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**Psychological abuse, substance abuse distress, dissatisfaction with friendships, and
incident psychiatric problems**

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Abstract

Objective: The aim of this study was to assess the mediating role of dissatisfaction with friendships in adulthood in the associations between psychological abuse in childhood, substance abuse distress in childhood, and incident psychiatric problems (IPPs) in adulthood over 13 years of follow-up. **Methods:** We used data collected from 1994 to 2008 within the framework of the Tromsø Study (N=9,502), a representative, longitudinal, prospective cohort study. Poisson regression analysis was used to assess the associations between psychological abuse, substance abuse distress, dissatisfaction with friendships in adulthood, and IPPs in adulthood. Indirect effects and proportion mediated (%) were assessed with the difference-in-coefficients method. **Results:** Psychological abuse (relative risk [RR]=1.66, 95% confidence interval [CI]: 1.45-1.89) and substance abuse distress in childhood (RR=1.38, 95% CI: 1.18-1.62) were associated with an increased risk of dissatisfaction with friendships in adulthood. Dissatisfaction with friendships in adulthood was associated with an increased risk of IPPs in adulthood (RR=1.71, 95% CI: 1.33-2.20). Moreover, dissatisfaction with friendships in adulthood mediated 9.31% (95% CI: 4.25-14.57) of the association between psychological abuse in childhood and IPPs in adulthood, and 9.17% (95% CI: 4.35-16.33) of the association between substance abuse distress in childhood and IPPs in adulthood. **Conclusions:** Dissatisfaction with friendships in adulthood mediates a minor proportion of the associations between psychological abuse, substance abuse distress, and IPPs in adulthood. Interventions aimed at decreasing dissatisfaction with friendships may dampen some of the effect of psychological abuse and substance abuse distress in childhood on IPPs in adulthood.

Key words: developmental psychopathology; emotional abuse; epidemiology; health psychology; mental abuse; mental health; psychiatric disorders; social relations; verbal abuse; verbal aggression

Highlights

- Psychological abuse and substance abuse distress in childhood are independently associated with an increased risk of dissatisfaction with friendships in adulthood.
- Psychological abuse, substance abuse distress, and dissatisfaction with friendships in adulthood are independently associated with an increased risk of incident psychiatric problems in adulthood.
- Dissatisfaction with friendships in adulthood independently mediates the effect of psychological abuse and substance abuse distress in childhood on incident psychiatric problems in adulthood.

INTRODUCTION

Psychological abuse in childhood often emerges as the most significant adverse childhood experience (ACE) in terms of its long-term effects on health and well-being in adulthood [1-4]. For instance, a recent report showed that psychological abuse in childhood explained a greater proportion of the variation in internalizing symptoms (depression and anxiety), health-related quality of life, and subjective well-being in adulthood, than physical abuse in childhood, parental education, socioeconomic conditions in childhood, and alcohol intake in adulthood [1]. It was also found that, compared to those exposed to physical abuse in childhood, those exposed to both psychological abuse and substance abuse distress in childhood (i.e., distress caused by problematic familial substance use) had significantly higher internalizing symptoms and lower subjective well-being in adulthood [1]. These findings suggest that psychological abuse and substance abuse distress in childhood maybe more important for health and well-being in adulthood than socioeconomic adversity and physical abuse in childhood (see also [2]). However, comprehensive studies are still needed to determine the mediating and protective causal mechanisms that act on these associations [5-8].

The risky families model [9], emotional dysregulation model [10], and biological embedding hypothesis [11, 12] all suggest that ACEs influence incident psychiatric problems (IPPs) in adulthood by provoking socio-emotional impairments [6, 7]. These impairments include symptoms and behaviours like, impulsivity, poor social skills, mistrust, reactive aggression, excessive reassurance-seeking, or hostility, and individuals with these impairments are more likely to be rejected by their normally-functioning peers [13, 14]; as a consequence, affected individuals may suffer from social isolation or loneliness [1, 6, 7]. For example, previous studies reported an association between ACEs and outcomes like poor social competence, oppositional behavior [15], lower levels of self-esteem [13], poor

interpersonal relationships, increased impulsive risk-taking behavior [16], affect dysregulation, poor self-image [17], and attributions [18]. Other evidence [1] has shown that psychological abuse and substance abuse distress in childhood explains up to 20% of the variation in perceived social support in adulthood. These findings suggest that deficits in social skills and socio-emotional impairments caused by psychological abuse and substance abuse distress in childhood not only reduces or hampers the capacity for developing and maintaining a social support network, but also that affected individuals may have a greater need for social relations [6, 19].

A functional social behaviour depends on a person's capacity for social interaction, which is an important part of maintaining a social support network and social relationships with peers [6, 7, 18]. The biological embedding hypothesis [11, 12] suggests that associations between psychological abuse, substance abuse distress, and IPPs and are partly driven by scarring, or embedding that limits one's ability to maintain and develop social relationships [6, 7]. As Pearlin et al. [20, p.211] noted, ". . . early abuse could exert harmful influences on one's scholastic performance, the regularity and quality of work, the ability to form and maintain supportive social relationships, leisure activities, self-concepts, or decision making processes". Indeed, previous studies have shown that psychological abuse in childhood can lead to high emotional reactivity in adulthood [21, 22]. For instance, previous studies have shown that psychological abuse in childhood (even when substance abuse distress in childhood is controlled for [23]) is associated with problem behaviours and antisocial behaviours [24, 25], which in turn may influence emotion dysregulation and maladaptive emotion regulation patterns in adulthood [6, 7, 26]. Behavioural problems and externalising behaviours (e.g., aggression) may create an inability to maintain and develop social relationships, which may influence IPPs in adulthood via feelings of loneliness and social isolation [1, 6, 7, 10, 27-29]. Other evidence suggests that deficits in emotion regulation

mediate the association between psychological abuse, substance abuse distress, and a wide range of psychopathologies in adulthood [10, 26, 30-33].

A key question in developmental psychopathology and psychology of social relations is whether dissatisfaction with friendships in adulthood (i.e., perceived inadequacy of the quality and quantity of friendships) has a mediating role, i.e., do ACEs affect one's perception of desired (or needed) quality and quantity of friendships, which in turn affects IPPs in adulthood (conceptualised as the indirect effect) [1, 6, 7]. It is of theoretical importance to answer this question if we want to determine the possible etiological role dissatisfaction with friendships in adulthood plays in the development of IPPs [1, 6, 7, 34, 35]. Dissatisfaction with friendships refers to the distressing feeling that accompanies discrepancies between one's desired and actual quality and quantity of friendships [6, 7]; it is a subjective phenomenon, i.e., it is not necessarily synonymous with 'lack of social support' or 'objective social isolation', as a person may perceive dissatisfaction with friendships even when an ample number of social contacts or sources of support exist [6, 7]. The advantage of obtaining a subjective evaluation from respondents is that it takes into account the cognitive mediating factors between interpersonal deficiency and emotional response [36, 37]. Indeed, previous evidence [6] has indicated that objective indices of social support are less important mediators of ACEs→IPPs associations, than the measures that take in account the discrepancy between achieved and desired quality and quantity of friendships. Although some definitions of loneliness entail feelings of dissatisfaction [37, 38], the subtle difference between the concept of "dissatisfaction with friendships" [6, 7] and "loneliness" [36] is that the former evaluates *both* the quality and quantity of friendships, while the latter may evaluate either one of these, or both with reference to social relations in a broader context. The commonalities between "dissatisfaction with friendships", "loneliness" and "perceived social isolation" are that they are unpleasant and distressing. Indeed, research on animal

models, such as rats and monkeys, suggests the existence of a biological mechanism between social isolation and psychiatric disorders [39-41].

Drawing upon the seminal contributions by Weiss, Peplau, and Perlman [e.g., 36, 37, 38, 42-45], Hawkley and Cacioppo [46] proposed the phenomena of the “loneliness loop”, which may explain the association between dissatisfaction with friendships and IPPs [7]. Dissatisfaction with friendships is capable of making an individual more dismissive and avoidant in their social relationships because they expect social rejection and negative social interactions, making them more socially withdrawn [6, 7, 42]. The *incapacity* to maintain and develop social relationships combined with negative social expectations tends to elicit behaviours from others that confirm these expectations as “self-fulfilling prophecies” [7, 36]. This self-reinforcing “loneliness loop” may contribute to IPPs via feelings of ostracism, negativism, hostility [47, 48], pessimism [43], and rejection [7, 46, 49] (see also the construct of “inhibited sociability” [50]).

Few previous studies [1, 6, 7, 31, 51, 52] have considered the mediating role of perceived social support in the association between psychological abuse, substance abuse distress, and IPPs; however, the question of whether *feelings* of dissatisfaction or lack of fulfillment with social connections mediates the association between psychological abuse, substance abuse distress, and IPPs in adulthood remains unclear [6, 7]. In addition, there were several other limitations in previous studies. Firstly, several studies [6, 7, 31, 51-53] constructed a cumulative index of ACEs, by counting the number of adversities or stressors in childhood on an additive scale. This makes it impossible to assess whether psychological abuse or substance abuse distress *independently* affect IPPs in adulthood. For instance, by conceptualizing an index of ACEs in a dose-response manner [5, 6, 8, 53], the type of ACE and accumulation of ACE are confounded [1, 2]. Someone who reports being psychologically abused in childhood is not the same as a person who experienced distress in childhood due to

problematic familial substance abuse, yet both these individuals would receive a score of 1 in an index of ACEs.

Secondly, some studies [31, 51, 52, 54] relied on very small, selective study samples, which are prone to selection bias and are not helpful in determining general population estimates. Thirdly, some studies [1, 31, 51, 53, 54] assessed the association between perceived social support and IPPs in a cross-sectional sample, which makes it impossible to ascertain the temporal order between these variables. Fourth, one study [52] did not present the indirect effect estimates and corresponding confidence intervals (CIs). Lastly, few studies [35, 53, 54] that assessed the associations between psychological abuse in childhood, perceived social support, and psychopathology in adulthood did not consider the mediating role of perceived social support in the analysis.

The questions this study aims to address are: (1) are those who experience psychological abuse or substance abuse distress in childhood more likely to experience dissatisfaction with friendships in early mid-life?; (2) are those who experience dissatisfaction with friendships in early mid-life more likely to develop psychopathology in early old age?; (3) are those who experience psychological abuse or substance abuse distress in childhood more likely to develop psychopathology in early old age?; and (4) what proportion of these associations are mediated via dissatisfaction with friendships in early mid-life?

METHODS

Study population

The Tromsø Study is a longitudinal prospective cohort study and its participants are considered representative of the adult population residing in the municipality of Tromsø [55]. The primary and initial aim of Tromsø Study was to understand the causes of cardiovascular diseases in Norway [55]. Between 1974 and 2007-2008, six waves, or surveys, of the Tromsø Study were conducted (referred to as Tromsø I-VI) [55]. To be eligible for the present analyses, participants had to have attended both the Tromsø IV (1994-1995), and Tromsø VI (2007-2008) surveys (N=9,502). Only individuals who participated in Tromsø IV and Tromsø VI were eligible for inclusion because psychological abuse and substance abuse distress in childhood were only measured in Tromsø VI, and dissatisfaction with friendships was only measured in Tromsø IV.

Ethical approval

This investigation was carried out in accordance with the latest version of the Declaration of Helsinki. The Tromsø Study has been approved by the Regional Committee for Medical and Health Research Ethics, the Data Inspectorate, and the Norwegian Directorate of Health.

Written informed consent was obtained from all individual participants included in the study.

Study variables

Exposure (psychological abuse and substance abuse distress in childhood)

Self-reported information on psychological abuse and substance abuse distress in childhood was measured in Tromsø VI by the question: “Have you over a long period experienced any of the following as a child?” followed by two types of ACEs: (i) being tormented, or threatened with violence; (ii) someone in your close family using alcohol or drugs in such a

way that caused you worry. Participants who responded positively to either of these types of ACEs were classified as exposed to psychological abuse and substance abuse distress in childhood, respectively [1, 5, 6, 8].

Mediator (dissatisfaction with friendships)

The operational definition of dissatisfaction with friendships in this study was the perception that one's social needs were not met by the quantity and quality of friends. In contrast to the objective measures of social support, dissatisfaction with friendships focuses on the discrepancy between one's achieved and desired quality and quantity of friendships.

Dissatisfaction with friendships was measured in the Tromsø IV questionnaire (mean age: 46.85 years) by the question "Do you feel that you have enough good friends?" (yes=0, no=1). Those responding 'no' were categorised as dissatisfied with friendships, while those responding 'yes' were categorised as satisfied with friendships.

Outcome (incident psychiatric problems)

Psychiatric problems were measured by the question: "Do you have, or have you had psychiatric problems for which you sought help?" (0=no, 1=yes). Cases of IPPs [56] were defined as participants who reported a diagnosis of a psychopathology between Tromsø IV and Tromsø VI (i.e., between 1994 and 2008). In order to preserve temporality between dissatisfaction with friendships and psychiatric diagnosis, prevalent psychiatric diagnosis (i.e., those diagnosed before Tromsø IV, n=823) were excluded from the study sample. Of the remaining 9,502 participants included in this analysis, there were 322 cases of IPPs diagnosed during the study period (i.e., between 1994 and 2008). The associations between

ACEs and *prevalence* of psychiatric problems has been shown in an earlier study that also used data from the Tromsø Study [56].

Confounding variables (Tromsø IV)

The potential confounding variables age, gender, living in Norway at age 1 year (yes/no), parental history of psychopathology (yes/no) and dementia (yes/no), physical activity, alcohol frequency (times/month), beer frequency (times/fortnight), living with spouse (yes/no), and participation in organised social gatherings were chosen based on *a priori* knowledge of the association between psychological abuse, substance abuse distress, dissatisfaction with friendships, and psychiatric problems [5-8, 57]. Valid information on age and gender was obtained from Statistics Norway by using the unique personal identification number of each participant. The test-retest reliability of mother's and father's history of psychopathology in this sample were Kappa: 0.57 (95% CI: 0.52-0.62) and Kappa: 0.61 (95% CI: 0.53; 0.69), respectively. Physical activity was measured with the question [57], "How has your weekly average physical activity in leisure time been during this last year?" The response alternatives were: 'none', 'less than 1', '1-2', and '3 or more' hours/week. Participation in organised social gatherings was measured as: "How often do you normally participate in organised gatherings?" The response alternatives were: 'never, or just a few times a year', '1-2 times a month', 'approximately once a week', and 'more than once a week'. Psychological abuse in childhood may confound the substance abuse distress→dissatisfaction with friendships, and the substance abuse distress→IPPs associations; therefore, it was also included as a confounding variable when substance abuse distress was used as a predictor in the statistical model (Table 4). Similarly, substance abuse distress in childhood may confound the psychological abuse→dissatisfaction with friendships, and psychological abuse→IPPs

associations; therefore, it was also included as a confounding variable when psychological abuse was used as a predictor in the statistical model (Table 4).

Statistical analysis

All analyses were conducted using Stata version 15. Missing values were generated with multiple imputation (with chained equations). A comparison between the complete-case (excluding missing) and the imputed dataset is presented with proportions (%), and means (standard error, SE). All statistical analyses were performed on the imputed dataset, and both unadjusted (crude) and adjusted estimates are presented.

The association between psychological abuse, substance abuse distress, dissatisfaction with friendships in adulthood, and IPPs in adulthood were assessed by Poisson regression analysis with a robust error variance [58]. Relative risks (RRs) and 95% CIs are presented. No statistically significant multiplicative interactions between psychological abuse, substance abuse distress, dissatisfaction with friendships, and confounding variables were observed in this sample.

Mediation was assessed with the difference-in-coefficients method [2]. Four estimates are presented: total effects (adjusted for confounding variables), direct effects (adjusted for confounding variables and dissatisfaction with friendships), indirect effects, and proportion mediated (%).

The indirect effect was calculated as [58]:

$$\beta_{\text{Indirect effect}} = \beta_{\text{Total effect}} - \beta_{\text{Direct effect}}$$

Proportion mediated (%) was calculated as [2]:

$$\text{Proportion mediated (\%)} = \frac{\beta_{\text{Total effect}} - \beta_{\text{Direct effect}}}{\beta_{\text{Total effect}}} * 100$$

SEs were derived with bias-corrected bootstrapping [58] for hypothesis testing, and 95% CIs are presented.

RESULTS

The majority of the 9,502 respondents were aged 45 years and above (61.5%), were female (52.8%), and were living with a spouse (83.9%) (Table 1). A minor proportion of the respondents reported parental history of dementia (11.4%), having lived outside of Norway at age 1 (2.0%), and not living with a spouse (16.1%) in 1994-1995 (Tromsø IV) (Table 1). Only 7.2% of respondents reported psychological abuse in childhood, and 5.8% reported substance abuse distress in childhood (Table 1). A substantial proportion (17.1%) of respondents reported dissatisfaction with friendships in adulthood, and a minor proportion (3.4%) reported IPPs during the study period (1994/1995-2007/2008) (Table 1).

Psychological abuse in childhood was significantly ($p < 0.05$) associated with *not* living with a spouse in adulthood (RR=1.05, 95% CI: 1.01, 1.09); however, substance abuse distress in childhood was not significantly associated ($p = 0.793$) with living with a spouse in adulthood. Respondents that were *not* living with a spouse in adulthood had a 5% increased risk ($p < 0.001$) of dissatisfaction with friendships in adulthood (RR=1.05, 95% CI: 1.02, 1.08). Although living with a spouse was associated (RR=0.92, 95% CI: 0.68, 1.26) with a lower risk of IPPs, the association was not statistically significant ($p = 0.611$).

In the fully-adjusted models, psychological abuse in childhood was associated with a 66% higher risk of dissatisfaction with friendships in adulthood (RR=1.66, 95% CI: 1.45-1.89) while substance abuse distress in childhood was associated with a 38% higher risk of dissatisfaction with friendships in adulthood (RR=1.38, 95% CI: 1.18-1.62) (Table 2). In the fully-adjusted model, dissatisfaction with friendships was associated with a 71% higher risk of IPPs during the study period (RR=1.71, 95% CI: 1.33-2.20) (Table 3).

Psychological abuse in childhood was associated with a more than two-fold higher risk of IPPs in adulthood (RR_{Total Effect}=2.03, 95% CI: 1.66-2.51), while substance abuse

distress in childhood was associated with 47% higher risk of IPPs in adulthood ($RR_{Total\ Effect}=1.47$, 95% CI: 1.35-1.80) (Table 4). Decomposition of total effects into direct and indirect effects showed that psychological abuse and substance abuse distress in childhood affects IPPs both independent of dissatisfaction with friendships ($p<0.05$), and via dissatisfaction with friendships in adulthood ($p<0.05$). Dissatisfaction with friendships in adulthood mediated 9.31% (95% CI: 4.25-14.57) of the association between psychological abuse in childhood and IPPs in adulthood, and 9.17% (95% CI: 4.35-16.33) of the association between substance abuse distress in childhood and IPPs in adulthood (Table 4).

DISCUSSION

This is the first study that sought to determine whether dissatisfaction with friendships in adulthood functions as a mediator by which psychological abuse or substance abuse distress in childhood affects IPPs in adulthood. In this representative sample of 9,520 individuals, psychological abuse and substance abuse distress in childhood were *independently* associated with dissatisfaction with friendships in adulthood, and psychological abuse, substance abuse distress, and dissatisfaction with friendships were *independently* associated with increased risk of IPPs in adulthood. Dissatisfaction with friendships does not play a moderating role in the association between psychological abuse, substance abuse distress, and IPPs in adulthood; however, it significantly mediates approximately 9% of the association between each of these ACEs and IPPs in adulthood. The proportion mediated estimate of approximately 9% is certainly modest in absolute terms, but within the age span and as a single indicator for mediator (dissatisfaction with friendships in adulthood) it could be interpreted as relatively sizable. Moreover, the large number of confounding variables included in this study suggests that the mediating mechanism, although small, may be real.

Genetic influences [59, 60], ACEs [1, 6-8, 56, 61], environmental exposures, and ongoing stress are factors that combine to determine how an individual responds to stress, as well as their vulnerability to psychopathology in adulthood [11, 51, 62]. Accordingly, it is important to determine whether the mediated effect (indirect effect) is due to dissatisfaction with friendships or some other unmeasured or unaccounted-for variable [5, 6]. Several studies reported a strong relationship between indicators of perceived social support, marital status, and socially patterned differences in behavioural factors such as alcohol intake, participation in organised social gatherings, and physical activity [57, 63-66]. Others have shown that these factors are associated with ACEs [1, 5, 23, 67-72] and psychopathology in adulthood [1, 5, 57]. Participation in organised social gatherings, beer frequency, and physical activity

were not significantly associated with psychological abuse or substance abuse distress in childhood (data not shown). Similarly, indicators of alcohol intake and physical activity were not significantly associated with dissatisfaction with friendships in adulthood, and none of the behavioural factors were significantly associated with IPPs in this sample (data not shown). Moreover, living with a spouse in adulthood was not significantly associated with IPPs in adulthood.

This study focused on only two indicators of ACEs, as other indicators, such as sexual abuse, separation of parents, witnessing domestic violence in the home, living with someone with psychiatric disorders, living with someone who has been incarcerated, etc., were not measured in the Tromsø Study. Retrospective mismeasurement of psychological abuse and substance abuse distress in childhood maybe influenced by age, perceived social isolation, and psychological state of the respondents [38, 56, 73-75]; however, a review of the previous studies suggest that these biases should be fairly low [30, 56, 73, 74, 76, 77]. Moreover, in a study by Fergusson et al.,[77] differential recall bias was responsible for less than 1% of the association between retrospective self-reports of ACEs and mental health. For this reason, the observed association between ACEs and mental health closely approximated the true association [77]. Brown et al. [76] also found that there was no significant recall bias other than some evidence of underreporting of ACEs. Previous studies have reported prevalence estimates of psychological abuse in Norway of 8.3-16% [78-81]. Clearly, psychological abuse in childhood is under-estimated in this study sample. Consequently, it is plausible that the magnitude of associations presented here are under-estimated. Additionally, the psychological abuse variable did not differentiate between abuse in peer groups or in the family environment, and these settings may be differentially related to the absence of later, good-quality peer friendships, and psychopathology in adulthood. For instance, a recent study

showed that adversity in the family environment is not related to lower-quality friendships in early or late adolescence [82].

Respondents with certain psychiatric problems may have a tendency to form rather cynical and pessimistic perceptions of their childhood [6, 7], which in turn may lead to overestimation in the associations between psychological abuse, substance abuse distress, and IPPs. Information on specific psychopathology and who assigned psychiatric diagnoses was not measured. Psychiatric problems may span from mild cases of insomnia and phobia to severe disorders, such as schizophrenia and psychosis. It is plausible that the hypothesized mechanism applies only to certain, not all, psychiatric problems. Indeed, each psychiatric disorder may have different biological and psychological mechanisms.

The present study deals only with dissatisfaction with friendships rather than the whole construct of perceived social support [6, 7]. The drawback of using a single item for measuring dissatisfaction with friendships is that it may capture related concepts such as self-esteem and neuroticism. Therefore, in the absence of self-esteem or neuroticism as control variables in the models, it is plausible that the indirect effects presented here are overestimated.

Methodologically, the present study improves on existing research, as we evaluated the *independent* effect of psychological abuse and substance abuse distress in childhood on IPPs. Previous studies [5-8, 31, 51-53] lacked specificity and nuance regarding psychological abuse and substance abuse distress in childhood because they constructed a cumulative index of ACEs. In contrast to previous studies that used a small and selective sample of participants enrolled from treatment centers [51], public child welfare systems [52], medical centers [31], and primary care clinics [54], the present study used a large, regionally representative, general population-based sample of respondents without regard to their health status. We have presented the indirect effects and proportion of mediated effect estimates, which makes

it easier to ascertain the relative importance of ‘dissatisfaction with friendships in adulthood’ in the association between psychological abuse, substance abuse distress, and IPPs in adulthood. Lastly, we measured dissatisfaction with friendships in adulthood 13 years before the measurement of IPPs, which avoids the possibility of mood congruency bias and colouring of self-reports via current state of mind. Although social support is one of the most well-studied psychological constructs/processes with respect to ACEs and mental health in adulthood [1, 6, 7], the conceptual novelty of this study is that it highlights dissatisfaction with friendships in adulthood as a mechanism through which psychological abuse and substance abuse distress in childhood independently influence IPPs in adulthood.

This study contributes to the growing recognition [6, 7] that indicators of perceived social support in adulthood are one of the most robust and consistent mediators in the association between ACEs and mental health outcomes in adulthood. Previous evidence on other potential mediators, such as education [8, 61], and smoking [5] is much weaker. However, a few questions remain unanswered: do measures of perceived social support mediate the ACEs→IPPs in adulthood association above and beyond socio-emotional impairments, behavioural problems, emotion dysregulation, emotional inhibition, attachment styles, social competence, and social skills? What proportion of the ACEs→IPPs in adulthood association is attributable to respondent’s dissatisfaction with friendships, *independent* of socio-emotional impairments, behavioural problems, emotion dysregulation, emotional inhibition, attachment styles, social competence, and social skills? Future studies could address these questions.

Interventions aimed at decreasing dissatisfaction with friendships (and not necessarily aimed at increasing the number of friends) in adulthood may dampen some of the effect of psychological abuse and substance abuse distress in childhood on IPPs in adulthood. It may not be accurate to assume that people have a choice to maintain an active social life for a

better psychological well-being [1]. The socioemotional impairments caused by psychological abuse and substance abuse distress in childhood may affect one's ability to maintain and develop social relationships [6, 7]. Therefore, individuals who experienced psychological abuse or substance abuse distress in childhood may require person-specific interventions to reduce their feelings of dissatisfaction with friendships. For instance, interpersonal therapy aimed at reducing feelings of dissatisfaction with friendships may diminish the long-term consequences of psychological abuse and substance abuse distress in childhood on IPPs in adulthood.

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1. General characteristics of the study sample (N=9,502).

Characteristics		Complete-	Imputed
		case dataset	dataset
		n (%)	(%)
Age (in 1994) ^b	mean (SE)	46.9 (0.12)	– ^b
	25-34	1878 (19.8)	– ^b
	35-44	1784 (18.8)	– ^b
	45-54	3340 (35.2)	– ^b
	55-64	1842 (19.4)	– ^b
	65-74	658 (6.9)	– ^b
Gender ^b	Male	4486 (47.2)	– ^b
	Female	5016 (52.8)	– ^b
History of psychopathology, mother ^b	Yes	549 (5.8)	– ^b
	No	8953 (94.2)	– ^b
History of psychopathology, father ^b	Yes	201 (2.1)	– ^b
	No	9301 (97.9)	– ^b
Parental history of dementia ^b	Yes	1082 (11.4)	– ^b
	No	8420 (88.6)	– ^b
Lived in Norway at age 1 ^a	Yes	8287 (98.0)	98.0
	No	169 (2.0)	2.0
Living with spouse ^a	Yes	7159 (84.2)	83.9
	No	1342 (15.8)	16.1
Alcohol frequency (times/month) ^a	Mean (SE)	3.19 (0.04)	3.13 (0.04)
Beer frequency (glasses/fortnight) ^a	Mean (SE)	1.78 (0.04)	1.70 (0.03)
Physical activity hours/week ^a	None	900 (9.5)	9.5
	<1	1443 (15.3)	15.2
	1-2	3405 (36.0)	36.0
	>2	3714 (39.3)	39.3
Participation in social gatherings ^a	Never or few times/year	4449 (51.7)	52.1
	1-2 times/month	2212 (25.7)	25.6
	Approx. once/week	1259 (14.6)	14.5
	More than once/week	681 (7.9)	7.8
Exposure			
Psychological abuse in childhood ^b	Yes	684 (7.2)	– ^b
	No	8818 (92.8)	– ^b
Substance abuse distress in childhood ^b	Yes	551 (5.8)	– ^b
	No	8951 (94.2)	– ^b
Mediator			
Dissatisfaction with friendships ^a	Dissatisfied with friendships	1478 (17.2)	17.1
	Satisfied with friendships	7122 (82.8)	82.9
Outcome			
Incident psychiatric problems (IPPs) ^a	Yes	322 (3.4)	3.4
	No	9070 (96.6)	96.6

^aThe numbers for some variables do not add up to 9,502 due to missing values.

^bThere were no missing values, so no imputations were made for these variables.

SE=standard error

1 **Table 2. Association between adverse childhood experiences and dissatisfaction with friendships in adulthood (N=9,502).**

	Dissatisfaction with friendships in adulthood			
	Unadjusted		Adjusted	
	RR ^a	95% CI	RR	95% CI
Psychological abuse in childhood	1.93	1.70, 2.18	1.66 ^b	1.45, 1.89
Substance abuse distress in childhood	1.58	1.36, 1.84	1.38 ^c	1.18, 1.62

2 ^a Unadjusted

3 ^b Adjusted for age, gender, parental history of psychopathology and dementia, living in Norway at age 1 year, living with spouse, alcohol intake,
4 physical activity, participation in organised social gatherings, and substance abuse distress in childhood.

5 ^c Adjusted for age, gender, parental history of psychopathology and dementia, living in Norway at age 1 year, living with spouse, alcohol intake,
6 physical activity, participation in organised social gatherings and psychological abuse in childhood.

7 RR=relative risk, CI=confidence interval

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27 **Table 3. Association between dissatisfaction with friendships in adulthood and incident psychiatric problems in adulthood (N=9,502).**

	Incident psychiatric problems in adulthood ^b			
	Unadjusted		Adjusted	
	RR	95% CI	RR	95% CI
Dissatisfaction with friendships in adulthood^a	2.01 ^c	1.57, 2.57	1.71 ^d	1.33, 2.20

28 ^a Dissatisfaction with friendships was measured in 1994-1995

29 ^b Incident psychiatric problems were measured in 2007-2008

30 ^c Unadjusted

31 ^d Adjusted for age, gender, parental history of psychopathology and dementia, living in Norway at age 1 year, living with spouse, alcohol intake,
 32 physical activity, participation in organised social gatherings, psychological abuse, and substance abuse distress in childhood.

33 RR=relative risk; CI=confidence interval.

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54 Table 4. Direct and indirect effect (via dissatisfaction with friendships) of adverse childhood experiences on incident psychiatric problems
 55 (N=9,502).

	Incident psychiatric problems in adulthood							
	Total effect		Direct effect ^b		Indirect effect		Proportion mediated	
	RR	95% CI	RR	95% CI	RR	95% CI	%	95% CI
Psychological abuse in childhood	2.03 ^a	1.66, 2.51	1.90	1.55, 2.41	1.07 ^a	1.05, 1.11	9.31 ^a	4.25, 14.57
Substance abuse distress in childhood	1.47 ^c	1.35, 1.80	1.42	1.29, 1.70	1.04 ^c	1.01, 1.07	9.17 ^c	4.35, 16.33

56 ^aAdjusted for age, gender, parental history of psychopathology and dementia, living in Norway at age 1 year, living with spouse,
 57 alcohol intake, physical activity, participation in organised social gatherings, and substance abuse distress in childhood.

58 ^bAdjusted for age, gender, parental history of psychopathology and dementia, living in Norway at age 1 year, living with spouse,
 59 alcohol intake, physical activity, participation in organised social gatherings, psychological abuse/substance abuse distress in childhood,
 60 and dissatisfaction with friendships.

61 ^cAdjusted for age, gender, parental history of psychopathology and dementia, living in Norway at age 1 year, living with spouse,
 62 alcohol intake, physical activity, participation in organised social gatherings, and psychological abuse in childhood.

63 RR=relative risk; CI=confidence interval

64