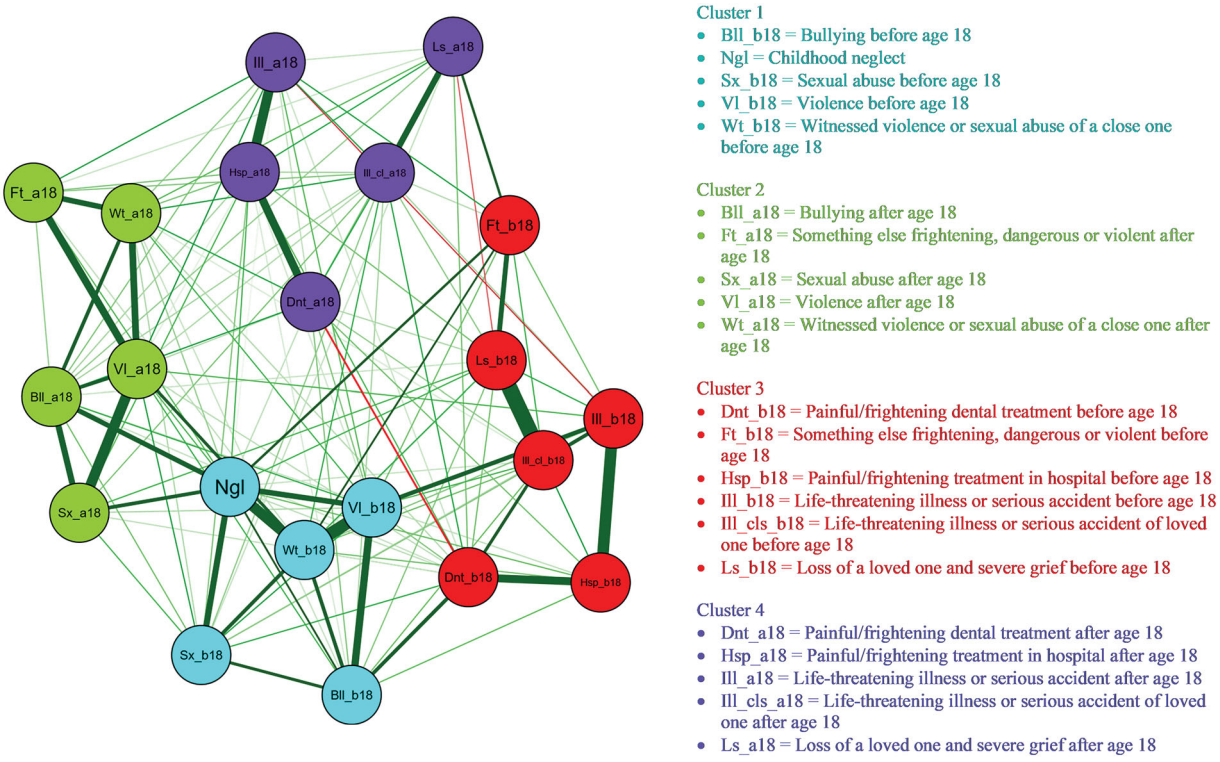


**Figure 1.** Network of SLEs in childhood/adolescence and adulthood. The thickness of the line indicates the strength of the association. Negative associations are in red. Different node colours indicate clusters of SLEs detected in the network.

dangerous, or violent before age 18; and 4) a life-threatening illness or serious accident, painful/frightening hospital treatment, painful/frightening dental treatment, a life-threatening illness or serious accident of a loved one, and the loss of a loved one and severe grief after age 18. The network analysis further showed that the centrality stability coefficients were .67 for strength, .52 for closeness, and .13 for betweenness, suggesting that the results for betweenness should not be interpreted (the centrality stability plot and the results of bootstrapped difference tests can be found in Figure S2 and S3 in the online supplementary material, respectively). Childhood neglect, violence before and after age 18, and witnessing violence or sexual abuse of a close one before age 18 had the highest strength and closeness (Figure 2, left panel). The bridge centrality stability coefficients were .52 for bridge strength and bridge closeness and .13 for bridge betweenness, suggesting unstable results for bridge betweenness (the bridge centrality stability plot and the results of bootstrapped difference tests are shown in Figure S4 and S5 in the online supplementary material, respectively). Childhood neglect and violence after age 18 had the highest bridge strength, and childhood neglect and witnessing violence or sexual abuse of a close one before age 18 had the highest bridge closeness (Figure 2, right panel). There were no statistically significant differences between the networks of female and male participants with respect to the global structure ($M = 0.83$, $p = .149$) and the global strength ($S = 6.75$, $p = .111$).

Table 2 displays the results from the analyses predicting the sum of reported SLEs in adulthood from the sum of SLEs in childhood/adolescence and the specific SLEs in childhood/adolescence. The results showed that with an increasing number of SLEs in childhood/adolescence, the number of SLEs in adulthood also increased. All SLEs in childhood/adolescence except for a life-threatening illness or serious accident of a loved one significantly predicted the number of SLEs in adulthood with childhood neglect as the strongest individual predictor.

The results of the logistic regression analyses predicting SLE exposure in adulthood from SLEs in childhood/adolescence are presented in Table 3 and in Table 4. As shown in Table 3, exposure to any SLE in childhood/adolescence was significantly associated with exposure to all assessed SLEs in adulthood, with odd ratios (*OR*s) ranging from 1.39 (95% CI 1.29–1.49) (life-threatening illness or serious accident) to 2.71 (95% CI 2.26–3.26) (sexual abuse). Further, the associations between the number of SLEs experienced in childhood/adolescence and SLEs in adulthood were examined. No SLEs in childhood/adolescence were reported by 54.7% of the participants, one SLE by 25.1%, two SLEs by 11.7%, and three or more SLEs by 8.5% of the participants. The results showed an increase in the *OR*s for all SLEs in adulthood with an increasing number of SLEs in childhood/adolescence. When three or more SLEs were experienced in childhood, the likelihood of SLE exposure in

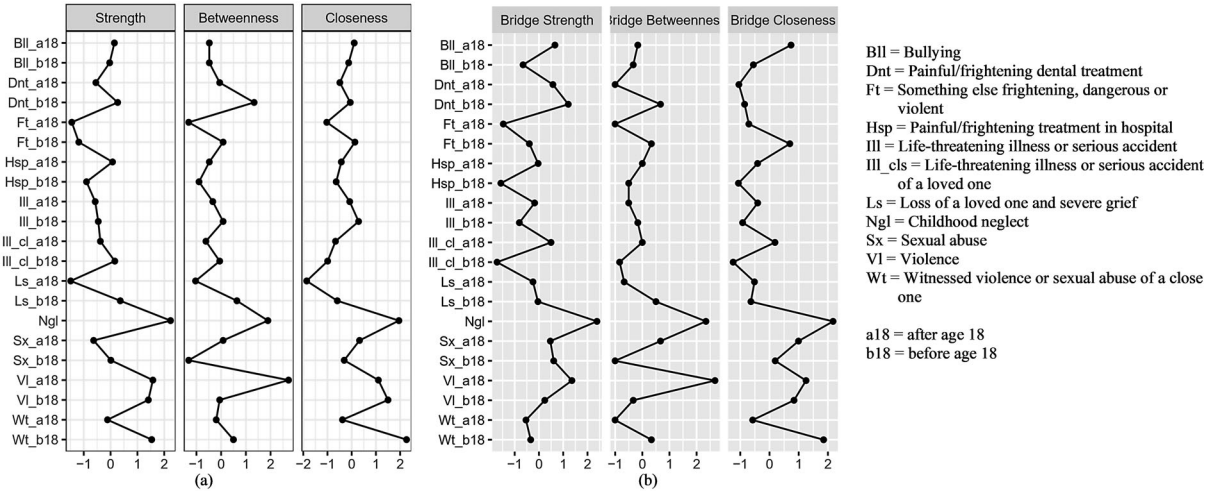


**Figure 2.** Centrality (a) and bridge centrality (b) of the nodes. Centrality indices are shown as z-scores.

adulthood was highest for sexual abuse (*OR* = 4.57, 95% CI 3.60–5.79).

Table 4 displays the results of the analyses predicting SLE exposure in adulthood from specific SLEs in childhood/adolescence. Exposure to all SLEs in adulthood was uniquely predicted by several SLEs in childhood/adolescence. However, the number and combinations of SLEs in childhood/adolescence that predicted SLEs in adulthood differed between types of SLEs (see Table 4). For example, sexual abuse in adulthood was uniquely predicted by only four SLEs in childhood/adolescence (neglect, violence, loss of a loved one and severe grief, and painful/frightening dental treatment), whereas illness-related SLEs in adulthood (one's or a loved one's life-threatening illness or serious accident and painful/frightening treatment by dentist or in hospital) were predicted by eight and nine SLEs in childhood. Neglect, sexual abuse, and painful/frightening dental treatment in childhood/adolescence were unique predictors of nine of the ten SLEs in adulthood. A life-threatening illness or serious accident of a loved one in childhood/adolescence predicted only significantly one's life-threatening illness or serious accident and painful/frightening dental treatment in adulthood when controlling for demographics and the remaining SLEs in childhood/adolescence that were assessed.

**Table 2.** Negative binomial regression analysis predicting the sum of reported SLEs in adulthood from the sum of SLEs in childhood/adolescence and the specific SLEs in childhood/adolescence.

| | *B* (95% CI) | *SE* | *p* |
|---|---|---|---|
| *Sum of SLEs before age 18* | | | |
| Intercept | 0.07 (−0.03, 0.16) | 0.05 | .169 |
| Age | 0.00 (0.00, 0.00) | 0.00 | .517 |
| Sex | −0.11 (−0.13, −0.08) | 0.01 | < .001 |
| Secondary education | 0.06 (0.02, 0.10) | 0.02 | .006 |
| Tertiary education (< 4 years) | 0.08 (0.03, 0.12) | 0.02 | .001 |
| Tertiary education (> 4 years) | 0.00 (−0.04, 0.04) | 0.02 | .976 |
| Non-Norwegian ethnicity | 0.23 (0.18, 0.28) | 0.02 | < .001 |
| One SLE vs no SLEs | 0.26 (0.23, 0.30) | 0.02 | < .001 |
| Two SLEs vs no SLEs | 0.46 (0.41, 0.50) | 0.02 | < .001 |
| ≥ Three SLEs vs no SLEs | 0.66 (0.62, 0.71) | 0.02 | < .001 |
| *Specific SLEs before age 18* | | | |
| Intercept | 0.11 (0.02, 0.21) | 0.05 | .020 |
| Age | 0.00 (0.00, 0.00) | 0.00 | .185 |
| Sex | −0.09 (−0.12, −0.06) | 0.02 | <.001 |
| Secondary education | 0.06 (0.02, 0.10) | 0.02 | .004 |
| Tertiary education (< 4 years) | 0.08 (0.04, 0.13) | 0.02 | <.001 |
| Tertiary education (> 4 years) | 0.00 (−0.04, 0.05) | 0.02 | .860 |
| Non-Norwegian ethnicity | 0.22 (0.17, 0.27) | 0.02 | <.001 |
| Serious illness/ accident | 0.07 (0.01, 0.13) | 0.03 | .027 |
| Violence | 0.17 (0.11, 0.23) | 0.03 | <.001 |
| Sexual abuse | 0.23 (0.18, 0.28) | 0.03 | <.001 |
| Bullying | 0.15 (0.11, 0.18) | 0.02 | <.001 |
| Witnessing viol./sex. abuse | 0.18 (0.12, 0.25) | 0.03 | <.001 |
| Something else frightening | 0.24 (0.16, 0.32) | 0.04 | <.001 |
| Loss and severe grief | 0.07 (0.00, 0.13) | 0.03 | .037 |
| Painful/frightening treatment in hospital | 0.10 (0.03, 0.17) | 0.04 | .006 |
| Painful/frightening dental treatment | 0.23 (0.20, 0.27) | 0.02 | <.001 |
| Illness/accident of a loved one | 0.06 (−0.01, 0.12) | 0.03 | .097 |
| Childhood neglect | 0.30 (0.25, 0.36) | 0.03 | <.001 |

## 4. Discussion

The purpose of the present study was to investigate the associations between SLEs in childhood/adolescence and in adulthood among participants of the population-based Tromsø7 study. In Tromsø7, exposure to eleven SLEs in childhood/adolescence and ten SLEs in adulthood was assessed. The results showed medium-sized to large correlations between SLEs in childhood/adolescence and SLEs in adulthood, respectively. The correlations were somewhat lower for SLEs across childhood/adolescence and adulthood. The network analysis suggested four clusters of SLEs in childhood/adolescence and in adulthood. Childhood neglect and exposure to violence had the highest centrality in the network and the highest bridge centrality between SLEs in childhood/adolescence and adulthood. The results finally showed that exposure to SLEs in childhood/adolescence predicted the number of SLEs in adulthood in a dose–response relationship as well as the exposure to the specific SLE

**Table 3.** Predicting SLE exposure in adulthood from any SLE and the sum of SLEs in childhood/adolescence.

| | Serious illness/ accident *OR* (95% CI) | Violence *OR* (95% CI) | Sexual abuse *OR* (95% CI) | Bullying *OR* (95% CI) | Witnessing. viol./sex. abuse *OR* (95% CI) | Something else frightening *OR* (95% CI) | Loss and severe grief *OR* (95% CI) | Painful hospital treatment *OR* (95% CI) | Painful dental treatment *OR* (95% CI) | Illness/accident of a loved one *OR* (95% CI) |
|---|---|---|---|---|---|---|---|---|---|---|
| *Any SLE* | | | | | | | | | | |
| Intercept | 0.06* (0.05, 0.08) | 0.43* (0.31, 0.59) | 0.04* (0.02, 0.08) | 0.12* (0.08, 0.18) | 0.18* (0.12, 0.28) | 0.05* (0.03, 0.07) | 0.22* (0.18, 0.27) | 0.07* (0.05, 0.10) | 0.12* (0.08, 0.18) | 0.41* (0.33, 0.50) |
| Age | 1.02* (1.01, 1.02) | 0.96* (0.96, 0.97) | 0.98* (0.98, 0.99) | 0.98* (0.98, 0.99) | 0.97* (0.97, 0.98) | 0.99* (0.98, 0.99) | 1.02* (1.01, 1.02) | 1.00 (0.99, 1.00) | 0.99* (0.98, 0.99) | 1.00 (1.00, 1.00) |
| Sex | 1.47* (1.37, 1.58) | 1.43* (1.31, 1.57) | 0.10* (0.07, 0.13) | 0.65* (0.58, 0.73) | 0.90 (0.79, 1.01) | 1.73* (1.53, 1.96) | 0.61* (0.57, 0.65) | 0.85* (0.77, 0.95) | 1.05 (0.94, 1.18) | 0.69* (0.65, 0.73) |
| Secondary education | 1.02 (0.92, 1.13) | 1.08 (0.94, 1.24) | 1.31 (0.97, 1.77) | 1.34* (1.12, 1.62) | 1.05 (0.88, 1.27) | 1.26* (1.03, 1.54) | 0.91* (0.84, 0.99) | 1.05 (0.90, 1.23) | 1.07 (0.91, 1.26) | 1.25* (1.15, 1.37) |
| Tertiary education (< 4 years) | 1.07 (0.96, 1.20) | 1.21* (1.04, 1.40) | 1.74* (1.29, 2.37) | 1.56* (1.29, 1.90) | 1.06 (0.87, 1.29) | 1.64* (1.34, 2.01) | 0.74* (0.67, 0.82) | 1.28* (1.08, 1.51) | 1.01 (0.85, 1.21) | 1.29* (1.17, 1.42) |
| Tertiary education (> 4 years) | 1.01 (0.91, 1.12) | 1.02 (0.89, 1.18) | 1.83* (1.38, 2.43) | 1.63* (1.37, 1.96) | 0.87 (0.72, 1.05) | 1.57* (1.30, 1.92) | 0.54* (0.50, 0.60) | 1.05 (0.90, 1.23) | 0.80* (0.67, 0.95) | 1.35* (1.23, 1.47) |
| Non-Norwegian ethnicity | 1.37* (1.21, 1.54) | 1.71* (1.49, 1.96) | 1.69* (1.33, 2.12) | 1.79* (1.52, 2.09) | 1.78* (1.48, 2.12) | 1.67* (1.39, 1.99) | 1.26* (1.12, 1.41) | 1.36* (1.14, 1.60) | 1.84* (1.55, 2.18) | 1.01 (0.91, 1.13) |
| Any SLE before age 18 | 1.39* (1.29, 1.49) | 2.07* (1.89, 2.28) | 2.71* (2.26, 3.26) | 1.88* (1.68, 2.10) | 1.98* (1.75, 2.25) | 1.62* (1.43, 1.83) | 1.45* (1.36, 1.55) | 1.80* (1.62, 2.00) | 1.52* (1.36, 1.71) | 1.76* (1.66, 1.87) |
| *Sum of SLEs* | | | | | | | | | | |
| Intercept | 0.06* (0.05, 0.07) | 0.39* (0.29, 0.54) | 0.04* (0.02, 0.07) | 0.11* (0.07, 0.16) | 0.16* (0.11, 0.25) | 0.04* (0.03, 0.07) | 0.21* (0.17, 0.26) | 0.06* (0.04, 0.09) | 0.11* (0.08, 0.17) | 0.38* (0.31, 0.47) |
| Age | 1.02* (1.01, 1.02) | 0.97* (0.96, 0.97) | 0.99 (0.98, 1.00) | 0.98* (0.98, 0.99) | 0.98* (0.97, 0.98) | 0.99 (0.98, 1.00) | 1.02* (1.01, 1.02) | 1.00 (0.99, 1.00) | 0.99* (0.98, 0.99) | 1.00 (1.00, 1.00) |
| Sex | 1.49* (1.39, 1.60) | 1.46* (1.33, 1.60) | 0.10* (0.07, 0.13) | 0.66* (0.59, 0.74) | 0.91 (0.81, 1.03) | 1.77* (1.56, 2.00) | 0.61* (0.57, 0.65) | 0.87* (0.78, 0.97) | 1.06 (0.95, 1.19) | 0.69* (0.65, 0.73) |
| Secondary education | 1.03 (0.93, 1.14) | 1.08 (0.94, 1.25) | 1.30 (0.97, 1.76) | 1.34* (1.12, 1.62) | 1.05 (0.88, 1.27) | 1.25* (1.02, 1.53) | 0.92 (0.84, 1.00) | 1.06 (0.91, 1.25) | 1.07 (0.90, 1.26) | 1.25* (1.15, 1.37) |
| Tertiary education (< 4 years) | 1.08 (0.97, 1.20) | 1.21* (1.04, 1.41) | 1.73* (1.28, 2.36) | 1.57* (1.29, 1.90) | 1.06 (0.87, 1.30) | 1.64* (1.34, 2.02) | 0.74* (0.67, 0.82) | 1.28* (1.09, 1.52) | 1.01 (0.84, 1.21) | 1.29* (1.18, 1.42) |
| Tertiary education (> 4 years) | 1.01 (0.91, 1.12) | 1.03 (0.90, 1.19) | 1.82* (1.38, 2.42) | 1.64* (1.37, 1.97) | 0.88 (0.73, 1.06) | 1.58* (1.30, 1.93) | 0.55* (0.50, 0.60) | 1.06 (0.91, 1.25) | 0.80* (0.67, 0.95) | 1.35* (1.24, 1.48) |
| Non-Norwegian ethnicity | 1.33* (1.18, 1.50) | 1.64* (1.43, 1.89) | 1.60* (1.26, 2.02) | 1.71* (1.45, 2.00) | 1.69* (1.41, 2.02) | 1.58* (1.31, 1.89) | 1.22* (1.09, 1.37) | 1.29* (1.09, 1.53) | 1.78* (1.50, 2.10) | 0.98 (0.88, 1.09) |
| One SLE vs no SLEs | 1.21* (1.11, 1.32) | 1.67* (1.49, 1.87) | 2.02* (1.62, 2.51) | 1.46 * (1.27, 1.68) | 1.47* (1.25, 1.71) | 1.24* (1.06, 1.44) | 1.32* (1.23, 1.43) | 1.39* (1.22, 1.58) | 1.28* (1.11, 1.47) | 1.52* (1.42, 1.63) |
| Two SLEs vs no SLEs | 1.43* (1.28, 1.60) | 2.29* (2.00, 2.61) | 2.84* (2.21, 3.63) | 2.10* (1.79, 2.47) | 2.27* (1.90, 2.70) | 1.79* (1.49, 2.13) | 1.48* (1.34, 1.64) | 1.99* (1.70, 2.32) | 1.64* (1.38, 1.93) | 1.94* (1.77, 2.13) |
| ≥ Three SLEs vs no SLEs | 1.99* (1.76, 2.24) | 3.06* (2.66, 3.51) | 4.57* (3.60, 5.79) | 2.85* (2.42, 3.35) | 3.13* (2.62, 3.73) | 2.56* (2.13, 3.06) | 1.89* (1.69, 2.11) | 2.91* (2.48, 3.39) | 2.09* (1.75, 2.49) | 2.40* (2.16, 2.67) |

Note. * $p < .05$. *OR* = Odds ratio. *ORs* > 1 indicate a positive association, *ORs* < 1 indicate a negative relationship.

**Table 4.** Predicting SLE exposure in adulthood from SLEs in childhood/adolescence.

| | Serious illness/ accident | Violence | Sexual abuse | Bullying | Witnessing viol./ sex. abuse | Something else frightening | Loss and severe grief | Painful hospital treatment | Painful dental treatment | Illness/accident of a loved one |
|---|---|---|---|---|---|---|---|---|---|---|
| | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) | *OR* (95% CI) |
| Intercept | 0.06* (0.05, 0.08) | 0.40* (0.29, 0.55) | 0.05* (0.03, 0.10) | 0.12* (0.08, 0.18) | 0.18* (0.12, 0.28) | 0.04* (0.03, 0.06) | 0.22* (0.18, 0.28) | 0.06* (0.04, 0.09) | 0.12* (0.08, 0.17) | 0.41* (0.34, 0.51) |
| Age | 1.02* (1.01, 1.02) | 0.97* (0.96, 0.97) | 0.98* (0.98, 0.99) | 0.98* (0.98, 0.99) | 0.97* (0.97, 0.98) | 0.99 (0.98, 1.00) | 1.02* (1.01, 1.02) | 1.00 (0.99, 1.00) | 0.99* (0.98, 0.99) | 1.00 (1.00, 1.00) |
| Sex | 1.53* (1.42, 1.65) | 1.63* (1.48, 1.80) | 0.10* (0.07, 0.13) | 0.68* (0.60, 0.77) | 0.92 (0.81, 1.05) | 1.88* (1.65, 2.15) | 0.61* (0.58, 0.66) | 0.88* (0.79, 0.99) | 1.08 (0.96, 1.22) | 0.69* (0.65, 0.74) |
| Secondary education | 1.02 (0.92, 1.13) | 1.10 (0.95, 1.28) | 1.32 (0.97, 1.81) | 1.35* (1.11, 1.63) | 1.08 (0.90, 1.31) | 1.26* (1.03, 1.55) | 0.92 (0.85, 1.01) | 1.08 (0.92, 1.27) | 1.06 (0.89, 1.25) | 1.25* (1.14, 1.37) |
| Tertiary education (< 4 years) | 1.07 (0.95, 1.19) | 1.21* (1.04, 1.41) | 1.80* (1.32, 2.48) | 1.60* (1.31, 1.95) | 1.07 (0.87, 1.31) | 1.62* (1.31, 2.01) | 0.75* (0.68, 0.82) | 1.28* (1.08, 1.52) | 1.04 (0.87, 1.25) | 1.30* (1.18, 1.43) |
| Tertiary education (> 4 years) | 1.00 (0.90, 1.11) | 1.07 (0.93, 1.24) | 1.87* (1.40, 2.51) | 1.64* (1.36, 1.98) | 0.88 (0.73, 1.07) | 1.55* (1.27, 1.90) | 0.56* (0.51, 0.61) | 1.09 (0.92, 1.28) | 0.77* (0.64, 0.92) | 1.37* (1.26, 1.51) |
| Non-Norwegian ethnicity | 1.33* (1.17, 1.51) | 1.65* (1.43, 1.90) | 1.51* (1.18, 1.93) | 1.67* (1.41, 1.97) | 1.61* (1.33, 1.94) | 1.57* (1.29, 1.88) | 1.21* (1.08, 1.36) | 1.29* (1.08, 1.53) | 1.69* (1.41, 2.01) | 0.98 (0.88, 1.10) |
| Serious illness/ accident | 0.62* (0.52, 0.74) | 1.39* (1.16, 1.66) | 1.17 (0.83, 1.62) | 1.06 (0.84, 1.33) | 1.23 (0.96, 1.55) | 0.99 (0.76, 1.27) | 1.20* (1.04, 1.38) | 1.15 (0.92, 1.43) | 1.07 (0.84, 1.35) | 1.32* (1.15, 1.50) |
| Violence | 1.56* (1.35, 1.81) | 0.75* (0.62, 0.89) | 1.86* (1.38, 2.48) | 1.74* (1.43, 2.12) | 1.56* (1.25, 1.92) | 1.12 (0.89, 1.41) | 1.01 (0.87, 1.16) | 1.45* (1.18, 1.76) | 1.46* (1.18, 1.80) | 1.20* (1.05, 1.37) |
| Sexual abuse | 1.39* (1.21, 1.59) | 2.03* (1.74, 2.36) | 1.17 (0.91, 1.49) | 1.33* (1.10, 1.59) | 1.42* (1.16, 1.74) | 1.56* (1.25, 1.92) | 1.19* (1.05, 1.35) | 1.41* (1.18, 1.69) | 1.30* (1.06, 1.58) | 1.23* (1.10, 1.39) |
| Bullying | 0.99 (0.89, 1.09) | 1.34* (1.19, 1.51) | 1.18 (0.95, 1.46) | 0.94 (0.80, 1.09) | 1.29* (1.10, 1.50) | 1.20* (1.02, 1.41) | 1.26* (1.15, 1.38) | 1.26* (1.09, 1.44) | 1.41* (1.21, 1.63) | 1.28* (1.18, 1.39) |
| Witnessing viol./ sex. abuse | 1.15 (0.96, 1.37) | 1.90* (1.58, 2.28) | 1.10 (0.79, 1.50) | 0.94 (0.74, 1.19) | 1.19 (0.93, 1.52) | 1.50* (1.17, 1.91) | 1.13 (0.96, 1.33) | 1.06 (0.84, 1.33) | 1.06 (0.82, 1.36) | 1.54* (1.32, 1.79) |
| Something else frightening | 1.47* (1.21, 1.79) | 1.09 (0.81, 1.44) | 1.29 (0.83, 1.95) | 0.85 (0.59, 1.20) | 1.16 (0.80, 1.63) | 0.92 (0.62, 1.33) | 1.56* (1.30, 1.88) | 1.40* (1.05, 1.83) | 1.49* (1.09, 1.99) | 1.53* (1.27, 1.83) |
| Loss and severe grief | 1.10 (0.93, 1.29) | 0.99 (0.81, 1.21) | 1.61* (1.19, 2.15) | 1.28* (1.02, 1.60) | 0.94 (0.71, 1.21) | 1.18 (0.91, 1.52) | 0.71* (0.61, 0.83) | 1.43* (1.16, 1.76) | 1.31* (1.04, 1.64) | 1.23* (1.08, 1.41) |
| Painful treatment in hospital | 1.23* (1.02, 1.48) | 1.02 (0.80, 1.28) | 1.34 (0.93, 1.89) | 1.33* (1.03, 1.71) | 1.08 (0.80, 1.44) | 1.37* (1.02, 1.81) | 1.12 (0.94, 1.33) | 0.57* (0.41, 0.78) | 1.67* (1.28, 2.15) | 1.08 (0.92, 1.27) |
| Painful dental treatment | 1.29* (1.18, 1.41) | 1.35* (1.20, 1.51) | 1.53* (1.25, 1.87) | 1.34* (1.17, 1.54) | 1.42* (1.23, 1.65) | 1.01 (0.86, 1.18) | 1.47* (1.36, 1.60) | 1.55* (1.37, 1.76) | 0.63* (0.53, 0.74) | 1.65* (1.53, 1.78) |
| Illness/accident of a loved one | 1.20* (1.01, 1.42) | 1.03 (0.83, 1.26) | 1.16 (0.82, 1.61) | 1.08 (0.84, 1.38) | 1.28 (0.99, 1.65) | 1.14 (0.87, 1.49) | 1.15 (0.97, 1.34) | 0.95 (0.74, 1.21) | 1.39* (1.08, 1.76) | 0.87 (0.75, 1.02) |
| Childhood neglect | 1.41* (1.22, 1.62) | 1.89* (1.62, 2.20) | 2.36* (1.84, 3.01) | 2.67* (2.25, 3.16) | 1.69* (1.38, 2.06) | 1.99* (1.62, 2.42) | 1.17* (1.02, 1.33) | 1.77* (1.48, 2.11) | 1.40* (1.14, 1.71) | 1.07 (0.94, 1.21) |

Note. * $p < .05$. *OR* = Odds ratio. *OR*s > 1 indicate a positive association, *OR*s < 1 indicate a negative relationship.

categories in adulthood. Childhood neglect was the strongest individual predictor for SLE exposure in adulthood.

In line with previous studies, the results of the present study showed that SLEs are systematically connected with each other. Although all SLEs that were assessed in the Tromsø7 study were intercorrelated to varying degrees, four groups of SLEs emerged in the network analysis. The four groups were differentiated by age at exposure and types of SLEs. Two groups comprised SLEs in childhood/adolescence, and two groups consisted of SLEs in adulthood. The first group of SLEs in childhood/adolescence included having experienced and witnessed violence, sexual abuse, childhood neglect, and bullying. These SLEs can be characterized as interpersonal as they are caused by the intentional actions of other persons or parental negligence (Allen, 2001). In contrast, the second cluster of SLEs in childhood/adolescence were more impersonal in nature. Having experienced a life-threatening illness or a serious accident was related to painful/frightening treatment at hospital, which again was associated with painful/frightening dental treatment. Further, part of this cluster of SLEs were a life-threatening illness or serious accident of a loved one and the loss of a loved one and experiencing severe grief, which were strongly related. This association is consistent with studies suggesting that the risk of developing complicated grief is increased after the loss of a loved one due to serious illness (e.g. cancer; Kersting et al., 2011) and unnatural death, such as accident (Djelantik et al., 2020). Finally, having experienced something else frightening, dangerous, or violent, such as a natural disaster, war, or terror attack, was included in this group of PTEs in childhood/adolescence via its association with the loss of a loved one and severe grief. Given that many participants were old enough to have experienced the Second World War (Thimm et al., 2021), it can be speculated that this association is due to the loss of a loved one during the war. The two groups of SLEs in adulthood were highly similar to the two groups of SLEs in childhood/adolescence. However, in adulthood, exposure to something else frightening was clustered with the interpersonal SLEs in adulthood and most strongly related to having experienced and witnessed violence. Thus, this broad SLE category had different connections with other SLEs in childhood/adolescence and in adulthood in the Tromsø7 sample.

The study's findings further suggest that SLEs in childhood/adolescence predict subsequent exposure to SLEs in adulthood. The results showed that exposure to any SLE in childhood/adolescence increased the risk of experiencing all SLEs that were assessed in adulthood, especially sexual abuse and violence. In accordance with the established dose–response relationships of SLEs in childhood with somatic health, mental health, and functioning in adulthood (Copeland et al., 2018; Felitti et al., 1998), the present study found that the number of SLEs in childhood/adolescence also predicted the number of SLEs in adulthood. Further, the sum of childhood/adolescent SLEs predicted the occurrence of specific SLEs in adulthood, especially the violence-related SLEs with the highest risk for sexual abuse. These results are consistent with studies reporting significant associations between SLEs in childhood and adulthood (e.g. Dias et al., 2017; Fanslow et al., 2021; Li et al., 2019; Ports et al., 2016; Widom et al., 2008).

While the majority of SLEs in childhood/adolescence were positively associated with SLE exposure in adulthood, there were a few small negative associations between SLEs in childhood/adolescence and their counterparts in adulthood, including painful/frightening dental treatment, a life-threatening illness or accident, and the loss of a loved one and severe grief. The oral health and availability of dental health services in northern Norway have improved over the years (Grytten & Skau, 2022), and the focus has shifted from symptom driven, invasive treatment to preventive and patient centred treatment approaches. Hence, the changes in the provision and nature of dental services, could help explain the finding that reporting painful/frightening dental treatment in childhood decreased the odds of reporting such events in adulthood in the current sample. The negative correlations for a life-threatening illness or serious accident and the loss of a loved one and severe grief may be due to participants focusing on the most salient illness/accident and loss in their life, which may have happened in childhood/adolescence or in adulthood.

Across the different statistical analyses, childhood neglect appeared as an important predictor of other SLEs in childhood/adolescence and adulthood. For example, childhood neglect was the strongest predictor of the number of SLEs experienced in adulthood and predicted significantly all specific SLEs in adulthood, except for a life-threatening illness or serious accident of a loved one. Moreover, in network analysis, childhood neglect showed the highest bridge strength, indicating that childhood neglect had the strongest associations with SLEs in adulthood of all SLEs in childhood. These findings align with studies suggesting that parental care is a protective factor for revictimization after sexual abuse in childhood (Scoglio et al., 2021). The association between childhood neglect and subsequent SLEs in adulthood has also been found in previous investigations (Dias et al., 2017; Gama et al., 2021). However, in these studies, childhood emotional abuse, which was not assessed in the present study, was a stronger predictor for SLE exposure in adulthood than physical and emotional neglect in childhood (Dias et al., 2017;

Gama et al., 2021). Interestingly, in the present study, childhood neglect was very highly correlated with thinking a lot about the SLE(s) one has experienced, suggesting that the participants were especially preoccupied with the lack of care in childhood compared to other SLEs.

In addition to childhood neglect, SLEs in childhood/adolescence and adulthood were predicted by other SLEs. For example, painful/frightening dental treatment in childhood/adolescence predicted most SLEs in adulthood, suggesting that single SLEs can increase the risk of experiencing a variety of subsequent SLEs. The current study does not provide information about the possible mechanisms that link SLEs in childhood/adolescence and SLEs in adulthood. However, it seems likely that reexposure to SLEs is the result of an interplay between cognitive, emotional, and neurophysiological factors (McLaughlin et al., 2020). Cognitive factors include changes in information processing after SLEs, such as increased threat monitoring and the development of negative cognitive schemas that lead to the misinterpretation of situations (McLaughlin & Lambert, 2017; Pilkington et al., 2021). Emotional factors refer to alterations in emotion processing after SLEs, e.g. increased emotional reactivity and maladaptive emotion regulation (McLaughlin et al., 2020). Supporting the role of emotion, several studies have reported that mental health problems are a risk factor for reexposure to SLEs (e.g. Miron & Orcutt, 2014; Papalia et al., 2021). A recent review (Walker & Wamser-Nanney, 2022) proposed posttraumatic stress symptoms as a core factor that can explain other suggested psychological factors for reexposure to SLEs, such as emotion regulation difficulties, anger and aggression, impaired risk recognition, and maladaptive coping strategies (e.g. substance misuse). McLaughlin et al. (2014) suggested that exposure to threat or deprivation influences neural development and behaviour. Consistent with this view, alterations in brain structure, connectivity, and function have been documented after SLE exposure (Teicher et al., 2016), which may lead to changes in psychological functioning that make the individual vulnerable to subsequent SLEs. From an evolutionary perspective, early experiences of harshness or unpredictability may lead to accelerated life history strategies, including risk-taking behaviours (Ellis et al., 2009). The increased risk of experiencing painful/frightening treatment in hospital or by a dentist in adulthood after SLEs in childhood observed in the present study can be explained by increased pain sensitivity after SLEs (Nanavaty et al., 2023). It is also conceivable that SLEs in childhood, especially neglect, increase the risk of poor dental health and thereby the need for extensive and potentially painful/frightening dental treatment in adulthood (cf. Valencia-Rojas et al., 2008).

However, the causes for reexposure to SLEs may lie not only within the individual, and contextual factors can also play a role, such as the social environment. In the present study, a life-threatening illness or serious accident of a loved one was also predicted by other SLEs, which cannot be explained by individual factors. Rather, this finding suggests that the person who has experienced SLEs tends to live in a social environment, in which the risk of having a life-threatening illness or serious accident is increased. It has, for example, been demonstrated that low socioeconomic status and belonging to an ethnic minority is associated with poorer health (Bleich et al., 2012).

The findings of the present study underscore the importance of the prevention of SLEs and the early intervention after SLEs to hinder the accumulation of SLEs and the development of mental and somatic health problems that follows with multiple SLE exposure. The prevention of SLEs should address the individual, relationship, community, and societal level (Magruder et al., 2017). Generally, social support has been identified as a protective factor against psychological problems after SLE exposure (McLaughlin et al., 2020). A particular emphasis should be given to the prevention of childhood neglect as the study's findings indicate that particularly childhood neglect increases the risk for reexposure to SLEs. Thus, parental care should be an important public health focus.

The large sample, the assessment of a wide range of SLEs, and the use of network analysis are strengths of the present study. On the other hand, SLEs were comprised in a limited number of categories. The results from network analyses depend on the elements that are included, which limits the generalizability of the study findings. Further, age at exposure beyond the broad categories of childhood/adolescence and adulthood as well as the frequency of exposures to the different SLEs as factors that can possible affect reexposure to SLEs were not assessed. Moreover, the level of distress caused by the different SLEs was not measured. The retrospective assessment of SLEs involves a risk of recall bias. For example, mental health factors and personality dispositions have shown to have an impact on the recollection of adverse childhood experiences (Colman et al., 2016; Reuben et al., 2016). Finally, the Tromsø7 sample may not be representative for the population from which it was drawn (Thimm et al., 2021).

In the light of the present study's limitations, future investigations into the associations between SLEs should include more information about the exposure to SLEs (i.e. age and dose of exposure) and the individual's response to the exposure (e.g. distress and posttraumatic stress symptoms). It is also recommended that the selection of SLEs that are assessed is guided

by recent research on the core underlying dimensions of adversity (e.g. Ellis et al., 2022) and includes emotional abuse.

Taken together, the results of the present study suggest that SLEs are systematically interconnected. SLEs in adulthood were significantly predicted by SLEs in childhood and adolescence, especially by physical and emotional neglect. Public health policies should aim at the prevention of SLEs and the early intervention after SLE exposure, especially in childhood.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Data availability

The data that support the findings of this study are available from the Tromsø study upon application. Legal restrictions apply to the availability of these data. Information on how to apply for access to data from the Tromsø study is available at https://uit.no/research/tromsostudy.

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