



## Research paper

# The bidirectional temporal relationship between parenting stress and child maltreatment: A cross-lagged study based on intervention and cohort data



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## ABSTRACT

**Background:** Parenting stress has long been proposed as a major risk factor for child maltreatment. However, there is a lack of evidence from existing studies on the temporal sequence to establish a causal relationship. This study aims to examine bidirectional temporal relationships between parenting stress and child maltreatment.

**Methods:** Longitudinal data from two different sources were analysed: a pre-post study of an online parenting programme conducted across six countries - the ePLH Evaluation Study, and a prospective cohort study in the United States - LONGSCAN. Cross-lagged panel model on parenting stress and child maltreatment was used in each dataset.

**Results:** Based on repeatedly measured data of 484 caregivers in the ePLH study across five time points (every two weeks), we found that parenting stress at an earlier time point predicted later child maltreatment (IRR = 1.14, 95 % CI: 1.10,1.18). In addition, the occurrence of child maltreatment was associated with higher subsequent short-term parenting stress (IRR = 1.04, 95 % CI: 1.01,1.08) and thus could form a vicious circle. In the LONGSCAN analysis with 772 caregivers who were followed up from child age of 6 to child age of 16, we also found parenting stress at an earlier time point predicted later child maltreatment ( $\beta = 0.11$ , 95 % CI: 0.01,0.20), but did not observe an association between child maltreatment and subsequent long-term parenting stress.

**Limitations:** Potential information bias on the measurements.

**Conclusions:** This study provides evidence for a bidirectional temporal relationship between parenting stress and child maltreatment, which should be considered in parenting intervention programmes.

## 1. Introduction

Child maltreatment is a global public health problem, with approximately one billion children experiencing some form of violence each year (Hillis et al., 2016). Among the many risk factors for child maltreatment, parenting stress has been identified as a potential cause of

child maltreatment (Chung et al., 2020; Maguire-Jack and Negash, 2016; Stith et al., 2009; Olmsted et al., 1982; Crouch and Behl, 2001; El-Kamary et al., 2004; Hillson and Kuiper, 1994; Miragoli et al., 2018; Graham et al., 2001). However, there is still a lack of evidence from longitudinal studies examining the causal relationship between parenting stress and child maltreatment. While existing research on risk

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factors can help predict child maltreatment to identify individuals and populations in need of prevention and treatment, it cannot explain why these factors lead to child maltreatment in certain circumstances, limiting the role of research for developing and implementing parenting guidance and programme. The US National Research Council's New Directions in Child Maltreatment and Neglect Research also reiterated this lack of causal research on the risk of child maltreatment and neglect in the existing literature (National Research Council, 2014).

According to the criteria of a formal test of a causal model, at least four conditions must be met to support a causal effect of a hypothesised risk factor (Hill, 1965; Schuck and Widom, 2001). Firstly, it is crucial to establish the presence of a logical relationship. Subsequently, empirical evidence should be provided to demonstrate a meaningful correlation between the variables. Furthermore, it is essential to establish appropriate temporal evidence to ascertain the temporal order of events. Lastly, rigorous analysis is required to rule out alternative explanations or confounding variables to confirm that the observed relationship is not spurious or attributable to other factors. Although existing literature on the relationship between stress and child maltreatment has provided a logical justification for this relationship and support for an empirical correlation (Olmsted et al., 1982; Chan, 1994; Hillson and Kuiper, 1994; Graham et al., 2001; Griffith, 2020), the evidence for justifying the correct temporal sequence is still limited. A longitudinal study conducted by Prendergast and MacPhee (2020) showed that increases in parenting stress between child age 1 and age 3 were associated with higher levels of child maltreatment at age 3, though the association varied by parents' baseline risk of maltreatment.

The Stress and Coping Model of Child Maltreatment Theory (Hillson and Kuiper, 1994) states that child maltreatment results from parents encountering difficulties in coping with stress. When looking at child maltreatment and neglect problems from a stress and coping perspective, nearly all identifiable risk factors of child maltreatment, whether from child or parental or ecological, can be considered potential stressors. All parents face varying degrees of stress due to the inherent pressures of parenting (Spinelli et al., 2020; Clément and Chamberland, 2009; Curenton et al., 2009; Deater-Deckard and Petrill, 2004). Parenting requires considerable time, as well as physical and emotional investment (Crnic and Greenberg, 1990; Belsky, 1984; Bronfenbrenner, 1979; Garbarino, 1977), and the cumulative task and resource demands of parenting can cause a loss of time, energy, and control over self and life for parents (Garbe et al., 2020; Berry and Jones, 1995). Even though daily tasks alone may not lead to high levels of stress, cumulative exposure can lead to significant parenting stress (Platt et al., 2016; Deater-Deckard and Petrill, 2004; Crnic and Greenberg, 1990) which in turn can lead to strained parent-child relationships and an increased risk of child maltreatment (Essler et al., 2021; Rodriguez-JenKins and Marcenko, 2014; Crouch and Behl, 2001; Miragoli et al., 2018; El-Kamary et al., 2004).

Although not all people with high parenting stress abuse their children, parenting stress is associated with various aspects of parenting problems, such as harsh parenting (Clément and Chamberland, 2009; Webster-Stratton, 1990) and negative and controlling behaviour (Mak et al., 2020; Huth-Bocks and Hughes, 2008; Bigras et al., 1996). According to the third and fourth wave of the Fragile Families and Child Wellbeing study in the United States in 2016, parenting stress directly predicted child maltreatment (Barnhart and Maguire-Jack, 2016). In addition, high levels of parenting stress have been shown to increase behavioural problems in children or further exacerbate their existing behavioural problems (Margalit and Kleitman, 2006), which may in turn increase the risk of maltreatment.

In previous studies, the link between child maltreatment and parenting stress has often been examined as unidirectional (i.e., parenting stress leading to child maltreatment). However, some circumstantial evidence points to a bidirectional relationship (i.e., perpetrating child maltreatment may also lead to an increased level of parenting stress). In 2008, the American Academy of Pediatrics stated

that children who have been abused in their early childhood may later develop serious behavioural problems, including emotional instability, depression, and aggression toward others or violent tendencies (American Academy of Pediatrics et al., 2008; John et al., 2018; Trickett and Kuczynski, 1986). Neurobiology studies have also found that early childhood maltreatment can lead to impaired language, emotional, and cognitive development (Teicher and Samson, 2016; Zimmer and Panko, 2006; Delima and Vimpani, 2011; Beeghly and Cicchetti, 1994), which can become a source of parenting stress. In addition, from a psychological perspective, it is plausible that parents could feel guilty and regretful and blame themselves after committing maltreatment; such negative emotions may increase their level of parenting stress. Therefore, assessing the bidirectional relationship between child abuse and parenting stress is necessary.

We hypothesised that there is a bidirectional causal relationship (i.e. reciprocal causality (Yu et al., 2015; Yoon and Brown, 2014)) between parenting stress and child maltreatment, which means parenting stress increases the risk of child maltreatment, while child maltreatment also increases subsequent parenting stress level. Instead of conducting randomised controlled trials, relying on longitudinal data to provide chronological evidence on this relationship is an appropriate approach at present. In this regard, this study aims to examine the bidirectional temporal relationships between parenting stress and child maltreatment using data from two longitudinal studies: the e-Parenting for Lifelong Health Evaluation Study (ePLH) and the Longitudinal Studies in Child Abuse and Neglect (LONGSCAN). The ePLH study was a pre-post pilot of an online parenting intervention (ParentChat) conducted during the COVID-19 pandemic, with dynamic measurements of parenting-related variables across multiple time points (measured every two weeks) instead of traditional pre- and post-tests. In addition, this study used longitudinal data from an observational cohort study, LONGSCAN, with long-term follow-up of children and caregivers (Runyan et al., 2014). While longitudinal data from the ePLH study provided the opportunity to examine short-term time-series effects between parenting variables under the intervention settings, the LONGSCAN study provided data under the natural settings and could draw inference on the long-term associations between parenting stress and child maltreatment (as mentioned above, the two variables might be linked through their long-term influences on children's behavioural, emotional and cognitive development). To be noted, the purpose of this study is not to compare the results from the two datasets directly but rather to examine the same underlying causal evidence across different settings.

## 2. Methods

### 2.1. Participants

Study 1 was based on the ePLH evaluation of ParentChat, a 16-session evidence-based online intervention focused on increasing positive parenting and reducing child maltreatment for children aged 2–17 (ClinicalTrials.gov ID: NCT04809272). The intervention was based on the in-person Parenting for Lifelong Health programmes developed in the Global South (Cluver et al., 2018; Ward et al., 2020), but adapted for delivery via either online chat groups (e.g., WhatsApp or Viber) or a combination of Zoom video sessions plus online chat groups. The study involved 484 caregivers from six low- and middle-income countries: North Macedonia, Malaysia, Moldova, Montenegro, the Philippines, and South Africa. Informed consent was obtained for experimentation with human subjects.

Study 2 was based on publicly available data from LONGSCAN, a multi-site, multi-wave, prospective cohort study of child maltreatment in the United States (Runyan et al., 2014; Runyan et al., 1998). Children and their caregivers were enrolled at or before child age of four and prospectively followed at two-year intervals until age 18. While child maltreatment was measured at each time point, parenting stress was only measured when the children were 6 and 16 years old. Therefore, we

obtained a dataset consisting of 772 participants who had data at both time points. The data were made available by the National Data Archive on Child Abuse and Neglect, Cornell University, Ithaca, NY, and have been used with permission.

## 2.2. Measurements

ePLH collected a total of six measurements of the target variables, which were pre-intervention measurement, post-intervention measurement and four measurements during the intervention (once every four sessions). All measurements were adapted from standardised scales for utility of administration via phone weblink assessments. The time interval between the pre-intervention measurement and the first during-intervention measurement ranged from weeks to months across participants, so pre-intervention data were not included in the analysis. The five time points included in the analysis were four during-intervention and one post-intervention measurements. In this way, data collection occurred under intervention, and the time interval between each measurement was two weeks.

*Child maltreatment* measure was the sum of physical maltreatment and emotional maltreatment using an adaptation of the ISPCAN Child Abuse Screening Tools-Trial (Parent) (ICAST-TP) - Physical and Emotional Abuse Subscales (4 items, [Meinck et al., 2018](#)). The ICAST-TP measures parental reports of the incidence of maltreatment perpetrated against their child over the past week using a frequency score on a scale of 0 to 7, or 8 or more times; the items are “In the past week, how often did you discipline [Child Nickname] by spanking, slapping, or hitting with your hand?”, “... hitting child with an object”, “... yelling or screaming at child” and “... saying mean thing that upset child”.

*Parenting stress* was measured using an item adapted from the Parent Daily Report Scale ([Patterson et al., 1982](#)). Parents reported their feelings within the past week instead of the past 24 h: “How many times in the past week did you feel very stressed as a parent/caregiver?” The item was also rated on a frequency scale of 0 to 7, or 8 or more times.

In the LONGSCAN study, the measure of *child maltreatment* was determined by reviewing case records from child protective services at each data collection site, for confirmed child maltreatment. Case records of confirmed maltreatment from county-level files were reviewed and coded using a modified version of the Maltreatment Classification System ([Barnett et al., 1993](#)). Trained abstractors coded relevant information onto the maltreatment data collection form on a regular basis. This study utilised the derived maltreatment dataset from LONGSCAN. The dataset includes various forms of maltreatment, physical maltreatment, sexual maltreatment, neglect, emotional maltreatment, moral maltreatment, legal maltreatment, educational maltreatment, and drugs/alcohol maltreatment. The analysis focused on child maltreatment records between the child age of 4 and 6 (referred to as the “six-year-old group”) and between the child age of 14 and 16 (referred to as the “16-year-old group”).

LONGSCAN employed the parent-reported Everyday Stressors Index (ESI) as a measure of parenting stress, consisting of 20 items with a score range of 0–3 for each item ([Hall, 1983](#)). According to [Gómez et al. \(2015\)](#), the scale encompasses two major categories of stressors: daily stressors and *parenting stress*. Specifically, the present study focused on the sub-scale for parenting stress, which included items related to parenting concerns about children’s behaviour, time constraints, transportation issues, discipline challenges, school performance, children’s health, and difficulties with the children’s father (i.e., items 4, 6, 7, 9, 12, 14, and 18).

## 2.3. Statistical analyses

In the present study we used cross-lagged panel analysis to examine the potential bidirectional temporal relations among variables of child maltreatment and parenting stress. The cross-lagged panel models (CLPM) were implemented based on (generalised) structural equation

modelling (SEM) in Stata 15. Cross-lagged panel models can analyse reciprocal relationships between two or more observed variables measured at two or more distinct time points, including both autoregressive effects (the association of a variable on itself at a later point) and cross-lagged effects (an association of a variable with another variable at a later point) within the model ([Selig and Little, 2012](#)). The two variables in the ePLH study were measured by frequency (that is, the number of occurrences in a past period of time). After the dispersion test, both variables conformed to the Poisson distribution, so the generalised structural equation modelling was set to Poisson distribution for ePLH (Model 1). Detailed distribution check is presented in the Appendix 1.

For the primary analysis with LONGSCAN, we used the aggregate of all maltreatment records recorded by child protective services as the overall measure of child maltreatment, that is, the sum of physical maltreatment, sexual maltreatment, neglect, emotional maltreatment, moral maltreatment, legal maltreatment, educational maltreatment, and drugs/alcohol maltreatment (Model 2, linear structural equation modelling). To make the analyses of LONGSCAN and ePLH more comparable, we also used the sum of physical maltreatment and emotional maltreatment recorded by child protective services as the measure of child maltreatment in Model 3.

An alternative statistical method is random-intercept cross-lagged panel model (RI-CLPM), which was developed to further differentiate between within-person and between-person variations ([Hamaker et al., 2015](#); [Murray et al., 2020](#)). However, there is still debate on the choice between traditional CLPM and RI-CLPM ([Orth et al., 2021](#); [Lüdtke and Robitzsch, 2023](#)). As pointed out by [Lüdtke and Robitzsch \(2023\)](#), from a causal inference perspective, RI-CLPM targets a different causal estimand than the traditional CLPM. The within-person cross-lagged effect in the RI-CLPM provides an estimate of the effect of increasing the exposure by one unit around the person mean, therefore only captures temporary fluctuations around the individual person means and ignores systematic differences. In addition, one benefit of RI-CLPM - accounting for unobserved between-person confounding factors has been shown to be only valid under restrictive conditions ([Lüdtke and Robitzsch, 2023](#)). Based on these considerations, we used traditional CLPM in the current study and therefore our results cannot provide insights on the partition of the cross-lagged effects.

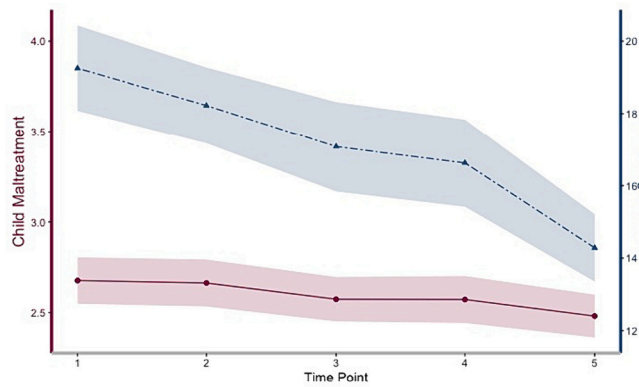
In addition, we conducted the following sensitivity analyses to assess the robustness of the main findings: (1) in the ePLH study, instead of assuming a fixed set of cross-lagged effects over different time points, we removed the constraints and estimated flexible coefficients across time points (Model 4); (2) in the LONGSCAN study, we modelled child maltreatment as a categorical variable instead: in Model 5 we coded child maltreatment as whether there was record in at least one of the six maltreatment dimensions, and in Model 6 we coded child maltreatment as whether there was record in at least one of physical maltreatment and emotional maltreatment; and (3) in both studies, we adjusted for a range of baseline covariates in the cross-lagged panel models: in the ePLH study we controlled for country, child age, child gender, parent age, parent gender, parent education level, parent employment status, parent marital status and family poverty level (Model 7); and in the LONGSCAN study we controlled for region, child gender, parent age, parent gender, parent education level, parent employment status, parent marital status and family income level (Model 8).

## 3. Results

### 3.1. ePLH-child maltreatment and parenting stress

Of the 484 caregivers in the ePLH study, 94 % were female, and the average age was 39.6 years (SD = 8.6). The changes of child maltreatment and parenting stress based on ePLH data are shown in [Fig. 1](#). A decreasing trend was observed for both variables over time.

[Table 1](#) and [Fig. 2](#) show the results of the cross-lagged panel model on the bidirectional relationship between child maltreatment and



**Fig. 1.** Changes of child maltreatment and parenting stress over time in ePLH study. *Note.* A double Y-axis design is adopted, the one on the right (plum color) refers to child maltreatment, and the one on the left refers to parenting stress (blue). The dots and triangles in the line chart represent the mean values of child maltreatment and parenting stress across participants at each time point, and the plum and blue ribbons represent the standard errors. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

parenting stress (Model 1). We found that during the intervention, one standard deviation increase in parenting stress was associated with 14 % higher risk of subsequent child maltreatment after two weeks (incidence rate ratio, IRR = 1.14, 95 % CI [1.10,1.18]). At the same time, higher child maltreatment was also associated with the increase of parenting stress later on (IRR = 1.04, 95 % CI [1.01,1.08]). Although this effect was not as strong as that of parenting stress on child maltreatment, it still implies that the increase of parenting stress and more frequent child maltreatment could form a vicious circle.

Results of the sensitivity analysis modelling flexible coefficients for the cross-lagged effects over different time points are shown in Appendix 2. Some variations in the coefficients were observed: the IRR per unit fluctuated around 1.05 (the estimate in Model 1) from 1.03 to 1.08 for parenting stress and subsequent child maltreatment, and fluctuated around 1.01 (the estimate in Model 1) from 1.01 to 1.03 for child maltreatment and subsequent parenting stress. The sensitivity analysis adjusting for a range of covariates showed consistent results as in the main analysis (Appendix 3).

**Table 1**  
Cross-lagged panel model examining bidirectional effects between child maltreatment and parenting stress based on ePLH data.

	Dependent variable		Independent variable	$\beta$	SE	<i>p</i> -value	IRR	95 % CI	IRR <sub>1 SD</sub>	95 % CI <sub>1 SD</sub>
Model 1	Maltreatment	~	Parenting stress	0.05	0.01	<0.001	1.05	1.04, 1.07	1.14	1.10, 1.18
	Parenting stress	~	Maltreatment	0.01	0.00	0.024	1.01	1.001, 1.02	1.04	1.01, 1.08

*Note.* SE = standard error; IRR = incidence rate ratio; CI = confidence interval. The IRR<sub>1 SD</sub> in the table is the elevated relative risk for the dependent variable when the independent variable increases by one standard deviation.

**3.2. LONGSCAN-child maltreatment and parenting stress**

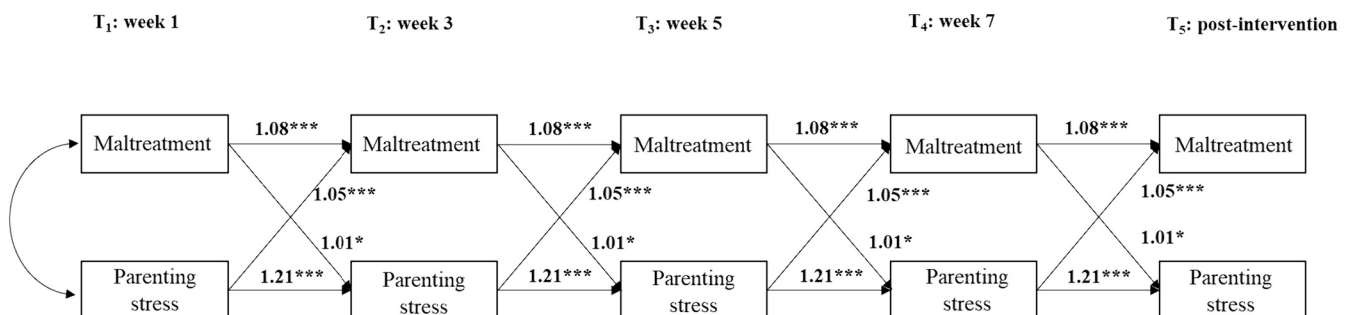
The mean age of the 772 caregivers included in the LONGSCAN study when the child was six years old was 35.5 years (SD = 10.3), and 92 % of them were female. 18.7 % of the caregivers were documented to have at least one reports (or allegations or substantiations) of the six types of child maltreatment between the child age of 4 and 6, and this proportion became 9.8 % by the time the child was 14–16 years old. 10.5 % of parents were documented to have physical or emotional maltreatment when the child was 4–6 years old, and 5.7 % by the time the child was 14–16 years old. The mean value of parenting stress was 1.95 (SE = 0.02) when the child was six years old, and 2.02 (SE = 0.02) when the child was sixteen years old.

Table 2 shows the temporal relationship between child maltreatment and parenting stress in the LONGSCAN data. The specified Model 2 provided a good fit to the observed data; the fitting indices of this linear SEM model were: Comparative Fit Index (CFI) = 0.996, Tucker-Lewis index (TLI) = 0.979, Root Mean Square Error of Approximation (RMSEA) = 0.025, Standardised Root Mean Square Residual (SRMR) = 0.013.

Fig. 3 shows that, according to Model 2, parenting stress at the child age of six was significantly correlated with parenting stress at the child age of 16. This suggests that parents with high parenting stress during early childhood exhibited higher stress levels throughout the parenting period. Parenting stress at age six predicted child maltreatment at age 16 ( $\beta = 0.11$ , 95 % CI [0.01, 0.20]); in other words, the results indicated that parenting stress during early childhood has a long-term impact on adolescence maltreatment. In contrast, there is no evidence that early child maltreatment predicted later parenting stress in adolescence.

Model 3 which focused on emotional and physical maltreatments yielded similar results as the main analysis (Model 2). Parenting stress in early childhood predicted later emotional/physical adolescence maltreatment ( $\beta = 0.06$ , 95 % CI [0.01, 0.10]), but there is no evidence that early child maltreatment predicted later parenting stress. The sensitivity analyses modelling child maltreatment as a categorical variable and adjusting for a range of covariates also showed consistent results (Appendix 4 and 5).

Analyses of longitudinal data from ePLH and LONGSCAN suggest that higher parenting stress predicts higher risk of child maltreatment. In ePLH analysis, we found that child maltreatment can also predict later parenting stress, but this was not observed in LONGSCAN. This is likely



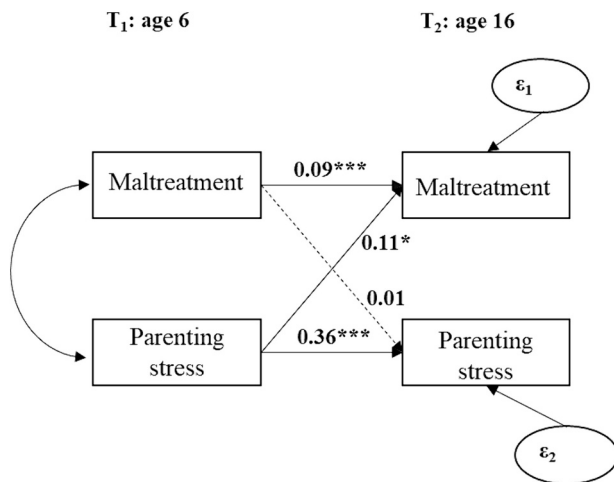
**Fig. 2.** Cross-lagged panel model examining bidirectional effects between child maltreatment and parenting stress based on ePLH data. *Note.* The effects sizes in the figure are incidence rate ratios (IRRs); “\*” refers to  $p < 0.05$ ; “\*\*\*” refers to  $p < 0.001$ .

**Table 2**

Cross-lagged panel model examining bidirectional effects between child maltreatment and parenting stress based on LONGSCAN data.

	Dependent variable		Independent variable	$\beta$	SE	<i>p</i> value	95 % CI
Model 2	Maltreatment (total score)	~	Parenting stress	0.11	0.05	0.030	0.01, 0.20
	Parenting stress	~	Maltreatment (total score)	0.01	0.02	0.642	−0.03, 0.05
Model 3	Maltreatment (emotional +physical)	~	Parenting stress	0.06	0.02	0.008	0.01, 0.10
	Parenting stress	~	Maltreatment (emotional +physical)	0.03	0.06	0.558	−0.08, 0.15

Note. SE = standard error; CI = confidence interval.



**Fig. 3.** Cross-lagged panel model examining bidirectional effects between child maltreatment and parenting stress based on LONGSCAN data. Note. The effect sizes in the figure are  $\beta$  coefficients; “\*\*\*” refers to  $p < 0.05$ ; “\*\*\*\*” refers to  $p < 0.001$ .

because ePLH had only two weeks interval between two time points, and child maltreatment could increase parents' negative emotions, such as guilt, and thus increase transient parenting stress (see more in discussion). In addition, data from ePLH study also suggest that under parenting intervention scenarios, managing parenting stress could significantly reduce future child maltreatment.

#### 4. Discussion

The situation of child maltreatment varies greatly over time and across different cultures. Using data since the 1990s in the United States, and recent data during the COVID-19 pandemic in low- and middle-income countries, this study examined the temporal relationship between parenting stress and child maltreatment. The results from both short-term longitudinal data (16-session online parenting intervention study) and long-term longitudinal data (cohort study) suggest that higher parenting stress could predict a higher risk of future child maltreatment. This result is consistent with previous research; in several cross-sectional studies, parenting stress was associated with increased parental preference for corporal punishment (Rousseau et al., 2013; Clément and Chamberland, 2009), and the likelihood of physical child maltreatment (Crouch and Behl, 2001; Miragoli et al., 2018). A large-scale survey in 1980 also showed that the rate of child maltreatment increased with the number of stressors experienced during the year (Straus, 1980). There was also experimental evidence that the maltreatment potential increased in high-pressure environments (Schellenbach et al., 1991). The present study is significant in that it provides an important piece of causal evidence for the relationship between parenting stress and child maltreatment—chronological evidence.

The short-term association between parenting stress and subsequent child maltreatment could be explained by the Stress and Coping Model of Child Maltreatment Theory (Hillson and Kuiper, 1994). According to

the theory, when parents are faced with parenting stressors, one type of inappropriate coping strategy is behaviour and mental disengagement and dysfunctional use of social support, which would lead to child neglect; another problematic coping strategy is focusing on and venting of emotions, which could lead to child abuse. Besides this theory, empirical studies also indicated that parenting stress could lead to controlling behaviour and strained parent-child relationships, and thus an increased risk of child maltreatment (Essler et al., 2021; Rodriguez-JenKins and Marcenko, 2014; Clément and Chamberland, 2009; Mak et al., 2020). As for the long-term association between parenting stress and future child maltreatment observed in the LONGSCAN data, a potential mechanism is that parenting stress in early childhood could lead to behavioural problems and developmental issues in children (Margalit and Kleitman, 2006), which may in turn increase the risk of maltreatment later on. In addition, according to the results of the cross-lagged panel models of both databases, we found that parenting stress at previous time points can predict parenting stress at later time points. This indicates that parenting stress is likely to be a long-term state, especially for the LONGSCAN data which spanned a decade. This may be because the triggers of parenting stress, such as parents' high workload and low social support (Östberg and Hagekull, 2000) are difficult to improve in a short period of time. The persistent elevated parenting stress could lead to long-term strained parent-child relationships and increase maltreatment potential.

In the comparison of the two databases, child maltreatment was associated with higher subsequent parenting stress in the short term, but this effect was not observed in the long term. This finding may be explained by a synergistic change in parenting stress and child maltreatment caused by the intervention, but it may also be a result of parental guilt or other negative emotions that immediately occurred after the maltreatment. However, existing research has focused on the consequences of child maltreatment to children, and little research has focused on parenting stress and emotional changes after child maltreatment. This study found that caregiver stress could be a contributing factor to child maltreatment, while also underscoring the importance of paying attention to parental psychological changes. In addition, researchers have long believed that stress is the cause of child maltreatment, but our observation of a bidirectional relationship suggests that there is likely a cycle (i.e., a positive feedback loop) in the short term.

The ePLH data are from a pilot parenting intervention study. We removed the baseline data, that is, the data collected prior to the intervention, and only used data collected during and post intervention, so the findings should be interpreted in the context of the intervention. The ecological validity of the relevant conclusions under natural conditions still needs to be investigated. However, our results directly reflect mechanisms of reducing child maltreatment under the intervention of ePLH, which can provide insights for future evidence-based parenting intervention studies. One practical implication of our study is that the stress-related affective factors should be considered as an important target or component in parenting intervention programs and clinical practice, such as encouraging parents to adopt appropriate coping strategies against parenting stress or helping parents to identify avoidable stressors. Such intervention strategy could be extremely useful for parents with child maltreatment records, because given the positive feedback loop between parenting stress and child maltreatment,

those parents may have even higher parenting stress.

There are some limitations in this study. Our measurement of parenting stress in the ePLH study was only based on one question adapted from an existing scale to allow for phone-based assessments using weblinks in low-resource settings. To reduce participant burden, surveys used in parenting intervention studies often settle on using short versions of measurements. In addition, the accurate measurement of child maltreatment has always been a topic of common concern among researchers in this field. Recorded incidents of child maltreatment in the LONGSCAN study were likely to be fewer than that actually happened (Gilbert et al., 2012). Parent-reported measures of child maltreatment used by ePLH also have risks of underreporting and potential measurement errors, even with the commonly used and validated ICAST-TP scale. The measurement in the ICAST-TP scale used a frequency score on a scale of 0 to 7, or 8 or more times. The common approach is to treat 8/8+ as 8, which can also lead to the underestimation of child maltreatment. Future studies with more comprehensive assessment of parenting stress and the combination of objectively recorded and self-reported maltreatment events are needed to validate our findings. In addition, it would be informative if future studies could also assess parents' general stress (apart from the parenting stress) when investigating the stress-maltreatment associations. Finally, although it would not be feasible to manipulate parenting stress in real life, lab experiments with hypothetical scenarios (i.e. manipulating the level of parenting stress in high-pressure vs. low-pressure environments) may provide another piece of causal evidence and more insights into the psychological mechanisms.

In conclusion, results from two different longitudinal data sources indicate that parenting stress at an earlier time point predicted later child maltreatment. Additionally, the occurrence of child maltreatment also predicts subsequent short-term parenting stress, suggesting the presence of a vicious cycle between the two variables. However, there is no evidence to suggest that child maltreatment predicts parenting stress in the long term. This study provides chronological evidence for the potential causal relationship between parenting stress and child maltreatment, highlighting the importance of child maltreatment interventions including content to reduce parenting stress or increase caregivers' ability of coping with and managing stress.

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### CRedit authorship contribution statement

**Qing Han:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Rosanne Joczson:** Writing – review & editing, Project administration. **Ivo Kunovski:** Writing – review & editing, Project administration. **Marija Raleva:** Writing – review & editing, Project administration. **Rumaya Juhari:** Writing – review & editing, Project administration. **Kufre Okop:** Writing – review & editing, Project administration.

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### Declaration of competing interest

None.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2024.03.063>.

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