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Regular Article

Neglect and adolescent internalizing mental health: Testing competing longitudinal hypotheses

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Abstract

Neglect remains understudied compared to other forms of maltreatment. While studies have shown that neglect has negative effects on mental health in adolescence, yet unresolved is whether these impacts result from critical period or cumulative effects. In the present article, we use a novel approach to compare these two hypotheses from the impact of two types of neglect, failure to provide (FTP) and lack of supervision (LOS), on adolescent depression and internalizing symptoms. Data derive from the LONGSCAN consortium, a diverse, multi-site, prospective study of children from approximately age 2–16. Despite our hypothesis that the critical period of early childhood would have the greatest impact on adolescent internalizing mental health, exposure to neglect during the critical period of adolescence (ages 12–16) was the best-fitting model for the effects of FTP neglect on depression, and the effects of LOS neglect on both depression and internalizing symptoms. The cumulative model (exposure across all time periods) best explained the effects of FTP neglect on internalizing symptoms. Results were robust to the addition of control variables, including other forms of maltreatment. These findings demonstrate that responding to neglect into adolescence must be considered as urgent for child welfare systems.

Keywords: neglect; longitudinal analysis; adolescence; depression; mental health

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Introduction

In 1984, Wolock and Horowitz (1984) famously termed the lack of attention to child neglect in the research literature the "neglect of neglect." Nearly four decades later, neglect continues to be understudied compared to physical and sexual abuse. Although there is growing literature demonstrating that neglect impacts brain development and psychosocial wellbeing in ways comparable to the effects of abuse (McLaughlin et al., 2017; Painter & Scannapieco, 2013), the lack of attention to neglect continues to leave fundamental research questions unanswered about its impacts. One of these questions is how neglect imparts harm across development: is there a critical period in which children are most susceptible to neglect? Or is the exposure to neglect over multiple periods the most damaging to development? These competing hypotheses have rarely been directly compared in studies, and have rarely been carefully examined for neglect distinct from other forms of maltreatment.

Although the assumption is that early childhood exposure to maltreatment including neglect imparts the strongest harm, this has rarely been tested for neglect experiences across development, and the literature on these assumptions is not consistent (Schaefer et al., 2022). This study fills these important gaps in the literature by utilizing a prospective, longitudinal dataset to compare these competing hypotheses regarding neglect's effects on adolescent internalizing mental health. We examine two types of neglect – failure to provide and lack of supervision – using a detailed examination of development from ages 0–16. This novel analysis has important implications for research and practice, especially for how child welfare organizations address child neglect allegations throughout childhood and adolescence.

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Background and literature review

Definition and types of neglect

There is no federal definition of neglect, meaning that states may write their own statutory guidelines (Rebbe, 2018). However, neglect is largely thought of as encompassing "acts of omission," referring to a caregiver's failure to act, in contrast to the acts of commission involved in abuse, which are typically easier to define and identify (Child Welfare Gateway, 2018). Because acts of omission are difficult to clearly define, state standards typically specify that caregivers' actions or lack thereof must entail an imminent risk or demonstrated harm to children. This often is established by evidence of a pattern of behaviors over time, sometimes over multiple stages of development.

Although there are a variety of subtypes of neglect (e.g., Cozza et al., 2019), two broad types have been examined frequently in the literature: failure to provide (FTP) appropriate food, clothing, shelter, and medical needs; and a lack of supervision (LOS), referring to a caregiver who leaves their child unattended or does not engage in age-appropriate monitoring (Dubowitz et al., 2005). It is also important to note that both types of neglect change as children grow. For example, appropriate supervision of a

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two-year-old looks very different than for a fifteen-year-old. For the former, caregivers are expected to be present and watchful around the clock, ensuring that that the child does not experience an accident or wander off unattended. For a fifteen-year-old, such close supervision would be inappropriate; however, caregivers may be accused of LOS if their teen is engaging in delinquent behavior without a parental response (see DePanfilis, 2006; Rees et al., 2011). Similarly, a teen may be reasonably expected to serve themselves from food caregivers might purchase, whereas a two-year old would not. While both FTP and LOS neglect may impact development, some studies have found differential impacts. (e.g., Knutson et al., 2005; Logan-Greene & Semanchin Jones, 2018; Yang & Maguire-Jack, 2016). For example, Logan-Greene and Jones (2015) found that chronic FTP neglect significantly predicted aggression and delinquency among adolescents at age 14 but chronic LOS neglect did not.

Theorizing about neglect and mental health impacts

The impact of neglect has been theorized to harm mental health through social, cognitive, emotional, and neurobiological mechanisms (Cicchetti & Toth, 1995; De Bellis, 2001; Hildyard & Wolfe, 2002). This work is largely grounded in the developmental psychopathology approach to how negative experiences may contribute to psychosocioemotional problems over time/child development (e.g., Cicchetti & Rogosch, 2002; Manly et al., 2001; Rutter & Sroufe, 2000). Two of the most common types of mental health impacts that have been examined are depression and internalizing symptoms, which may include signs of depression but also encompasses anxiety, somatic complaints, and emotional disturbances (Compas et al., 2001). A lack of attention by caregivers during early development to children's physical and social needs can disrupt attachment pathways, thereby hampering future efforts to form essential healthy relationships that buffer against mental health problems (Hildyard & Wolfe, 2002). Both the deprivation of proper nutrients in childhood and the effects of chronic stress can activate neurobiological responses with a wide variety of cascading effects (Cowell et al., 2015).

Multiple hypotheses have been proposed for how child maltreatment may impact development throughout childhood. Two primary alternative hypotheses have been examined: the critical period hypothesis, and the cumulative hypothesis. In the critical period hypothesis, there is a time in development at which children are most sensitive to the experience of maltreatment, perhaps coinciding during an important period of physical, emotional, or cognitive changes that make maltreatment more damaging than it would be at another time (e.g., Nelson & Gabard-Durnam, 2020; Thornberry et al., 2001). The timing of neglect likely matters, since particular periods of brain development may be more sensitive to the effects of adversity (Tottenham & Sheridan, 2010). This evidence frequently points to early childhood as the most critical for brain development, thus the common hypothesis that neglect or other forms of maltreatment will be the most harmful in early childhood. Under this hypothesis, maltreatment that occurs during other periods is less important and would not significantly affect outcomes, when exposure during the critical period is examined (see Schaefer et al., 2022 for a recent review).

Conversely, the cumulative exposure hypothesis suggests that the more exposure to maltreatment a youth has, the worse the outcomes (e.g., Appleyard et al., 2005; Jonson-Reid et al., 2012). From this perspective, the timing of when neglect occurs matters less than the total amount of exposure the child has had to neglect. In other words, chronic neglect yields a constant accumulation of deprivation, and the greater the accumulation of deprivation, the worse the mental health outcomes. Note, however, that this hypothesis does not necessarily specify how the impacts of exposure accumulate. For example, there could be a linear association (e.g., proportional impact, where 4 periods of exposure is twice as harmful as 2 periods of exposure), or there could be a nonlinear association, of which there are many types (e.g., squared impact, where 4 periods of exposure may be twice the exposure but squared (2*2) 4 times the harm).

Empirical evidence

Few published studies explore these hypotheses for global measures of maltreatment or for disaggregated neglect. Still, studies examining neglect are limited, since the majority of studies test any exposure, often using a dichotomous measure of neglect (never/ever, with varying time periods). A recent systematic review on the effects of child maltreatment on sensitive periods in development showed that findings are contradictory and that few studies directly compared the hypotheses of a critical period versus accumulating effects (Schaefer et al., 2022). In an early study that examined chronicity versus specific vulnerable periods using regression methods, Thornberry et al. (2001) compared the effects of exposure to maltreatment in early childhood (ages 0–5), late childhood (ages 6–11) and adolescence (ages 12–17) on a variety of outcomes, including depressive symptoms and internalizing problems. Perhaps surprisingly, their results largely showed that neglect during adolescence had the greatest impact on outcomes, including internalizing symptoms. These results did not directly compare the competing hypotheses using statistical tests, instead examining coefficients and odds ratios.

In a recent examination, Cowell et al., (2022) used ANCOVAs to examine whether timing and chronicity of maltreatment specifically in early childhood affected measures of self-control. They found that those who had been maltreated in the first year of life performed significantly worse than others either not maltreated or with time-limited maltreatment in other phases. However, they also found that chronicity of maltreatment, especially those with maltreatment across three time periods, showed the worst performance. Again, full models of these competing hypotheses were not compared.

However, there are statistical methods that allow for these questions to be addressed but that have not yet been applied to child maltreatment across development. Such approaches may help clarify the contradictory findings, since they can provide a direct statistical test of the competing hypotheses. One such technique was developed by Mishra et al. (2009) and uses a series of nested models that directly compare competing developmental hypotheses. In Mishra's approach, a specific version of one hypothesis is mathematically represented by a model and multiple models are estimated. This approach allows for direct comparison of models based on model fit statistics, which indicate the best-fitting model, and thus the most appropriate hypothesis. Thus, this approach focuses on overall model fit for multiple models rather than the statistical significance of specific coefficients within a single model.

For example, Mazza and colleagues (2017) utilized this technique to examine the effects of poverty at different stages of childhood on adolescent behavioral problems. They directly compared models that corresponded to three possible sensitive periods (ages 0–3, 5–7, and 8–12) with models of accumulated risk.

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They found that physical aggression was best explained by exposure to poverty in a sensitive period of 0–3, whereas the accumulation model best explained hyperactivity and oppositional behavior. The method has also been used to examine the effects of physical activity on health (Cooper et al., 2011), access to green space on aging (Cherrie et al., 2018), and prenatal depression on mother-infant interactions (Pearson et al., 2012), among other examinations. One recent article (Dunn et al., 2023) used a modified version of the Mishra et al. (2009) technique to examine the effects of harsh physical discipline and neglect on depression at age 9 to compare the sensitive period to the accumulation of risk models. They found that physical discipline's effects were best explained by critical period effects, whereas the effects of neglect aligned with the cumulative effects model. Yet, they did not examine subtypes of neglect. Given the contradictory evidence about critical periods versus accumulative risks in multiple fields, analyses that use prospective data to address competing hypotheses across developmental periods are both crucial and underutilized.

The present study

This study utilizes prospective, longitudinal data to test competing hypotheses about the impact of neglect on depression and internalizing symptoms across development. We directly compare whether increased depression and internalizing symptoms are best explained by exposure in one of four critical periods that were determined based both on the structure of the data and important developmental phases (early childhood, late childhood, early adolescence, or late adolescence) or whether cumulative risks across multiple developmental periods (up to 3 or up to 4 periods) specified as either linear or "tipping point" effects. We repeat these tests separately for both outcomes based on FTP and LOS neglect. Although there is little evidence that guided hypothesizing about the distinct effects of FTP versus LOS effect, based on the totality of the evidence and the theoretical understanding of developmental psychopathology related to child maltreatment, we hypothesized that the model for exposure during the critical period of early childhood would best explain depression and internalizing symptoms.

Methods

Sample

The LONGSCAN data derives from a collaboration between five study sites that included diverse samples but similar research methods and measurements (Runyan et al., 1998). The LONGSCAN data is unique in providing an opportunity to examine the effects of childhood maltreatment on development from early childhood to age 18 using repeated interviews. Sampling methods differed across sites. For example, in San Diego, the sample consisted of children that had been removed from their home for maltreatment prior to age 3.5. Seattle recruited children considered as having moderate risk for maltreatment by local Child Protective Services workers. The Chicago sample included infants that had received an allegation of maltreatment. Finally, the North Carolina sample matched infants deemed as high risk with a control group both the same year. Because maltreatment status was an eligibility criterion that varied across study sites, geographic location is rarely included as a control variable in analyses that examine the effects of maltreatment.

The initial sample consisted of $N = 1{,}354$ children who were reassessed approximately every two years using the same measurement tools. The sample was approximately balanced by child's sex (51.5% female) and was diverse: 53.2% were Black, 26.1% were Caucasian, 11.9% were mixed race, 7.2% were Hispanic/Latino, and 1.6% were another race. 43.3% of caregivers reported<11 years of education, 32.2% reported 12 years, and 24.1% reported more than 12 years. The majority of the sample (58.7%) had a household income under $15,000; an additional 19.2% received $15,000–24,999, 11.3% received $25,000–39,999, and only 8.3% reported higher than $40,000.

Measures

Neglect

Survey data from participants was merged with official records of maltreatment from local authorities. LONGSCAN researchers utilized a modified maltreatment classification system (Barnett et al., 1993) to apply maltreatment codes to differing local definitions. Two categories of neglect were established: failure to provide and lack of supervision (Dubowitz et al., 2005). All screened-in allegations of neglect were included in this analysis due to evidence that substantiation is not a reliable marker of the existence or seriousness of maltreatment (Hussey et al., 2005; Kohl et al., 2009). We created indicators of whether there was any allegation of either type of neglect for each of the four time periods: ages 0–4, 5–8, 9–12, and 13–16. We created four time periods of equal intervals that roughly map onto developmental periods: infancy and early childhood, middle childhood, and adolescence.

Dependent variables

Two scales were used as indicators of mental health at age 16: the internalizing subscale from the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1991) and the Center for Epidemiological Studies Depression scale (CES-D; Radloff, 1977). Both of these scales have been extensively validated and are among the most widely used to assess youth mental health (Warnick et al., 2008) and depression (Vilagut et al., 2016).

The internalizing scale of the CBCL contains 31 questions answered by a caregiver about the presence and frequency of problematic behaviors from a child using the following anchors: 0 = absent, 1 = occurs sometimes, and 2 = occurs often. The CBCL has excellent psychometrics and is one of the most widely used scales for assessing children's psychosocial wellbeing. For the internalizing scale at age 16 in this study, $M = 6.87$ SD = 7.28, and $\alpha = 0.90$. Questions were answered by the caregivers.

The CES-D is also widely used to assess depression symptoms for a broad age range. It contains 20 questions with anchors given as 0 = "Rarely or none of the time," 1 = "Some or a little of the time," 2 = "Occasionally or a moderate amount of time," and 3 = "Most or all of the time." At age 16 in the LONGSCAN data, $M = 12.14$, SD = 10.17, and $\alpha = 0.82$. Questions were answered by the youth.

Control variables

Multiple variables were entered separately as controls to assess the robustness of the primary finding in light of variables known to affect study outcomes. Child *gender* was derived from the first time point and coded as male/female. Child's *race* included six categories: White, Black/African American, Latino/a, Native American, Asian, mixed race, and other. *Family poverty* was a yes/no binary, derived by comparing the household income and size between ages 0 – 4 to the federal poverty line standards at the

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time (Department of Health and Human Services, n.d.). A yes/no ever in *foster care* variable was calculated based on all study measures identified that include information about foster care placement at any timepoint. Three specific indicators assessed any screened-in allegations of *physical abuse, sexual abuse, emotional abuse* during the study period (ages 0–16), using methods similar to the exposure to neglect variables above but without separate examination at time period. The count of child maltreatment experiences, known as *polyvictimization*, was generated based on the same child welfare data as described above and used as an additional control variable. We also included *study site* as a control variable, although maltreatment status varied across sites (Runyan et al., 1998). By introducing control variables one at a time, we build a more interpretable and parsimonious model to understand each variable through isolating its effect while controlling for potential confounders. In other words, since there is quite a bit of overlap between control variables, such an approach allows us to avoid muticollinearity issues (e.g., there is conceptual overlap between each type of maltreatment and polyvictimization, which are also correlated with study site). Additionally, entering all control variables at once is not possible in this type of analysis due to a lack of power.

Analytic approach

This analysis proceeded in stages. First, overall depression and internalizing scores were analyzed using t-tests based on exposure to the two types of neglect in each time period. Next, average scores for both depression and internalizing were calculated for each possible combination of experiences across the four time periods. With two possible experiences of neglect (yes/no) in each of the four time periods, this results in 16 possible patterns of neglect a child can experience. These preliminary steps were a descriptive analysis of the data, which allowed us to identify significant associations between our neglect and mental health variables, and examine the distribution of longitudinal neglect patterns in our data.

An identical methodological approach was taken for both study outcomes and was based on the methods for the assessment of competing models as described in Mishra et al. (2009). This modeling approach began with the assignment of dummy variables to represent the binary exposure of neglect across the 4 developmental time periods. The saturated model, which is based on the standard, normal-based linear model, was that where the independent variables consisted of all the constructed dummy variables and their possible cross-products (see Table 1). Under this saturated model, all possible combinations of the dummy variables, i.e., all possible patterns of neglect across time, may correspond to potentially different mean values of the outcome. Upon inspection of model diagnostic plots, due to a slight right skew in the distribution of residuals corresponding to the original fitted models for both considered outcomes, it was decided that modeling of the square root of the outcomes would be most appropriate for making inferences and was used in all subsequent analyses. This saturated model was used as the full model in the calculation of p-values based on the general linear tests corresponding to each of the considered competing models.

We then estimate parameters corresponding to the reduced models that are associated with the specific versions of our 2 main hypotheses (listed in Table 1). Each hypothesis has associated parameter restrictions resulting in fewer unknown parameters to be estimated in comparison to the saturated model. For example, the critical period hypothesis where early childhood is the critical period estimates a coefficient for early childhood while assuming that the parameters for all subsequent periods are 0 (as identified in the model constraints identified in Table 1). We estimated all four possible versions of the critical period, where each developmental period was assumed to be the critical period. We also estimated multiple versions of the cumulative hypothesis – three based on the assumption that the accumulation of effects are linear through 2, 3, or 4 periods with equal weight for each time period. Additionally, moving beyond Mishra et al. (2009), we estimated a series of tipping point models which do not assume that the effect is linear, but rather, there may be a tipping point beyond which negative effects no longer accumulate. In the end of our analysis, we tested the recency model depicted by Dunn et al. (2018), which is similar to the cumulative hypothesis mentioned above, but with unequal weights attached to different time periods. In this model, the ages in years during the exposure are typically selected as weights to assess if there is a greater effect associated with exposures occurring within closer time periods. By incorporating this recency model, we were able to explore the nuanced dynamics of how the timing of adverse experiences influences developmental trajectories, providing a more detailed understanding of their impact on child mental health.

Thus, each version of the hypothesis corresponds to a separate model – a total of 13 models. An *F*-test, based on the general linear test for nested models, was conducted for each competing nested alternative model of interest, namely critical period, cumulative harm, cumulative tipping point, and recency. Candidates for model selection only included those which had a corresponding p-value>0.05, that is, models which were not identified as implausible as compared to the saturated model via the hypothesis test. Among this subset of identified plausible competing models, final selection was then based on use of the Akaike Information Criterion (AIC) to identify the best-fitting model, overall. All analyses were performed using SAS version 9.4 statistical software. These analyses were performed separately for both LOS and FTP neglect and each outcome and were then repeated with each control variable added separately. Models which simultaneously considered the collection of control variables were not used due to sparsity of data.

Results

Associations between neglect exposure and depression and internalizing (Table 2)

Exposure to the two types of neglect were examined using *t*-tests for impact on the two dependent variables (Table 2). As shown in Table 2, the only significant effects of neglect for depression were seen in adolescence (ages 12–16). Internalizing symptoms showed significant impacts from both FTP and LOS neglect in early childhood (0–4) and adolescence (12–16). In most other cases, exposure to neglect resulted in increases in depression and internalizing symptoms that were not significant at $p \leq 0.05$.

Profiles of longitudinal neglect exposure and depression (Tables 3–4)

Next, Tables 3 and 4 show the mean depression and internalizing scores for each permutation of exposure to FTP neglect and LOS neglect, respectively. We refer to each permutation as a profile,

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Table 1. Hypotheses tested

Hypothesis	Reduced regression model*	Description
Saturated model	$E(Y) = \alpha + \beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3 + \beta_4 P_4 + \beta_{12} P_1 P_2 + \beta_{13} P_1 P_3 + \beta_{14} P_1 P_4 + \beta_{23} P_2 P_3 + \beta_{24} P_2 P_3 + \beta_{34} P_3 P_4 + \beta_{123} P_1 P_2 P_3 + \beta_{124} P_1 P_2 P_3 + \beta_{134} P_1 P_3 P_4 + \beta_{234} P_2 P_3 P_4 + \beta_{1234} P_1 P_2 P_3 P_4$	Model containing all possible interactions, allowing for each unique pattern of neglect allegation to have a different outcome.
Critical 1	$E(Y) = \alpha + \beta_1 P_1$	Only the presence or absence of a neglect allegation in infancy (ages 1–4) is associated with negative effects, with neglect allegations at other developmental periods not being associated.
Critical 2	$E(Y) = \alpha + \beta_2 P_2$	Only the presence or absence of a neglect allegation in early childhood (ages 5–8) is associated with negative effects, with neglect allegations at other developmental periods not being associated.
Critical 3	$E(Y) = \alpha + \beta_3 P_3$	Only the presence or absence of a neglect allegation in late childhood (ages 9–12) is associated with negative effects, with neglect allegations at other developmental periods not being associated.
Critical 4	$E(Y) = \alpha + \beta_4 P_4$	Only the presences or absence of a neglect allegation in adolescence (ages 13–16) is associated with negative effects, with neglect allegations at other developmental periods not being associated.
Cumulative 2	$E(Y) = \alpha + \beta \sum_{i=1}^{2} P_i$	The effect on the outcome is proportional to the amount of exposure to neglect through early childhood (ages 5–8).
Cumulative 3	$E(Y) = \alpha + \beta \sum_{i=1}^{3} P_i$	The effect on the outcome is proportional to the amount of exposure to neglect through late childhood (ages 9–12).
Cumulative 4	$E(Y) = \alpha + \beta \sum_{i=1}^{4} P_i$	The effect on the outcome is proportional to the amount of exposure to neglect through early adolescence (ages 13–16).
Tipping Point 3,2	$E(Y) = \alpha + \beta \times I(\sum_{i=1}^{3} P_i)$ $I(\sum_{i=1}^{3} P_i) = \begin{cases} 1 & \sum_{i=1}^{3} P_i < 2 \\ 0 & \sum_{i=1}^{3} P_i \geq 2 \end{cases}$	Up to late childhood (ages 9–12), the negative effects of neglect are significant after exposure in at least two developmental periods.
Tipping Point 3,3	$E(Y) = \alpha + \beta \times I(\sum_{i=1}^{3} P_i)$ $I(\sum_{i=1}^{3} P_i) = \begin{cases} 1 & \sum_{i=1}^{3} P_i < 3 \\ 0 & \sum_{i=1}^{3} P_i = 3 \end{cases}$	Up to late childhood (ages 9–12), the negative effects of neglect are significant after exposure in at least three developmental periods.
Tipping Point 4,2	$E(Y) = \alpha + \beta \times I(\sum_{i=1}^{4} P_i)$ $I(\sum_{i=1}^{4} P_i) = \begin{cases} 1 & \sum_{i=1}^{4} P_i < 2 \\ 0 & \sum_{i=1}^{4} P_i \geq 2 \end{cases}$	Up to adolescence (ages 13–16), the negative effects of neglect are significant after exposure in at least two developmental periods.
Tipping Point 4,3	$E(Y) = \alpha + \beta \times I(\sum_{i=1}^{4} P_i)$ $I(\sum_{i=1}^{4} P_i) = \begin{cases} 1 & \sum_{i=1}^{4} P_i < 3 \\ 0 & \sum_{i=1}^{4} P_i \geq 3 \end{cases}$	Up to adolescence (ages 13–16), the negative effects of neglect are significant after exposure in at least three developmental periods.
Tipping Point 4,4	$E(Y) = \alpha + \beta \times I(\sum_{i=1}^{4} P_i)$ $I(\sum_{i=1}^{4} P_i) = \begin{cases} 1 & \sum_{i=1}^{4} P_i < 4 \\ 0 & \sum_{i=1}^{4} P_i = 4 \end{cases}$	Up to adolescence (ages 13–16), the negative effects of neglect are significant after exposure in at least four developmental periods.
Recency	$E(Y) = \alpha + \beta \times (\sum_{i=1}^{4} P_i \times Age_i)$	The effect on the outcome is proportional to the amount of exposure to neglect through early adolescence (ages 13–16), with each time period weighted by the age.

*P_1, P_2, P_3, and P_4 are indicator variables representing an neglect allegation at ages 1–4, 5–8, 9–12, and 13–16, respectively.

where each of the four time periods is represented by a single digit, sequentially. For example, the profile 0001 represents youth who only had an allegation of neglect in the fourth period, between ages 12–16, while the profile 1110 represents youth who had allegations of neglect for the first three time periods: ages 0–4, 5–8, and 9–12, but not for the fourth period (ages 13–16). For each of these profiles, the associated mean and SE of depression and allegation are presented, demonstrating differential impacts of neglect exposure combinations. As a general trend, more exposures across time periods appears to be related to higher depression and internalizing scores.

Model comparisons and best fit models

Tables 5 and 6 presents the model fit statistics comparing each of the competing models against the fully saturated model (see Table 1) for FTP and LOS neglect, respectively. Two model fit statistics were utilized: AIC and the results from the nested model test. In this case, a significant p indicates that the saturated model is statistically preferable; a non-significant p value indicates lack of evidence that the alternative model is different than the saturated model, which is notable since the alternative model is more efficient (i.e., estimates fewer parameters).

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Table 2. Sample descriptions and significance tests for depression and internalizing scores based on allegations of neglect across development, means and (standard deviations)

	Depression			Internalizing		
Neglect type:	No	Yes	*p*	No	Yes	*p*
FTP 0-4	12.22 (9.95)	12.00 (10.55)	0.77	**6.22 (6.94)**	**7.88 (7.68)**	**<0.01**
FTP 5-8	11.92 (10.03)	13.46 (10.97)	0.14	6.68 (7.11)	7.97 (8.13)	0.10
FTP 9-12	11.95 (9.93)	13.83 (11.98)	0.17	6.72 (7.28)	8.04 (7.19)	0.09
FTP 13-16	**11.71 (9.75)**	**20.22 (12.93)**	**<0.01**	**6.69 (7.08)**	**10.17 (9.70)**	**0.02**
LOS 0-4	12.15 (10.16)	12.13(10.25)	0.98	**6.47 (7.07)**	**7.99 (7.75)**	**0.01**
LOS 5-8	12.07 (10.15)	12.50(10.31)	0.65	6.64 (7.05)	8.00 (8.23)	0.06
LOS 9-12	12.02 (9.96)	13.11(11.80)	0.41	6.70 (7.12)	8.21 (8.32)	0.09
LOS 13-16	**11.73 (9.80)**	**17.55(13.19)**	**<0.01**	**6.57 (7.06)**	**10.66 (8.84)**	**<0.01**

FTP = Failure to Provide; LOS = Lack of Supervision.

Table 3. Distributions of allegations of failure to provide neglect across the four time periods and each profiles' depression and internalizing score means and standard errors

		Depression		Internalizing	
Profile	Frequency	Mean	SE	Mean	SE
0000	498	11.70	0.47	5.63	0.30
0001	16	16.70	4.37	13.83	4.11
0010	24	13.10	2.16	7.63	1.39
0011	8	23.20	6.51	8.71	1.80
0100	62	13.80	1.63	7.49	1.53
0101	7	27.00	8.71	11.33	4.10
0110	14	11.17	5.67	9.00	3.68
0111	9	15.50	7.50	16.50	6.50
1000	141	10.89	0.68	7.77	0.52
1001	5	21.33	4.82	6.73	2.42
1010	17	13.35	2.26	8.50	1.60
1011	7	23.60	8.48	14.40	3.98
1100	33	13.10	1.60	8.87	1.23
1101	6	20.33	8.69	7.67	4.41
1110	24	10.55	2.69	6.21	0.99
1111	4	15.75	6.86	3.75	1.75

Note. The left-hand column shows all different combinations of 0 = no allegations and 1 = any failure to provide allegations for each of the four age categories (0–4, 5–8, 9–12, and 13–16). For example, 1100 = failure to provide allegations in both 0–4 and 5–8, but none in 9–12 or 13–16.

Table 4. Distributions of lack of supervision neglect profiles across the four time periods and each profiles' depression and internalizing score means and standard errors

		Depression		Internalizing	
Profile	Frequency	Mean	SE	Mean	SE
0000	498	11.54	0.45	5.94	0.30
0001	16	20.80	3.54	9.63	1.49
0010	24	12.25	2.28	8.50	1.58
0011	8	24.67	6.64	9.88	3.13
0100	62	13.00	1.21	8.08	1.19
0101	7	12.00	3.89	11.86	3.78
0110	14	13.77	4.08	5.36	1.79
0111	9	13.33	4.09	8.11	1.80
1000	141	11.70	0.88	7.33	0.60
1001	5	27.25	5.66	13.80	3.87
1010	17	11.64	2.02	7.47	1.39
1011	7	18.00	7.83	18.00	6.21
1100	33	12.52	2.08	8.45	1.33
1101	6	13.30	4.06	11.33	2.50
1110	15	9.36	2.61	7.13	2.03
1111	6	10.83	3.98	5.00	2.56

In each case, one model emerged as the best fit based on these two criteria. As shown in Table 5, the *critical period 4 model* fit the data best for depression, suggesting that FTP in adolescence is a critical period for depression symptoms, regardless of what happened in other time periods. The beta for this coefficient was 1.08, $p<0.001$. For internalizing symptoms, the *accumulated 4 model* fit best, indicating that the amount of FTP across all four time periods best explained the outcome. The beta for internalizing was 0.24, $p<0.001$. For LOS neglect, the *critical period 4 model* fit best for both depression and internalizing. The beta for the depression model was 0.77, $p<0.001$; for internalizing it was 0.83, $p<0.001$.

Sensitivity analyses

Results with the addition of the control variables to each model are reported in Table 7. In general, control variables did not change the best-fitting model, with some exceptions. For models predicting adolescent depression based on FTP neglect, the addition of foster care and study site changed the best-fitting model from Critical period 4 to Recency 4; no changes were seen for LOS neglect models with control variables added. For internalizing symptoms,

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Table 5. Model comparison statistics for failure to provide with the best-fitting model in bold text

	Depression			Internalizing		
	F	*p*	AIC	*F*	*p*	AIC
Critical 1	2.08	0.01	2983.87	1.85	0.03	3072.60
Critical 2	1.90	0.02	2981.43	2.36	<0.01	3079.69
Critical 3	1.93	0.02	2981.89	2.35	<0.01	3079.55
Critical 4	**0.77**	**0.70**	**2965.66**	1.97	0.02	3074.23
Cumulative 2	2.10	0.01	2984.22	1.75	0.04	3071.25
Cumulative 3	2.05	0.01	2983.48	1.65	0.06	3069.89
Cumulative 4	1.82	0.03	2980.39	**1.35**	**0.17**	**3065.68**
Tipping 3,2	1.97	0.02	2982.41	2.17	0.01	3074.23
Tipping 3,3	2.11	0.01	2984.28	2.62	<0.01	3083.24
Tipping 4,2	1.53	0.09	2976.30	2.08	0.01	3075.81
Tipping 4,3	2.05	0.01	2983.50	2.49	<0.01	3081.41
Tipping 4,4	2.09	0.01	2984.03	2.60	<0.01	3082.95
Recency 4	1.19	0.28	2971.58	1.56	0.09	3068.57
Saturated	1.97	0.02	2982.74	2.45	0.00	3074.64

Note. AIC = Akaike Information Criterion.

Table 6. Model comparison statistics for lack of supervision with the best-fitting model in bold text

	Depression			Internalizing		
	F	*p*	AIC	*F*	*p*	AIC
Critical 1	1.88	0.03	2984.35	2.50	<0.01	3075.18
Critical 2	1.85	0.03	2983.92	2.78	<0.01	3079.06
Critical 3	1.82	0.03	2983.57	2.83	<0.01	3079.75
Critical 4	**0.96**	**0.50**	**2971.52**	**1.59**	**0.07**	**3062.75**
Cumulative 2	1.87	0.03	2984.29	2.30	<0.01	3072.50
Cumulative 3	1.85	0.03	2984.01	2.23	<0.01	3071.50
Cumulative 4	1.70	0.05	2981.89	1.70	0.05	3064.17
Tipping 3,2	1.87	0.03	2984.27	2.66	<0.01	3077.49
Tipping 3,3	1.80	0.03	2983.32	3.07	<0.01	3083.01
Tipping 4,2	1.74	0.04	2982.40	2.24	<0.01	3071.73
Tipping 4,3	1.88	0.03	2984.37	2.75	<0.01	3078.72
Tipping 4,4	1.88	0.03	2984.32	3.05	<0.01	3082.79
Recency 4	1.42	0.14	2977.92	1.67	0.06	3063.83
Saturated	1.75	0.04	2985.96	2.88	<0.01	3068.30

Note. AIC = Akaike Information Criterion.

models for FTP changed as follows: the addition of race and foster care yielded the Recency 4 model as best-fitting, and Critical 4 was the best-fitting model when physical abuse, emotional abuse, polyvictimization, and study site were added. For LOS models, the addition of foster care changed the best-fitting model from Critical 4 to Recency 4, whereas the best-fitting model with foster care included became the Cumulative 4 model.

Table 7. Best-fitting models after the addition of each control variable

	Depression		Internalizing symptoms	
	Failure to Provide	Lack of Supervision	Failure to Provide	Lack of Supervision
No controls:	Critical 4	Critical 4	Cumulative 4	Critical 4
Race	Critical 4	Critical 4	**Recency 4**	Critical 4
Gender	Critical 4	Critical 4	Cumulative 4	Critical 4
Poverty	Critical 4	Critical 4	Cumulative 4	**Recency 4**
Foster care	**Recency 4**	Critical 4	**Recency 4**	**Cumulative 4**
Physical abuse	Critical 4	Critical 4	**Critical 4**	Critical 4
Sexual abuse	Critical 4	Critical 4	Cumulative 4	Critical 4
Emotional abuse	Critical 4	Critical 4	**Critical 4**	Critical 4
Polyvictmization	Critical 4	Critical 4	**Critical 4**	Critical 4
Study site	**Recency 4**	Critical 4	**Critical 4**	Critical 4

Note. Bold text indicates that the addition of the control variable changed the best-fitting model.

Discussion

To our knowledge, this is the first study to undertake this detailed type of examination of the longitudinal effects of both FTP and LOS neglect on adolescent internalizing mental health. We are the first to use Mishra and colleagues' (2009) approach to test competing hypotheses within the child welfare context. However, these results are congruent with prior studies that showed an overall pattern of negative impacts of neglect on mental health, even when controlling for other forms of maltreatment (Cohen & Thakur, 2021; Hecker et al., 2019; Horwitz et al., 2001). Contrary to our hypotheses, the critical period of early childhood neglect, while associated with a significant impact on internalizing symptoms, was not the best-fitting model in any of our tests. Instead, we found that adolescent exposure (between ages 12 and 16) had the most impact, either through a critical period impact (depression based on both FTP and LOS neglect and internalizing symptoms based on LOS neglect) or through the cumulative effects 4 model (internalizing based on FTP neglect), which specifies a linear relationship between neglect and the outcomes across all four developmental periods. Although our addition of the tipping point analysis extends the Mishra et al. (2009) model-testing technique, no tipping point model emerged as best-fitting in the present analysis. Inclusion of the recency model, as performed by Dunn and colleagues (2018), did not emerge as the best-fitting model in the overall tests, but did when some control variables were added (see below).

These results, while somewhat surprising, are congruent with some of the best-designed research to address maltreatment across time (e.g., Thornberry et al., 2001), however using more advanced statistical methodology. It also demonstrates what many experts have argued for a long time: despite neglect's deprioritization among child welfare organizations, neglect imparts significant harms to youth, even through adolescence (Fluke et al., 2008; Loman, 2006; Semanchin Jones & Logan-Greene, 2016). Child welfare workers often struggle with limited resources and pressures to focus on cases in which children are viewed as facing imminent risks to physical health and wellbeing, such as via physical or sexual abuse. However, these results show that neglect may also

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be understood as causing imminent risks to adolescent mental health

Failure to provide neglect

As mentioned, the effects of failure to provide differed across the two outcomes. For depression, the Critical 4 model was the best-fitting; the Cumulative 4 model fit best for internalizing symptoms. The CBCL measure of internalizing symptoms encompasses depression but is broader – including anxiety, withdrawal, and somatic complaints. Thus, these results suggest that internalizing in this larger sense has roots across childhood, with impacts stemming from long-term exposure to unmet needs. In a study on youth raised in state institutions, Bick et al. (2017) found that early deprivation caused neurological changes that appeared to account for internalizing symptoms in adolescence. Thus, FTP neglect may be imparting its impact via damage to brain development across time. Worth noting, however, is that the FTP results on internalizing symptoms changed the most when control variables were added (see below for a discussion).

In contrast, the results for depression had a stronger relationship to exposure to FTP neglect between ages 12 – 16. Thus, their symptoms may reflect the direct impact of the events or situations that caused the allegations of neglect or the investigation or interventions that followed. Adolescent depression is a significant risk factor for a wide variety of additional negative outcomes, including academic failure, sexual risk-taking, substance abuse, and self-harm, including suicide (e.g., Clayborne et al., 2019; Johnson et al., 2018); these issues require urgent attention when neglect is found among adolescents.

Lack of supervision neglect

For both depression and internalizing symptoms, the best-fitting model for LOS neglect was the Critical 4 model. As noted above, some types of neglect experiences may affect brain development. It is possible that LOS neglect does not affect neural development in the same way as deprivation neglect, meaning that mechanisms to mental health impacts would function through cognitive or social/emotional pathways, such as problems in attachment (Hildyard & Wolfe, 2002). The recent experiences of neglect may be causing negative self-evaluation of the adolescents who may experience self-blame for the lack of attention from their caregivers. Although adolescents are attempting to individuate from their caregivers, the relationship remains important (e.g., Spruit et al., 2020). Even if they are developing their independence, they still need their caregivers to set the structures and boundaries within which they can explore their own identities. With clear structures and boundaries, they may feel a sense of safety and security in their risk-taking. For example, allowing teenagers the freedom to spend time with their friends without parents hovering facilitates appropriate independence, but setting a curfew so they need to be home at a certain time reminds them they are loved (and would be missed if they don't come home).

Intervening in LOS of adolescents may be complicated, as their burgeoning independence may be making them hard for caregivers, especially those with other children or their own health complications, to supervise closely. The caregivers of adolescents who are cited for truancy or other delinquent behaviors may receive allegations of LOS. Indeed, this has even been described as a two-way street, in which "problem behavior by adolescents may affect parenting styles, rather than, or in addition to, vice versa" (Rees et al., 2011, p. 47). For these families, interventions that improve the caregiver/adolescent relationship may be more important than addressing pragmatic needs for childcare that are crucial in the younger years.

Inclusion of control variables

Several control variables were included to explore whether confounds could explain these findings (see Table 7). In the cases in which control variables did affect results, the best-fitting models toggled between Cumulative 4, Critical 4, and Recency 4. For depression as a result of FTP neglect, the inclusion of foster care and study site both caused the best-fitting model to switch to Recency 4. As some study sites recruited on the bases of maltreatment status (Runyan et al., 1998), this likely demonstrates the same phenomenon for both variables. The most likely explanation for this is likely that neglect was co-occurring with maltreatment resulting in foster care placement in earlier developmental periods; controlling for that causes the more recent experiences of neglect to emerge as distinct and with greater impact. The best-fitting model for depression based on LOS neglect did not change with any control variables.

The effects of internalizing symptoms were more vulnerable to the addition of control variables, especially for FTP neglect. While the best-fitting model for FTP neglect's effects on internalizing symptoms was Cumulative 4 without control variables, the inclusion of race and foster care changed the result to the Recency 4 model; physical abuse, emotional abuse, polyvictimization, and study site caused it to change to Critical 4. For LOS neglect, poverty caused the best-fitting model to become Recency 4, and foster care changed it to Cumulative 4. The differences between these models are subtle, and further examination is required to unpack why, for example, Recency 4 fits the data better for internalizing symptoms and FTP neglect than Cumulative 4 when race and foster care are controlled for. Both models include effects across childhood, but the Recency model weights adolescent experiences more heavily while the Cumulative model assumes constant weight (i.e., impact) for all time periods.

Yet, it is noteworthy that all these results consistently indicate that adolescence (ages 13–16) is a period during which the effects of two types of neglect are impactful on depression and internalizing symptoms, contrary to our original hypotheses about the importance of early childhood. In other words, an earlier critical period or any of the tipping point models (which de-emphasizes more recent developmental periods) did not emerge as one of the best-fitting models. Strikingly, adolescence becomes more prominent for FTP neglect and internalizing symptoms, which was the only pair with a cumulative effects finding as the best-fitting model. Thus, although there are some varying, nuanced results from this study, overall, the results are clear that neglect in adolescence has consequences for youth mental health, and should be addressed.

Statistical considerations

The specification of the effects across developmental periods using the Mishra et al. (2009) model is distinct. This approach has advanced our ability to elegantly test competing hypotheses, particularly longitudinal hypotheses.There remains tremendous potential in this approach. In particular, this approach can be used to test other possible hypotheses. For example, we primarily modeled cumulative effects of neglect as linear. As we began to question n this automatic assumption, we extended Mishra's modeling technique with the inclusion of the tipping point

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analyses. However, the tipping point tests were not best-fitting in any of the models tested in the present analysis. Nonetheless, we encourage others who may utilize the model-testing techniques for longitudinal data presented by Mishra et al., to consider whether they should test additional alternatives to linearly accumulating risks, as it is possible that the effects of accumulating experiences may be nonlinear (e.g., Patwardhan et al., 2017).

Limitations

Several limitations to this analysis are worth noting. First, the LONGSCAN data is not nationally representative and is becoming somewhat dated; however, no comparable dataset exists that allows for such a detailed examination of the longitudinal effects of maltreatment. Second, screened-in allegations do not capture all incidents; there may be unmeasured maltreatment occurring – in the form of neglect or other types – that are impacting the results found here. Along these lines, we did not disentangle substantiated versus unsubstantiated results, in part because of the findings in other research studies that neglect is more likely to be unsubstantiated (e.g., Kohl et al., 2009). We also did not attempt an analysis of the identity of the individual named as neglectful in the allegations. In a large sample, this would be difficult and complicated, possibly including multiple individuals for some allegations but single individuals for others – in some cases within the same developmental time period. This level of detailed analysis is beyond the scope of this manuscript. However, it is worth acknowledging that, in some cases, the individual who is alleged to have neglected their child was also tasked with answering questions about their child's mental health (internalizing symptoms), which were used as one of the dependent variables in this set of analyses. Still, it is important to note that the results of these analyses are quite consistent across the two dependent variables – depression scores from the CES-D, which were answered by the youth themselves, and internalizing symptoms from the CBCL, which were answered by the caregiver. Thus, while it is worth noting that some neglectful caregivers may not be attuned to their children's mental health symptomology, the results did not appear to differ significantly based on the individual responding to the questions on the measure. Similarly, the time frames for the two measures are different. The CBCL (internalizing symptoms) asked about symptoms in the last six months, and the CES-D (depression) asks about the last week. It's unclear if this explains the differences between the results for the two dependent variables.

An additional limitation is that we identified the best model based only on the hypotheses that we tested. There may be other hypotheses that better fit the model but are unexamined in this study. In fact, mathematically, there are an extensive number of models that can be tested, but we selected a testable number of models based on theoretical and empirical considerations. This method of analysis (Mishra et al., 2009) specifies the possible models of the effects of neglect on outcomes a priori, meaning that there may be other models that better explain the results of independent and dependent variables better than the ones we tested here (e.g., via multiplicative effects). Future studies can test this and other alternatives. Additionally, future analyses should attempt to control for all covariates (race, gender, type of maltreatment, etc.) simultaneously, which is not possible using the statistical approach with this dataset.

These results are further complicated by the fact that neglect in adolescence may look different than it does in early childhood. While some caregivers may be reported for not providing a minimal standard of care via FTP (e.g., insufficient food or shelter, failing to see medical care) or LOS neglect (leaving youth alone for excessive amounts of time), there may be other dynamics at play for older children. Caregivers may, for example, receive an allegation of lack of supervision when their teen engages in delinquent behavior or in statutory violations such as truancy (Ryan et al., 2013). This is a different type of neglect than caregivers who may leave a toddler unsupervised and receive the same allegation. The types of neglect that caregivers may be reported for change when for adolescents who function more independently and may speak to the youths' behaviors as much as the caregivers. Thus, the results shown here may in some cases represent a pattern of unhealthy interactions between youth and their caregivers as much as the more typical understanding of neglect as acts of omission (DePanfilis, 2006).

Conclusions

Adolescent neglect is underattended in two ways: First, because neglect receives less attention from researchers and practitioners compared to other forms of maltreatment. Second, because many believe that earlier experiences have the strongest impact on later development (e.g., Perry et al., 1995). While this may be the case for some outcomes, the present analysis demonstrates the importance of attending to neglect, especially in later childhood and adolescence. Although neglect remains the most common type of maltreatment, and as child welfare agencies continue to allow it to go unchecked across time periods (e.g., Semanchin Jones & Logan-Greene, 2016), research that demonstrates the salience of adolescent experiences shows that these experiences cannot be overlooked in adolescence and rather, must be addressed throughout development.

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