



The mediating role of posttraumatic stress reactions in the relationship between child abuse and physical health complaints in adolescence and young adulthood

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ABSTRACT

Background: Child abuse is associated with physical health problems in adolescence and adulthood, but the mechanisms involved are unclear. A possible mediating effect of post-traumatic stress reactions (PTSR) linking child abuse with later physical health complaints has not been fully investigated.

Objective: The current study investigated whether PTSR could be a potential mediator in the relationship between child abuse and physical health complaints in adolescents and young adults. If so, we also investigated whether this was the case for different child abuse types alone or in combination.

Method: The study sample comprised 506 adolescents and young adult victims of child abuse and 504 unexposed matched controls aged 16–33 from a community sample. We measured child abuse retrospectively and current PTSR at wave 1 (2013), and current physical health complaints at wave 2 (2014/15). We tested a model of PTSR as a possible mediator between child abuse and physical health complaints and conducted causal mediation analysis to estimate direct and indirect pathways. Each child abuse type was studied in isolation and in combination with other abuse types.

Results: PTSR had a notable, significant mediating effect on the relationship between child abuse and physical health complaints in our overall model (average causal mediation effect; ACME = 0.14, $p < 0.001$), accounting for 85% of the total effect. The mediated pathway was also significant in analyses of the different child abuse types. The mediating effect of PTSR was most prominent in individuals reporting exposure to more than one child abuse type.

Conclusions: The current study indicates that PTSR may be an important mediator in the relationship between child abuse and physical health complaints. Health professionals should be aware of the important role that PTSR may have in maintaining or exacerbating physical health problems in child abuse victims. However, a reverse model could not be tested in this study and the results need confirmation in future prospective studies.

El rol mediador de las reacciones de estrés traumático ón entre el maltrato infantil y las quejas de salud física en la adolescencia y la adultez joven

Antecedentes: El maltrato infantil se encuentra asociado con problemas de salud física en la adolescencia y en la adultez, pero los mecanismos involucrados no son claros. Un posible efecto mediador de las reacciones de estrés traumático (PTSR en su sigla en inglés) relacionando el maltrato infantil con quejas de salud física posteriores no ha sido investigado suficientemente.

Objetivo: El presente estudio investigó si la PTSR podría ser un mediador potencial en la relación entre el maltrato infantil y las quejas de salud física en adolescentes y adultos jóvenes. También investigamos si esto era el caso para diferentes tipos de maltrato infantil de forma individual o en combinación.

Método: La muestra del estudio consistió en 506 adolescentes y adultos jóvenes víctimas de maltrato infantil y 504 controles sin exposición al maltrato con edades de 16 a 33 años provenientes de una muestra comunitaria. Medimos el maltrato infantil retrospectivamente, el actual PTSR en la ola 1 (2013), y las quejas actuales de salud física en la ola 2 (2014/2015). Pusimos a prueba un modelo de la PTSR como un posible mediador entre el maltrato infantil y las quejas de salud física y llevamos a cabo un análisis de mediación causal para estimar los efectos directos e indirectos. Cada tipo de maltrato fue estudiado de forma separada y en combinación con otros tipos de abuso.

Resultados: La PTSR tuvo un efecto mediador significativo en la relación entre el maltrato infantil y las quejas de salud física en nuestro modelo general (efecto mediador causal promedio; ACME en sus siglas en inglés = 0.14, $p < 0.001$), correspondiendo al 85% del efecto

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maltrato infantil; maltrato físico infantil; abuso sexual infantil; maltrato emocional infantil; negligencia infantil; testigo de violencia intrafamiliar; salud física; reacción de Estrés postraumático

关键词

儿童虐待儿童身体虐待; 儿童性虐待; 儿童情绪虐待; 儿童忽视; 目睹父母间伴侣暴力; 身体健康; 创伤后应激反应

HIGHLIGHTS

- PTSR almost fully mediated the relationship between child abuse and physical health complaints in adolescents and young adults.
- The mediating effect of PTSR on physical health complaints was consistent for all child abuse types.
- Clinicians should be aware that PTSR may contribute to physical health complaints.
- Prevention and treatment of PTSR may prevent the development of physical health complaints in child abuse victims.

total. La mediación fue también significativa en los análisis de los diferentes tipos de maltrato infantil. El efecto mediador de la PRSR fue más prominente en aquellos individuos que reportaron la exposición a más de un tipo de maltrato infantil.

Conclusiones: PTSD podría ser un mediador importante en la relación entre el maltrato infantil y las quejas de salud física. Los profesionales de la salud deberían estar conscientes del rol que la PTSD puede tener en la mantención y la exacerbación de los problemas de salud física en las víctimas de maltrato infantil. Sin embargo, un modelo reverso no pudo ser probado y los resultados necesitan confirmación en futuros estudios prospectivos.

创伤后应激反应中介童年虐待与青春期和成年早期的身体健康的关系

背景: 儿童虐待与青春期和成年期的身体健康问题有关, 但所涉及的机制尚不清楚。创伤后应激反应 (PTSR) 可能在其中起中介作用, 但尚未得到充分研究。

目标: 本研究调查了 PTSD 是否可能潜在中介青少年和年轻成人中儿童虐待与身体健康问题之间的关系。如果中介作用存在, 我们进一步考察了不同童年虐待类型的独立或者叠加作用。

方法: 研究样本年龄在 16 – 33 岁, 包括 506 名来自社区样本的青少年和年轻成人, 他们都是童年虐待的受害者; 还有 504 名未遭受童年虐待的匹配对照。我们回溯性地测量了儿童虐待和当前 PTSD (第 1 波, 2013 年), 以及当前身体健康问题 (第 2 波, 2014/15 年)。我们考察了 PTSD 中介儿童虐待和身体健康问题之间的关系的可能模型, 并进行了因果中介分析以估计直接和间接途径。考察了每种儿童虐待的类型单独效应和叠加效应。

结果: 在我们的整体模型中, PTSD 对虐待儿童和身体健康问题之间的关系具有显著中介作用 (平均因果中介效应; $ACME = 0.14$, $p < 0.001$), 占总效应的 85%。在区别儿童虐待不同类型之后, 中介途径也是显著的。PTSR 的中介效应在暴露于多种虐待类型的个体中最为突出。

结论: 目前的研究表明, PTSD 可能是儿童虐待与身体健康问题之间关系的重要中介因素。卫生从业者应了解 PTSD 在维持或加剧虐待儿童受害者身体健康问题方面可能发挥的重要作用。然而, 在本研究中无法测试反向模型, 我们的结果需要在未来的前瞻性研究中得到证实。

1. Introduction

Previous research has revealed that child abuse may have a lifelong and profound impact on physical health (Afifi et al., 2007; Felitti et al., 1998; Widom, Czaja, Bentley, & Johnson, 2012). However, the pathways involved in this relationship are not fully understood. Several factors may be involved, such as pathophysiological responses to stress reactions, environmental, behavioural and psychological pathways (Heim, Ehler, Hanker, & Hellhammer, 1998; Kendall-Tackett, 2002). Posttraumatic stress reactions (PTSR) have consistently been found to relate to physical health and have previously been shown to be an important mediator in the relationship between trauma exposure and physical health complaints (Bugge et al., 2017; Wachen et al., 2013). A shared pathophysiological mechanism of hypothalamic-pituitary-adrenal (HPA) and the sympathetic-adrenal-medullary (SAM) stress axes giving rise to both PTSD and physical health problems has been postulated, although behavioural and psychological risk factors are also likely to contribute (Boscarino, 2004; Gupta, 2013; Heim et al., 2000). It is uncertain whether PTSD after child abuse follow the same path to physical health problems as for other types of trauma, nor do we know whether the potential effects of different child abuse types follow the same pathway leading to poor physical health. This study sought to explore these gaps.

1.1. Child abuse and physical health

The literature on the association between child abuse and physical health consistently shows findings of higher levels of physical health complaints among adolescent and adult victims of child abuse, such as abdominal and musculoskeletal pain, headaches and dizziness (Afifi et al., 2007; Annerback, Sahlqvist, Svedin, Wingren, & Gustafsson, 2012; Bonvanie, van Gils, Janssens, & Rosmalen, 2015; Felitti et al., 1998; Tietjen et al., 2014; Widom, Czaja, Bentley, & Johnson, 2012). Further, it is established that the total burden of child abuse experienced may influence physical health in a dose-response pattern, with more physical health problems associated with a higher number of child abuse types experienced (Afifi et al., 2016; Clemens et al., 2018; Felitti et al., 1998). Child abuse comprises a variety of different abuse exposures, but studies looking at the separate types of abuse, and their associations with physical health are lacking. In the current study, we use the World Health Organization's (WHO's) definition of child abuse, including physical abuse, sexual abuse, emotional abuse, neglect and witnessing parental intimate partner violence (IPV) (Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002). The various types of abuse do not necessarily have the same impact on long-term physical health (Clemens et al., 2018; Diaz, Simantov, & Rickert, 2002; Lamers-Winkelmann, De Schipper, & Oosterman, 2012), but research into these matters is

sparse. The literature suffers from an overemphasis of studies on physical and sexual abuse, and we know less about how emotional abuse, neglect and witnessing parental IPV relate to physical health. Moreover, it is well known that the various types of child abuse often, but not always, overlap (Herrenkohl & Herrenkohl, 2009). Hence, victims of child abuse range from individuals who have experienced a single violent event to individuals who have been exposed to multiple child abuse types over time. Research is thus needed to explore pathways between child abuse and physical health and to determine whether the pathways are the same for the different types of abuse.

1.2. Child abuse and posttraumatic stress reactions

PTSR are common psychological sequelae after experiencing a highly threatening traumatic event, such as child abuse. Certain characteristics of the abuse, such as the duration and chronicity, the involvement of threat or force, and feelings of guilt and shame, have been previously shown to predict PTSD (Cloitre et al., 2009, Kearney, Wechsler, Kaur, & Lemos-Miller, 2010). These characteristics may be features of many types of child abuse, including the less studied types of child abuse, such as emotional abuse, neglect or witnessing parental IPV (Dias, Sales, Mooren, Mota-Cardoso, & Kleber, 2017, Graham-Bermann, De Voe, Mattis, Lynch, & Thomas, 2006; Spinazzola et al., 2014, Widom, 1999), indicating that different types of child abuse may have similar psychological consequences, which may, in turn, impact the later development of physical health complaints.

1.3. PTSD and physical health

PTSR have consistently been associated with a broad spectrum of physical health problems in adult trauma survivors, such as musculoskeletal bodily pain, gastroenterological and cardiovascular symptoms (Asnaani, Reddy, & Shea, 2014; Bugge et al., 2017; Gupta, 2013; Harder et al., 2011). In the context of trauma exposure, researchers have suggested a neurobiological pathway linking PTSD to physical health problems, suggesting that PTSD activate the body's stress regulation system, leading to both over- and underactivation of systems controlling immune and inflammation responses (Kearney et al., 2010). Hence, these pathophysiological stress responses are likely to have a unique direct effect on physical health outcomes. Some of the key features of PTSD, including hyperarousal, reexperiencing and avoidance, have previously shown independent effects on physical health outcomes (Asnaani et al., 2014; Harder et al.,

2011). Hyperarousal symptoms, such as impaired sleep, fear, exaggerated startle response, negative thoughts and irritability are key features of PTSD and have previously been associated with increased inflammatory responses (Boscarino, 2004; Lindqvist et al., 2017). Results from these studies suggest that individuals with PTSD may be at risk of autoimmune diseases and inflammatory disorders. Reexperiencing symptoms of PTSD may manifest as physical sensations, such as pain, nausea, dizziness, trembling, and tachycardia, which can be misinterpreted to be of somatic origin and may contribute to the child abuse victim's perception of poorer physical health. Moreover, PTSD-related sleep disturbances adversely impact self-perceived physical health, quality of life and daily functioning (Germain, Buysse, & Nofzinger, 2008; Gupta, 2013; Krakow et al., 2002). Further, health risk behaviour following PTSD may represent a potential pathway linking PTSD with physical health outcomes. Victims of child abuse, in their effort to cope with posttraumatic stress reactions and regulate negative emotions, are at risk of engaging in health risk behaviours, such as alcohol and substance use (Hannan, Orcutt, Miron, & Thompson, 2017). Such health risk behaviours may have an independent, negative effect on physical health. Moreover, PTSD-related avoidance or emotional numbing, including social withdrawal and loneliness, may also lead to isolation and physical inactivity, which may, in turn, lead to physical health complaints and self-reported poor health status in adolescents and young adults (Granger, Williams, Di Nardo, Harrison, & Verma, 2017, Thoresen, Aakvaag, Strøm, Wentzel-Larsen, & Birkeland, 2018).

In summary, there is literature suggesting that PTSD may represent one important pathway between child abuse and later physical health complaints. To our knowledge, this is the first study that aims to estimate the potential indirect effect of PTSD on the association between child abuse and physical health complaints in adolescents and young adults. Further, there is a knowledge gap regarding whether such a pathway may exist across abuse types or is restricted to specific child abuse types. Therefore, we investigated different child abuse types separately and in combination with other child abuse types. Exploring the pathways between child abuse and physical health complaints may be important to understand why some victims of child abuse develop physical health problems in adolescence or young adulthood. New knowledge in this area may have implications for clinical interventions in the medical follow-up of victims of child abuse, as well as for the medical assessment of physical health complaints. Further, such knowledge may be important for the prevention of the early onset of physical health complaints among victims of child abuse.

1.4. Aims

The current study investigated a model of PTSD as a possible mediator linking child abuse with physical health complaints in adolescence and early adulthood. Using a population-based study sample comprising adolescents and young adult victims of child abuse and unexposed matched controls, we also explored this relationship for the different child abuse types (physical, sexual, emotional abuse, neglect and witnessing parental IPV), in combination with other abuse types and in isolation.

2. Methods

2.1. Participants

The data in this study was drawn from a two-wave general population study on violence and its long-term consequences. Wave 1 focused on studying the prevalence of exposure to violence in different age groups, and the second wave focused more extensively on health consequences. Wave 1 included two samples randomly drawn from the Norwegian Population Registry: an adult sample ($n = 4527$, response rate 42.9%, age range 18–75) and an adolescent sample ($n = 2062$, response rate 61.7%, age range 16–17 years) (Thoresen, Myhre, Wentzel-Larsen, Aakvaag, & Hjemdal, 2015). Wave 2 was a follow-up survey of a subselection of adolescents and young adults from wave 1, constituting 506 cases with reports of child abuse (<18 years) and 504 unexposed controls. Wave 2 of the study focused on revictimization and health-related consequences of abuse, such as physical health complaints. The recruitment process for wave 2 started by contacting the youngest participant from wave 1 with an affirmative answer on any of the questions of exposures to child abuse before age 18. For each case included in wave 2, a matched control by age and sex from wave 1 was included. Recruitment of participants ended when a pre-specified quota of participants (506 cases and 504 controls, $n = 1010$) was reached, which constituted the current study sample. Mean age was 20.9 years (SD 5.3), and 59.7% were females ($n = 603$). Most of the study participants ($n = 960$, 95.0%) were of Nordic origin. Cases had a significantly poorer self-perceived financial situation than controls. A detailed sample description of wave 2 participants is published elsewhere (Strom, Hjemdal, & Myhre et al., 2017). With respect to attrition from wave 1 to wave 2, our final sample included 1010 participants, which was 39.6% of the participants who we initially attempted to reach. Previously published attrition analyses between respondents and non-respondents showed minor differences concerning age, sex and sociodemographic characteristics. The majority of subjects lost to attrition comprised unreachable individuals without reports of child abuse exposure at wave 1 (Strom et al., 2017).

2.2. Procedure

Data collection was conducted by telephone interview by the professional data collection agency Ipsos. Before the first wave, a postal information letter about the survey was sent to potential participants about a week in advance, and participants were subsequently called and asked to give oral consent to participate. We used computer-assisted telephone interviews (CATI) using a detailed assessment of different exposures to child abuse with varying severity and duration. The study was approved by the Norwegian Regional Committee for Medical and Health Research Ethics (Oslo, Norway).

2.3. Measures

Exposure to child abuse was retrospectively assessed in wave 1. Inclusion in the case group required exposure to at least one of the following child abuse types before age 18: physical abuse, sexual abuse, emotional abuse, neglect and witnessing parental IPV. Except for sexual abuse, we only assessed child abuse from a parent or another caregiver.

Exposure to physical abuse was defined as an affirmative answer to one or more of the following items: (1) pinched hard, (2) shaken or pushed violently, (3) hit with a flat hand, (4) hit with a fist or a hard object (5) kicked, (6) beaten, or (7) physically attacked in other ways (Kilpatrick et al., 2003; Straus, Hamby, Boney-McCoy & Sugarman, 1996). Exposure to child sexual abuse was defined as an affirmative answer to any of the following items: (1) sexual abuse before age 13 (any form of sexual contact by someone who was at least five years older), (2) forcible rape (including intercourse, oral sex, anal sex, having fingers or objects put in the vagina or anus by use of physical force or threats), or (3) other forms of sexual contact before age 18 (including unwanted sexual contact while intoxicated), having been subject to fondling or touching of the genitals using physical force or threats, having been pressured into sexual acts or other, unspecified types of sexual assault (Kilpatrick et al., 2003; Tjaden & Thoennes, 1998). To assess emotional abuse, respondents were asked if they were repeatedly ridiculed, put down, ignored or told that they were not good by their parents or caregivers during childhood (Goodman, Corcoran, Turner, Yuan, & Green, 1998). An affirmative answer was defined as exposure to emotional abuse. Child neglect included one question on physical neglect and one question on emotional neglect. Participants ranked their answers on a five-point scale from 'never' to 'very often or always' in response to questions asking how often they had been taken care of and protected in their family of origin (physical neglect) or how often they felt loved (emotional neglect) (Centers for Disease Control and Prevention, 2014). Responding with 'never', 'seldom' or 'sometimes' to one or both questions

were defined as exposure to neglect. Exposure to witnessing parental IPV was defined as seeing or hearing violence between parents in which one of the parents had been slapping, hitting with the fist or an object, kicking, strangulating, or otherwise physically attacking the other parent (Kilpatrick et al., 2003). Control variables included wave 1 data on age, sex and national background (none versus one or both parents born within the Nordic countries).

The mediator variable (wave 1), PTSR over the past month, was measured by the abbreviated PCL-6 checklist. This measure has shown adequate psychometric properties for screening purposes in primary care (Lang & Stein, 2005). Participants were asked to rate on a five-point scale ranging from 0 (not at all) to 4 (extremely) how much they had been bothered by the following symptoms in the last month: Repeated, disturbing memories, thoughts, or images of a stressful experience from the past; feeling very upset when something reminded you of a stressful experience from the past; avoidance of activities or situations because of reminders of a stressful experience from the past; feeling distant or cut off from other people; feeling irritable or having angry outbursts; and difficulty concentrating.

Cronbach's alpha was 0.84.

To measure physical health complaints (wave 2), we applied the Children's Somatic Symptoms Inventory (CSSI-8), which is an abbreviated version of the Children's Somatization Inventory (CSI-24) (Walker, Beck, Garber, & Lambert, 2009). In collaboration with the authors of the original instrument, eight items were selected to represent multiple bodily systems and bodily pain. Participants were asked to rate the severity of each of the symptoms during the past month on a scale ranging from 0 (not bothered) to 3 (very much bothered). The items covered stomach pain, headache, back pain, arm or leg pain, faintness or dizziness, rapid heartbeat, nausea and weakness. Cronbach's alpha was 0.77.

Missing values in the dataset were minimal. In the entire dataset, only nine persons (0.89%) had missing

values for any of the items covering child abuse, and one person had missing data for ethnicity (0.09%). When creating mean scores for PCL-6 and CSSI-8, missing items were handled by the half-rule (the mean of the observed items when at least half of the items were observed). For PCL-6, only two participants had missing data for one of the items, and for CSSI-8, only three items had missing values. Hence, we were able to create mean scores for both scales for all participants.

2.4. Data analysis

A Pearson moment correlation was computed to assess the relationship between the mean score variables of posttraumatic stress reactions and physical health complaints.

To study whether PTSR mediated the relationship between child abuse and physical health complaints, we applied causal mediation analysis (Imai, Keele, & Tingley, 2010). Causal mediation analysis is a statistical procedure for estimating indirect (mediated) effects and direct effects in a setting when causality of the relationships has been assumed. The average direct effect (ADE) refers to the effect of the exposure variable (differences in physical health complaints between exposed and unexposed), not mediated via PTSR, keeping the mediated pathway fixed. The indirect effect or the average causal mediation effect (ACME), represents the effect mediated via PTSR. We first assessed the potential direct and indirect effect (through PTSR) of child abuse on physical health complaints contrasting cases to controls (Figure 1) (Walker et al., 2009). This strategy, however, may mask large differences between abuse types. Therefore, we added analyses of each abuse type occurring in isolation, and in combination with other abuse types. The results are shown as effect estimates, representing the difference in units for physical health complaints between the cases and controls. Further, we also estimated the mediated and direct effects as proportions of the total effect, given

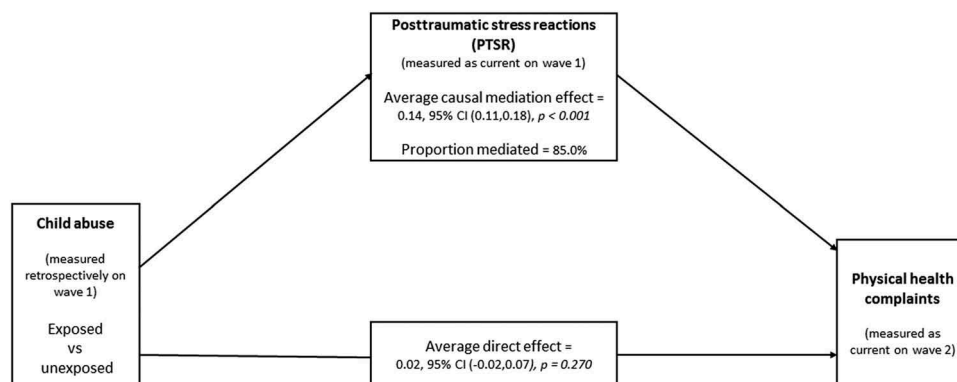


Figure 1. $N = 1009$. The average direct effect of child abuse on physical health complaints and the average causal mediation effect linking PTSR to physical health complaints (value of $p \leq 0.56$).

in percentages. To evaluate the mediating effect of PTSD on physical health complaints according to child abuse type, causal mediation analyses were conducted for each of the five studied child abuse types: the abuse type reported in isolation (no additional exposure to other abuse types) and the abuse type when reported in combination with other abuse types.

In a causal mediation analysis, one should only adjust for possible confounders occurring simultaneously or preferably before the exposure. Therefore, we only adjusted for age, sex and ethnicity. A central assumption in causal mediation analysis is sequential ignorability, a strong untestable assumption including the assumption that there are no unmeasured confounders, assuming that all confounders are included in the model. Although sequential ignorability is untestable, it is possible to perform a sensitivity analysis of the robustness of the results to deviations from this assumption. The sensitivity analysis includes a parameter ρ that measures the deviation from sequential ignorability. Technically, ρ is defined as the correlation between error terms in the submodels for the outcome and the mediator upon which the causal mediation analysis is based. Sequential ignorability implies that $\rho = 0$. When the estimates of ACME or ADE maintain the same sign for a wide range of values of ρ , the robustness of the causal mediation analysis is considered to be good. IBM SPSS Statistics Software version 25 was used to estimate Pearson's correlation coefficients. For causal mediation analyses, the R package *mediation* version 3.4.4 was used (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014). Confidence intervals in the causal mediation analyses were computed by the bootstrap BC_a procedure using 10000 replications.

3. Results

Overall, adolescents and young adults with reports of child abuse had a higher level of physical health complaints (M (SD) = 0.51 (0.48) versus 0.34 (0.34), $p < 0.001$) and of PTSD (M (SD) = 0.60 (0.75) versus 0.22 (0.39), $p < 0.001$) than unexposed controls. There was

a moderate positive correlation between the variables measuring physical health complaints and PTSD ($r = 0.599$, $N = 1010$, $p < 0.001$).

We found that PTSD almost fully mediated the relationship between child abuse and physical health complaints in adolescents and young adults (Figure 1), with the ACME accounting for 85.0% of the total effect. The total effect was 0.17 (95% CI: 0.12, 0.22, $p = 0.001$), representing the sum of the ADE and the ACME. The ADE (all effects other than the one mediated through PTSD) between child abuse and physical health complaints was insignificant.

When we conducted causal mediation analyses for each of the child abuse types, PTSD also significantly mediated the relationship between most of the child abuse types and physical health complaints (Table 1). This finding was consistent, both when studying abuse types in isolation (ACME, $p \leq 0.047$) and when the separate abuse types were studied in combination with other abuse types (ACME, $p \leq 0.001$). The highest mediated proportions were for neglect and for witnessing parental IPV when studied in combination with other abuse types (98% and 94%, respectively). The direct pathway was only significant for sexual and emotional abuse and for witnessing parental IPV.

Sensitivity analyses showed good robustness of the results, with boundary values of the sensitivity parameter at $\rho 0.41$ – 0.53 , while the estimates of the ACMEs kept the same sign. For the direct pathways (ADE), sensitivity analyses were performed for all statistically significant results, finding robust results, except for sexual abuse (boundary $\rho -0.22$) and emotional abuse (boundary $\rho -0.29$) when studied in combination with other types of abuse.

4. Discussion

This study highlights the important role that PTSD may have for the development of physical health complaints in adolescents and young adults with a history of child abuse. We found that PTSD almost fully mediated the relationship between exposure to

Table 1. Average direct effects (ADE) of child abuse types on physical health complaints, with the corresponding average causal mediating effects (ACME) linking PTSD to physical health complaints. The model is adjusted for age, sex and ethnicity.

Child abuse type	n	Average direct effect (ADE)			Average causal mediation effect (ACME)			Total effect	Proportion mediated (%)
		Estimate	95%CI	p	Estimate	95%CI	p		
All physically abused	267	0.00	-0.05, 0.06	0.968	0.14	0.11,0.19	<0.001	0.14	99.7
-Only physically abused	118	-0.06	-0.11, -0.01	0.018	0.03	0.00,0.07	0.047	-0.03	^a
All sexually abused	195	0.07	0.00, 0.15	0.040	0.20	0.15,0.26	<0.001	0.28	73.0
-Only sexually abused	100	0.09	0.01, 0.18	0.027	0.11	0.06,0.19	<0.001	0.21	54.9
All emotionally abused	158	0.12	0.04, 0.21	0.005	0.22	0.16,0.29	<0.001	0.34	65.4
-Only emotionally abused	37	0.15	0.01, 0.31	0.045	0.13	0.06,0.24	<0.001	0.28	46.6
All neglected subjects	109	0.00	-0.08, 0.09	0.950	0.23	0.16,0.33	<0.001	0.24	98.5
-Only neglected subjects	32	-0.08	-0.17, 0.05	0.180	0.06	-0.01,0.15	0.085	-0.02	^a
All subjects witnessing parental IPV	98	0.05	-0.04, 0.14	0.290	0.20	0.13,0.27	<0.001	0.80	79.7
-Only subjects witnessing parental IPV	20	0.14	0.01, 0.28	0.040	0.06	0.01,0.14	0.036	0.20	30.7

^aPercentages are not shown because the estimates of the direct (ADE) and indirect (ACME) pathways have different signs, so the interpretation of percentages has no value.

child abuse and physical health complaints. Our findings are consistent with studies from the trauma literature investigating health development following events, such as terrorist attacks and war, suggesting that PTSD may have mediating effects on later physical health outcomes (Bugge et al., 2017; Wachen et al., 2013). In child abuse research, PTSD have been found to mediate the relationship between exposure to sexual abuse in childhood and subsequent health risk behaviour (Hannan et al., 2017). No other studies that the authors are aware of have studied the mediating role of PTSD on physical health outcomes for child abuse exploring potential effects of different child abuse types. Thus, the current study may contribute to an improved understanding of the pathways linking child abuse with physical health.

We also found a consistent mediating effect of PTSD on physical health complaints for all child abuse types. Child abuse is a concept that comprises a variety of childhood experiences. Some but not all types of adversities fall both within the trauma and child abuse categorizations, such as sexual, physical abuse and witnessing parental IPV, representing threats to physical integrity. Nevertheless, an interesting finding was that PTSD accounted for a large portion of the effect on physical health complaints among the abuse types not obviously considered as a direct trauma, such as emotional abuse and neglect. This can be understood by looking at previous research describing the link between noncontact abuse and PTSD. For instance, features of emotional neglect, such as the lack of protection or supervision from a caregiver, are associated with PTSD (Dias et al., 2017; Widom, 1999). Additionally, emotional abuse, in terms of being repeatedly ridiculed or put down, is shown to have equivalent symptom frequencies of PTSD compared to physically and sexually abused subjects (Dias et al., 2017). Although there may be several reasons for PTSD to develop for the different child abuse types, findings from the current study suggest that PTSD may be a common mediator in developing physical health complaints in child abuse victims, regardless of abuse type. Thus, our results indicate that PTSD following any type of exposure to child abuse should be considered a risk factor for later physical health complaints. For some of the child abuse types, PTSD almost completely mediated the relationship between abuse and physical health complaints. However, for sexual and emotional abuse, we also identified direct effects between abuse and physical health complaints. This result suggests that additional pathways remain to be explored in understanding the complex relationship of how child abuse relates to physical health. Nevertheless, due to the low sample size for abuse types reported in isolation, sensitivity

analyses were not robust in these subgroups. Hence, interpretations should be made with caution.

Consistent with the growing literature that cumulative childhood trauma predicts increasing symptom complexity in adolescence and adulthood (Annerback et al., 2012; Cloitre et al., 2009) we found that the mediating effects of PTSD were most prominent on physical health complaints in individuals reporting exposure to more than one child abuse type. Thus, to summarize, our results suggest that exposure to different child abuse types has more adverse effects on the interplay between PTSD and physical health outcomes rather than exposure to any particular type of child abuse. This finding also illustrates an important point in child abuse research demonstrating that failure to account for exposure to other, co-occurring types of child abuse commonly leads to an overestimation of the effect of the single types of child abuse on health outcomes (Finkelhor, Ormrod, & Turner, 2007). The current study addresses this gap by accounting for additional child abuse exposures when studying the mediating effect of PTSD on physical health complaints.

4.1. Implications

The finding of PTSD as a possible mediator of physical health complaints in adolescents and young adults with experiences of child abuse is important, suggesting that early identification and treatment of PTSD may effectively prevent the development of PTSD into physical symptoms. Likewise, individuals presenting physical health symptoms of unknown origin in primary care may benefit from the identification and treatment of PTSD. In fact, treatments targeting PTSD have been shown to be beneficial to sleep impairment and self-perceived physical health (Galovski, Monson, Bruce, & Resick, 2009, Stevens, Holmgren, Walt, Gengler, & Hobfoll, 2017). Physical health complaints of unknown aetiology accounting for a large part of the burden of disease, are difficult to treat in the health-care system and are costly for society (Barsky, Orav, & Bates, 2005). As emphasized by the current study, PTSD and physical health complaints are closely related, warranting a balanced approach between biomedicine and psychology when treating patients with physical complaints of unknown aetiology following a standard medical assessment.

4.2. Strengths and limitations

This study had several strengths. The community sample made it possible to include individuals with a spectrum of child abuse experiences and thus provided new knowledge on the less studied types of child abuse (emotional abuse, neglect, witnessing

parental IPV) that are typically unreported to authorities. The broad assessment of child abuse provided reliable accuracy of the exposures. Another strength of this study is the use of behaviourally specific questions to measure child abuse, which has previously been shown to improve the sensitivity in assessing child abuse experiences (Fisher, Francis, & Turner, 2000). The possibility to use data from two different time points, along with the retrospective reports of abuse, allowed us to test the hypothesized mediator. Causal mediation analysis including sensitivity analysis represents a methodological improvement in making it possible to assess the robustness of the results. Sensitivity analysis showed good robustness of the results. Missing data were minimal.

Nevertheless, there were some important limitations of the current study. Child abuse was assessed with a retrospective self-report, which may be biased by factors such as poor memory and current mood. Moreover, the retrospective assessment of child abuse may have resulted in recall bias in terms of overreporting of adverse events because individuals with poor current health status may recall their experiences of child abuse better than individuals in good health (Fergusson, Horwood, & Woodward, 2000; McKinney, Harris, & Caetano, 2009). Moreover, the study did not investigate the chronicity and severity of the abuse in relation with PTSD and physical health. We have conducted the study in a presumably healthy young community sample, in which we found generally low levels of both PTSD and physical health complaints. Thus, further research is necessary to determine if our results are generalizable to more symptomatic samples. On the other hand, a negative selection bias may have increased our estimates, as individuals with health problems following abuse histories may have found it more relevant to participate in the current study. Similar to many longitudinal population surveys, attrition was also a factor that could further lead to biases. However, previously conducted population surveys on abuse and violence have shown comparable attrition rates to that of the current study (Amstadter et al., 2011; Turner, Finkelhor, Hamby, & Henly, 2017). Another statistical limitation was the low sample size of study participants who only reported exposure to one child abuse type. Moreover, causality is difficult to establish, and the influence of other possible common causal factors was not examined in the model.

Assumptions of causal directions are uncertain and necessarily have to be based on theoretical arguments in non-randomized studies. Still, given these assumptions, we have obtained estimates of mediated and direct effects with clear and consistent interpretations, and the sensitivity analyses indicated robust results. Because physical health complaints were not measured at wave 1, we were not able to test a model

with reverse causality. We could not exclude the existence of common causal factors influencing both physical health complaints and PTSD, although we did adjust for age, sex and ethnicity. Thus, the results need confirmation in future prospective studies.

5. Conclusion

The current study indicated that PTSD may be an important mediator between child abuse and physical health complaints in adolescence and early adulthood. Thus, health professionals should be aware of the role PTSD may have in maintaining or exacerbating physical health problems in victims of child abuse. Further, these findings may be of interest in the development of treatment interventions aimed at addressing the long-term physical health consequences of exposure to child abuse, warranting a balanced approach between biomedicine and psychology.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

- Afifi, T. O., Enns, M. W., Cox, B. J., de Graaf, R., Ten Have, M., Sareen, J. (2007). Child abuse and health-related quality of life in adulthood. *The Journal of Nervous and Mental Disease*, 195(10), 797–804.
- Afifi, T. O., MacMillan, H. L., Boyle, M., Cheung, K., Taillieu, T., Turner, S., & Sareen, J. (2016). Child abuse and physical health in adulthood. *Health Reports / Statistics Canada, Canadian Centre for Health Information - Rapports Sur La Sante / Statistique Canada, Centre Canadien D'information Sur La Sante*, 27(3), 10–18.
- Amstadter, A. B., Elwood, L. S., Begle, A. M., Gudmundsdottir, B., Smith, D. W., Resnick, H. S., ... Kilpatrick, D. G. (2011). Predictors of physical assault victimization: Findings from the national survey of adolescents. *Addictive Behaviors*, 36(8), 814–820.
- Annerback, E. M., Sahlqvist, L., Svedin, C. G., Wingren, G., & Gustafsson, P. A. (2012). Child physical abuse and concurrence of other types of child abuse in Sweden—associations with health and risk behaviors. *Child Abuse & Neglect*, 36(7–8), 585–595.
- Asnaani, A., Reddy, M. K., & Shea, M. T. (2014). The impact of PTSD symptoms on physical and mental health functioning in returning veterans. *Journal of Anxiety Disorders*, 28(3), 310–317.
- Barsky, A. J., Orav, E., & Bates, D. W. (2005). Somatization increases medical utilization and costs independent of psychiatric and medical comorbidity. *Archives of General Psychiatry*, 62(8), 903–910.

- Bonvanie, I. J., van Gils, A., Janssens, K. A. M., & Rosmalen, J. G. M. (2015). Sexual abuse predicts functional somatic symptoms: An adolescent population study. *Child Abuse & Neglect*, 46, 1–7.
- Boscarino, J. A. (2004). Posttraumatic stress disorder and physical illness: Results from clinical and epidemiologic studies. Biobehavioral stress response: Protective and damaging effects. *Annals of the New York Academy of Sciences*, 1032, 141–153.
- Bugge, I., Dyb, G., Stensland, S. O., Ekeberg, Ø., Wentzel-Larsen, T., & Diseth, T. H. (2017). Physical injury and somatic complaints: the mediating role of posttraumatic stress symptoms in young survivors of a terror attack. *Journal of Traumatic Stress*, 30(3), 229–236.
- Centers for Disease Control and Prevention. (2014). Family health history and health appraisal questionnaires. Retrieved from <http://www.cdc.gov/violenceprevention/acestudy/pdf/fhhflorna.pdf>
- Clemens, V., Huber-Lang, M., Plener, P. L., Brähler, E., Brown, R. C., & Fegert, J. M. (2018). Association of child maltreatment subtypes and long-term physical health in a German representative sample. *European Journal of Psychotraumatology*, 9(1), 1510278.
- Cloitre, M., Stolbach, B. C., Herman, J. L., van der Kolk, B., Pynoos, R., Wang, J., & Petkova, E. (2009). A developmental approach to complex PTSD: Childhood and adult cumulative trauma as predictors of symptom complexity. *Journal of Traumatic Stress*, 22(5), 399–408.
- Dias, A., Sales, L., Mooren, T., Mota-Cardoso, R., & Kleber, R. (2017). Child maltreatment, revictimization and post-traumatic stress disorder among adults in a community sample. *International Journal of Clinical and Health Psychology*, 17(2), 97–106.
- Diaz, A., Simantov, E., & Rickert, V. I. (2002). Effect of abuse on health: Results of a national survey. *Archives of Pediatrics & Adolescent Medicine*, 156(8), 811–817.
- Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., ... Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventive Medicine*, 14(4), 245–258.
- Fergusson, D. M., Horwood, L. J., & Woodward, L. J. (2000). The stability of child abuse reports: A longitudinal study of the reporting behaviour of young adults. *Psychological Medicine*, 30(3), 529–544.
- Finkelhor, D., Ormrod, R. K., & Turner, H. A. (2007). Poly-victimization: A neglected component in child victimization. *Child Abuse & Neglect*, 31(1), 7–26.
- Fisher, B. S. C., Francis, T., & Turner, M. G. (2000). *The sexual victimization of college women. Research report. Department of justice*. Washington: DC. Bureau of Justice Statistics.
- Galovski, T. E., Monson, C., Bruce, S. E., & Resick, P. A. (2009). Does cognitive-behavioral therapy for PTSD improve perceived health and sleep impairment? *Journal of Traumatic Stress*, 22(3), 197–204.
- Germain, A., Buysse, D. J., & Nofzinger, E. (2008). Sleep-specific mechanisms underlying posttraumatic stress disorder: Integrative review and neurobiological hypotheses. *Sleep Medicine Reviews*, 12(3), 185–195.
- Goodman, L. A., Corcoran, C., Turner, K., Yuan, N., & Green, B. L. (1998). Assessing traumatic event exposure: General issues and preliminary findings for the stressful life events screening questionnaire. *Journal of Traumatic Stress*, 11(3), 521–542.
- Graham-Bermann, S. A., De Voe, E. R., Mattis, J. S., Lynch, S., & Thomas, S. A. (2006). Ecological predictors of traumatic stress symptoms in caucasian and ethnic minority children exposed to intimate partner violence. *Violence against Women*, 12(7), 663–692.
- Granger, E., Williams, G., Di Nardo, F., Harrison, A., & Verma, A. (2017). The relationship between physical activity and self-rated health status in European adolescents: Results of the EURO-URHIS 2 survey. *European Journal of Public Health*, 27(suppl_2), 107–111.
- Gupta, M. A. (2013). Review of somatic symptoms in post-traumatic stress disorder. *International Review of Psychiatry (Abingdon, England)*, 25(1), 86–99.
- Hannan, S. M., Orcutt, H. K., Miron, L. R., & Thompson, K. L. (2017). Childhood sexual abuse and later alcohol-related problems: Investigating the roles of revictimization, PTSD, and drinking motivations among college women. *Journal of Interpersonal Violence*, 32(14), 2118–2138.
- Harder, L. H., Chen, S., Baker, D. G., Chow, B., McFall, M., Saxon, A., & Smith, M. W. (2011). The influence of posttraumatic stress disorder numbing and hyperarousal symptom clusters in the prediction of physical health status in veterans with chronic tobacco dependence and posttraumatic stress disorder. *The Journal of Nervous and Mental Disease*, 199(12), 940–945.
- Heim, C., Ehler, U., Hanker, J. P., & Hellhammer, D. H. (1998). Abuse-related posttraumatic stress disorder and alterations in the hypothalamic-pituitary-adrenal axis in women with chronic pelvic pain. *Psychosomatic Medicine*, 60(3), 309–318.
- Heim, C., Newport, D. J., Heit, S., Graham, Y. P., Wilcox, M., Bonsall, R., ... Nemeroff, C. B. (2000). Pituitary-adrenal and autonomic responses to stress in women after sexual and physical abuse in childhood. *JAMA*, 284(5), 592–597.
- Herrenkohl, R. C., & Herrenkohl, T. I. (2009). Assessing a child's experience of multiple maltreatment types: Some unfinished business. *Journal of Family Violence*, 24(7), 485.
- Imai, K., Keele, L., & Tingley, D. (2010). A general approach to causal mediation analysis. *Psychological Methods*, 15(4), 309–334.
- Kearney, C. A., Wechsler, A., Kaur, H., & Lemos-Miller, A. (2010). Posttraumatic stress disorder in maltreated youth: A review of contemporary research and thought. *Clinical Child and Family Psychology Review*, 13(1), 46–76.
- Kendall-Tackett, K. (2002). The health effects of childhood abuse: Four pathways by which abuse can influence health. *Child Abuse & Neglect*, 26(6–7), 715–729.
- Kilpatrick, D. G., Ruggiero, K. J., Acierno, R., Saunders, B. E., Resnick, H. S., & Best, C. L. (2003). Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity: Results from the national survey of adolescents. *Journal of Consulting and Clinical Psychology*, 71(4), 692–700.
- Krakow, B., Melendrez, D., Johnston, L., Warner, T. D., Clark, J. O., Pacheco, M., ... Schrader, R. (2002). Sleep-disordered breathing, psychiatric distress, and quality of life impairment in sexual assault survivors. *The Journal of Nervous and Mental Disease*, 190(7), 442–452.
- Krug, E. G., Dahlberg, L. L., Mercy, J. A., Zwi, A. B., & Lozano, R. (2002). *World report on violence and health*. Geneva, Switzerland: The World Health Organization (WHO).
- Lamers-Winkelmann, F., De Schipper, J., & Oosterman, M. (2012). Children's physical health complaints after

- exposure to intimate partner violence. *British Journal of Health Psychology*, 17(4), 771–784.
- Lang, A. J., & Stein, M. B. (2005). An abbreviated PTSD checklist for use as a screening instrument in primary care. *Behaviour Research and Therapy*, 43(5), 585–594.
- Lindqvist, D., Mellon, S. H., Dhabhar, F. S., Yehuda, R., Grenon, S. M., Flory, J. D., ... Wolkowitz, O. M. (2017). Increased circulating blood cell counts in combat-related PTSD: Associations with inflammation and PTSD severity. *Psychiatry Research*, 258, 330–336.
- McKinney, C. M., Harris, T. R., & Caetano, R. (2009). Reliability of self-reported childhood physical abuse by adults and factors predictive of inconsistent reporting. *Violence and Victims*, 24(5), 653–668.
- Spinazzola, J., Hodgdon, H. B., Liang, L.-J., Ford, J. D., Layne, C. M., Pynoos, R., ... Kisiel, C. (2014). Unseen wounds: The contribution of psychological maltreatment to child and adolescent mental health and risk outcomes. *Psychological Trauma: Theory, Research, Practice and Policy*, 6, S18–S28.
- Stevens, N. R., Holmgren, L., Walt, L., Gengler, R., & Hobfoll, S. E. (2017). Web-based trauma intervention for veterans has physical health payoff in randomized trial. *Psychological Trauma: Theory, Research, Practice and Policy*, 9(Suppl 1), 42–50.
- Straus, M. A., Hamby, S. L., Boney-McCoy, S., & Sugarman, D. B. (1996). The revised conflict tactics scales (CTS2) development and preliminary psychometric data. *Journal of Family Issues*, 17(3), 283–316.
- Strom, I. F., Hjemdal, O. K., Myhre, M. C. (2017). The social context of violence: A study of repeated victimization in adolescents and young adults. *Journal of Interpersonal Violence*. <https://doi.org/10.1177/0886260517696867>
- Thoresen, S., Aakvaag, H. F., Strøm, I. F., Wentzel-Larsen, T., & Birkeland, M. S. (2018). Loneliness as a mediator of the relationship between shame and health problems in young people exposed to childhood violence. *Social Science & Medicine*, 211, 183–189.
- Thoresen, S., Myhre, M., Wentzel-Larsen, T., Aakvaag, H. F., & Hjemdal, O. K. (2015). Violence against children, later victimisation, and mental health: A cross-sectional study of the general Norwegian population. *European Journal of Psychotraumatology*, 6(6), 26259.
- Tietjen, G. E., Buse, D. C., Fanning, K. M., Serrano, D., Reed, M. L., & Lipton, R. B. (2014). Recalled maltreatment, migraine, and tension-type headache: Results of the AMPP study. *Neurology*, 84(2), 132–140.
- Tingley, D., Yamamoto, T., Hirose, K., Keele, L., & Imai, K. (2014). Mediation: R Package for causal mediation analysis. *Journal of Statistical Software*, 59(5), 1–38.
- Tjaden, P. G., & Thoennes, N. (1998). *Prevalence, incidence and consequences of violence against women: Findings from the national violence against women survey*. Washington DC: U.S. Department of Justice, Office of Justice Programs, National Institute of Justice.
- Turner, H. A., Finkelhor, D., Hamby, S., & Henly, M. (2017). Victimization and adversity among children experiencing war-related parental absence or deployment in a nationally representative US sample. *Child Abuse & Neglect*, 67, 271–279.
- Wachen, J. S., Shipherd, J. C., Suvak, M., Vogt, D., King, L. A., & King, D. W. (2013). Posttraumatic stress symptomatology as a mediator of the relationship between warzone exposure and physical health symptoms in men and women. *Journal of Traumatic Stress*, 26(3), 319–328.
- Walker, L. S., Beck, J. E., Garber, J., & Lambert, W. (2009). Children's somatization inventory: Psychometric properties of the revised form (CSI-24). *Journal of Pediatric Psychology*, 34(4), 430–440.
- Widom, C. S. (1999). Posttraumatic stress disorder in abused and neglected children grown up. *American Journal of Psychiatry*, 156(8), 1223–1229.
- Widom, C. S., Czaja, S. J., Bentley, T., & Johnson, M. S. (2012). A prospective investigation of physical health outcomes in abused and neglected children: New findings from a 30-year follow-up. *American Journal of Public Health*, 102(6), 1135–1144.