

BUILDING FOUNDATIONS OF **RESILIENCE**

An Overview of Promising Approaches
to Buffer the Effects of Toxic Stress in Young Children



EARLY CHILDHOOD
COLORADO PARTNERSHIP

Background

The **Early Childhood Colorado Partnership** is a network of statewide and local agencies, nonprofits, early childhood councils, foundations, and universities, dedicated to supporting the vision of the Colorado Early Childhood Framework. The Partnership's efforts to ensure all Colorado children are valued, healthy, and thriving is focused through the lens of buffering the effects of early adversity and toxic stress.

The Partnership's working group with the focus to explore "**Strategies to Buffer Toxic Stress in the Early Years**" identified the need to navigate existing and emerging research toward the goal of building a shared understanding among the Partnership network and the community beyond about early adversity and toxic stress in young children. This comprehensive review of national literature provides background, promising approaches, and highlights of programs which have exhibited success in buffering the effects of toxic stress in young children. The hope is that this thorough literature review stimulates discussion and shared learning.

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THE FOUNDATIONS OF DEVELOPMENT

Children’s early life experiences can have profound and cascading effects on later development and influence health and life outcomes well into adulthood. The early development of a child’s brain is much like building a house. Some of the most intensive and formative development occurs during the initial stages, similar to laying a foundation, framing rooms, and installing electrical wiring in a home. When problems arise during these first steps that result in an unstable foundation or faulty circuits, for example, all subsequent construction can be affected. Although it is not impossible to remediate underlying problems at later stages of the building process, it is often far more challenging and costly to do so.

the PLASTICITY *of* EARLY DEVELOPMENT

THE PRENATAL PERIOD AND FIRST FEW YEARS of a child’s life represent a “sensitive period” in which development is more malleable. Over time, biological systems and behavior patterns become increasingly consolidated and therefore more difficult to change. This plasticity of the brain in the early years of life, in which children are particularly sensitive to environmental influences, has a dual nature. On one hand, the differences in a child’s experiences during the first years of life can lay the foundation for disparities in outcomes over the course of the lifespan, from widening achievement gaps over the course of a child’s educational career to substantial differences in health outcomes in adulthood. On the other hand, using the right tools and interventions during these formative years can leverage the plasticity of this developmental period, helping to “redraft” the blueprints that outline a child’s trajectory and fortify the foundation upon which a child’s future development is built.

This paper provides a review of the research in an emerging area of science exploring how early adversity and the experience of toxic stress can influence the “wiring” of biological systems and the development of children’s brain architecture. Although it has been known for decades that adverse experiences such as poverty, neglect, and abuse are connected to a host of negative outcomes, we are just beginning to understand the key role of toxic stress as an invisible link between early adversity and later outcomes. The research community is also exploring how interventions may help prevent or mitigate the effects of toxic stress. The review of the literature in this paper draws from a cross-disciplinary body of work that spans brain science, child development theory, and evaluations of interventions to identify characteristics of effective approaches and strategies to buffer the effects of toxic stress in young children.

The Mechanisms behind Toxic Stress

As research continues to illuminate the relationship between adverse childhood experiences and cognitive, social, and health outcomes, it is clear that there is a strong biological component to this story. Indeed, during the prenatal period and early years of life, children’s brains and bodies are constantly gathering information about their environment, learning if their immediate world is dangerous or secure, rich or deficient in food, and whether they can rely on others to meet their needs and protect them, or if they should direct resources to self-preservation.¹ This information becomes embedded in the blueprints for the development of key biological systems. For example, research indicates that children whose mothers are malnourished during pregnancy tend to develop lower metabolisms to prepare the child for a food-scarce environment. Even if the food conditions change soon after birth, the child’s metabolism remains low, increasing their risk of developing health problems such as diabetes and obesity.²

Similarly, young children who are exposed to high levels of environmental stress, such as chaotic and unpredictable living conditions, unreliable emotional support from caregivers, family conflict and instability, or fear of physical harm or abandonment, often develop physiologic stress response systems that prepare their brains and bodies to respond to chronic threats in environments that are unpredictable and dangerous. This biological embedding of early environmental experiences means that for children who experience chronic adversity, stress really does “get under the skin”—or to continue with the house-building analogy, stress can seep into the walls, changing the underlying circuitry in ways that are not apparent to the naked eye, but have significant consequences for later development and are more difficult to support and alter during later phases of construction.

UNDERSTANDING *the* STRESS RESPONSE SYSTEM

WITHIN MODERN HOMES, we have mechanisms to help us adjust our internal experiences in response to environmental conditions, like installing heating and cooling systems that are activated by changes in temperature. Similarly, our brains and bodies have developed mechanisms to respond to changes in our environment, and many of these systems undergo significant programming during the early years. One such system is the way in which our bodies react when we encounter a perceived threat or danger. Like a thermostat, when our threat detection systems reach a certain threshold, a complex system is activated and chemical signals cascade through our brains and bodies, resulting in higher levels of stress hormones, like cortisol. These processes are a cue for the body to switch on a host of defensive reactions such as elevated heart rate, blood pressure, and short-term immune processes to help the body mobilize resources like sending energy to muscles. When the threat is neutralized or we engage in active coping strategies to manage the threat, the stress “thermostat” sends messages to the body to deactivate these systems and return to baseline.

DIFFERENT TYPES *of* STRESS *and* SUPPORT

POSITIVE STRESS is a normal and essential part of healthy development for a child in the context of supportive caregiver interactions. Receiving an immunization or the first day in a new classroom are examples where a positive stress response may occur.

TOLERABLE STRESS occurs when a non-normative experience occurs that presents a greater degree of threat or adversity. In the context of caring adults and supportive interactions, long-term negative outcomes from these types of experiences can be greatly reduced or eliminated. The death of a loved one or natural disaster are examples of events for which tolerable stress can occur.

TOXIC STRESS can result from strong, frequent, or prolonged activation of the body's stress response systems in the absence of the buffering protection of a supportive adult relationship. Physical or emotional abuse, chronic neglect, caregiver substance abuse or mental illness, and exposure to violence are examples of potential triggers for toxic stress.³

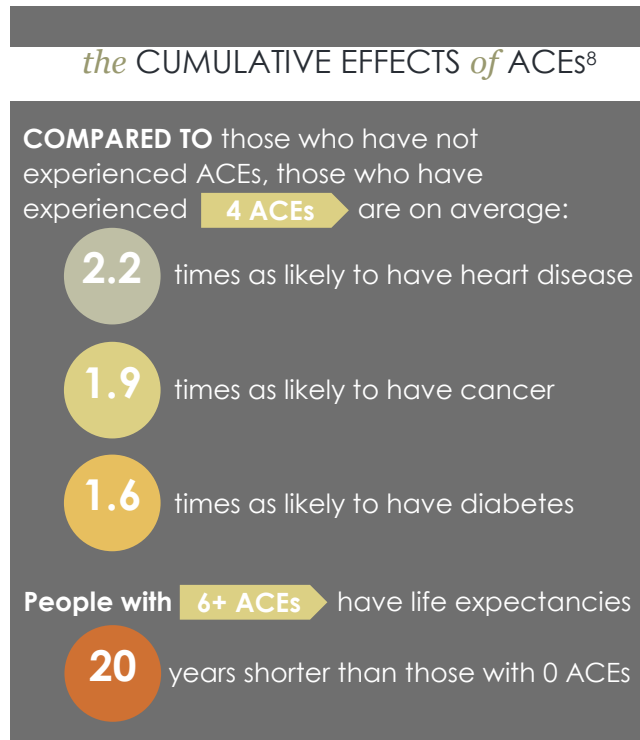
When Adaptations Become Maladaptive

Although our neurobiological responses to stress are protective and necessary to survival, the excessive, prolonged activation of these systems can have toxic effects on functioning and development.⁴ If this chronic activation of the stress response system occurs during early childhood—one of the most sensitive periods for brain development—there is a greater likelihood that long-term changes to this system will occur.⁵ Instead of constantly switching stress responses on and off, due to frequent triggering events, a child's stress response may develop a lower threshold for activation (much like setting your home thermostat to 40 degrees year-round), meaning that the system is usually on, regardless of the actual threat status. In extreme cases, the system can become underactive, as if the circuit has faltered from too many surges of activity and has consequently shut down.⁶ Over- or under-active stress response systems can also impact the functioning and even physical size and architecture of brain structures such as the amygdalae, hippocampi, and prefrontal cortex, which are vital to decision making, attention, memory, behavioral regulation, and impulse control.⁷

These physiological changes may have an adaptive function. For children who live in unpredictable environments where situations can quickly become unsafe, having a lower threshold for detecting danger, heightened alertness, and the ability to react to potential threats at any moment may be protective. However, these behaviors may manifest in ways that are inconsistent with the values and expectations of social contexts, such as schools. For example, a child who is constantly scanning her environment for threats may appear inattentive and have difficulty maintaining focus on schoolwork, or a child

who reacts to being accidentally bumped on the playground by immediately shoving another child without attention to additional social cues may be labeled as impulsive and aggressive.

In addition to these behavioral patterns that may undermine children’s success in school and other settings, there are other trade-offs to biological adaptations to stress. Just as keeping one’s air conditioning on at all times would be expensive and might lead to mechanical failure, having a stress response system that is chronically activated is costly for the body and can cause deterioration over time. Indeed, a growing body of research shows that there is a direct relationship between the cumulative number of adverse childhood experiences (or “ACEs”)—including family conflict, exposure to violence, disruptions in caregiving relationships, and economic hardship—and the likelihood of experiencing negative outcomes later in life.^{8,9}



How Caregiver Relationships Shape a Child's Response to Stress

Research indicates that early caregiving relationships are critical in helping regulate a child’s stress response system and can have strong buffering effects against the negative consequences of high environmental stress. When children experience a pattern of repeated sensitive and responsive caregiving interactions, they are more likely to develop a secure attachment relationship in which they view their caregiver as a trusted figure on whom they can rely as a source of protection and support.¹⁰ Research indicates that when securely attached young children are exposed to a stressor (e.g., immunizations at a well-baby exam, a visit to a new child care center), if their attachment figure is present, the child’s biological stress system is unlikely to be activated (although they still may cry and show signs of distress). In contrast, children who are insecurely attached show rises in stress hormones and activation of the biological stress response system.^{11, 12} This suggests that when children have a trusted caregiver which they can rely on to keep them safe, their brains and bodies do not need to spend energy activating their biological threat detection systems. In this way, children can devote their full resources and attention to other developmental tasks, such as

exploration and learning. In contrast, if a caregiver is an unreliable source of protection and external regulation, it may be more adaptive in the short-term for the child to rely on their own underdeveloped stress response systems, which can eventually lead to an over- or under-active stress response system.

CAREGIVER STRESS *and* WELL-BEING

MANY FACTORS can influence a caregiver’s capacity to engage in sensitive and responsive interactions with a child, including their own experience of stress. When caregivers confront multiple stressors without sufficient coping resources, their own well-being is affected, which can affect their ability to consistently engage in positive interactions with children.¹³ Furthermore, research suggests that caregivers facing chronic stressors—such as those associated with living in poverty—are more likely to show dysregulated stress response systems themselves (perhaps a legacy of their own adverse early experiences).¹⁴ As noted above, dysregulated stress response systems can affect key processes such as attention, emotion regulation, and problem solving, which, in turn, can affect caregiving practices.

Given that children’s development and psychological functioning unfolds within the context of relationships with caregivers, it would suggest that these relationships could be an important target of interventions to mitigate the effects of toxic stress.

BUFFERING THE EFFECTS OF TOXIC STRESS: PROMISING APPROACHES

As described above, research about early life stress suggests two important themes in thinking about intervention: First, children’s sensitivity to their environment during the first years of life means that this is a period of great risk if children are exposed to adverse experiences, but also a time of considerable opportunity to support developmental processes through the right interventions. Second, children’s relationships with those who care for them are key to preventing and buffering the effects of toxic stress. Our understanding of the mechanisms behind the effects of toxic stress, developmental theory, and a review of current interventions that have been shown to affect indicators of early life stress suggest that effective interventions work to build the capacity of caregivers in one or more of the following ways:

SUPPORTING sensitive and responsive **caregiver–child interactions**

PROMOTING **caregiver mental health** to support responsive caregiving

ENHANCING **caregivers’ economic stability** to decrease the cumulative stressors experienced by caregivers and children living in poverty

The following sections explore interventions that focus on the capacity-building of caregivers in each of these areas. Within each section—supporting sensitive and responsive caregiving interactions, promoting caregiver mental health, and enhancing caregivers’ economic stability—interventions are described that have been designed for parents (including foster parents) and teachers in early care and education settings as these caregivers play significant roles in children’s development. This comes with the understanding that there is an extensive network—including family members, friends, health care providers, home visitors, social workers, psychologists, and beyond—who have opportunities to create strong relationships with young children, support parents, and influence child development. It is likely that interventions that focus on the capacity-building of individuals in these roles may also help buffer the effects of toxic stress. However, the research in this field is in its initial stages and the largest amount of current research focuses on parents and teachers, thus they are the primary focus of this review.

REVIEWING *the* LITERATURE

STUDIES WERE included in this review based on a number of criteria. For each category of intervention (supporting caregiving interactions, promoting caregiver mental health, and enhancing caregivers’ economic stability), promising practices were sought for both parents and teachers. A number of filters were applied and if no studies meeting the first criteria were found, the second was used, and so forth.

- 1 Studies that included **biological indicators** of children’s stress response system functioning, such as the stress hormone cortisol.
- 2 Studies that included outcome measures of **children’s behaviors** that are often associated with the experience of early life stress (e.g., impulsivity, aggressive behaviors).
- 3 Studies that included measures of **caregiving behaviors** (e.g., sensitivity, quality of interactions)
- 4 Studies that included measures of **caregiver well-being** (e.g., mental health, stress levels)

The level of evidence was also considered, with priority given to interventions that have been evaluated with strongly designed studies (i.e., randomized controlled trials) and interventions that have multiple studies demonstrating their effectiveness. Some areas have very little research as of now, whereas some have many interventions that have been shown to be effective. Thus, this review presents a general overview and highlights of the current research base on promising practices to buffer the effects of early life stress.

Supporting Sensitive and Responsive Caregiving Interactions

PARENT INTERVENTIONS

Given that strong parent–child relationships are a major contributor to positive child outcomes, it is not surprising that a large number of interventions have focused on promoting warm, responsive, and consistent relationships between children and their primary caregivers. Yet, very few studies have examined whether changes in parenting can be directly linked to biological indicators of early life stress. However, a small number of studies evaluating parenting interventions have included physiological measures (or “biomarkers”) of children’s stress response system functioning, such as the stress hormone cortisol. For example, one intervention was designed to help parents better interpret and respond to children’s signals, enhance affectionate behavior, and provide more reliable support of children’s self-regulation through a series of parent–child sessions with trained parent coaches. Research on this program involving foster parents and families receiving child protective services indicated that children in the intervention program showed more normal patterns of cortisol production (levels lower than the control group and similar to children who had never been in foster care),^{15,16} with effects persisting for up to at least three years post-intervention.¹⁷ Similar interventions designed to support parents in reading children’s signals and responding sensitively and consistently have also demonstrated that it is possible to alter the functioning of children’s stress response systems after adverse experiences, suggesting that some of the biological effects of toxic stress can be reversed.¹⁸ Additionally, these interventions show promise of changing more readily observable outcomes such as improved caregiver mental health,^{19,20} sensitive parenting practices,^{21,22} attachment security,^{23,24,25} and improved social–emotional, behavioral, and cognitive outcomes for children.^{26,27,28}

COMMON FEATURES *of* EFFECTIVE PRACTICES

IN ATTEMPTING to understand how best to translate the research findings into practice, it is helpful to identify common features of interventions that have been shown to affect indicators of toxic stress. The interventions discussed above tend to focus on **promoting parental reflection**, particularly around their own upbringing experiences. **Supporting attunement** with their children, using videos and in-the-moment opportunities are used to help parents notice and respond to their children’s signals, know when and how to follow their child’s lead, and reduce frightening caregiving behavior. Through **modeling and coaching**, these interventions provide parents with concrete strategies that help parents engage in effective behavior management. Finally, these approaches place a high priority on the **relationship between the “intervener” (e.g., parent coach, therapist) and the parent.**

Supporting Sensitive and Responsive Caregiving Interactions

EARLY CARE AND EDUCATION INTERVENTIONS

Teacher–child relationships characterized by more warmth and responsiveness and less anger and harshness have been linked to children’s academic and social competence, particularly for children who face adverse experiences.^{29,30,31,32} However, no studies have yet examined improvements in child–teacher relationships with regard to biomarkers of stress response system activity as outcome measures. One study did find that children’s attachment relationship with their lead teacher predicted more normative cortisol patterns over the course of the day, and children with the “double protection” of maternal attachment and high classroom quality exhibited more normative cortisol patterns, suggesting that teacher–child relationships and classroom quality may play a role in children’s biological responses to stress.³³

Although no intervention studies have yet included physiologic outcome measures, there are well-documented approaches focused on strengthening teacher–child relationships that have demonstrated positive effects in terms of changing some child behaviors that are associated with the experience of toxic stress (e.g., self-regulation, aggressive behaviors, impulsivity). For example, the evidence-based Incredible Years Teacher Training program, which provides educators with concrete strategies for building positive relationships with children, has been linked to lower rates of challenging and aggressive behaviors in children.³⁴ Similarly, early childhood mental health consultation, in which a highly trained mental health professional and teacher engage in collaborative problem-solving around child behavioral issues, has been shown to reduce problematic behavior in young children and rates of preschool expulsion.^{35,36}

COMMON FEATURES *of* EFFECTIVE PRACTICES

INTERVENTIONS THAT strengthen teacher–child interactions tend to focus on helping teachers **recognize and respond to children’s needs** and **engage in calm, attuned, predictable interactions**. As a result of their deeper understanding of children’s behavior and effective strategies to respond to children’s needs, teachers in these programs have shown increases in supportive, responsive interactions with children, increased use of developmentally appropriate practices and expectations, and overall improvements in classroom climate^{37,38,39} Furthermore, these professional development approaches have been associated with decreases in teachers’ reports of job-related stress^{40,41} and lower rates of staff turnover in early childhood settings, which likely affect these caregivers’ abilities to help buffer the effects of stress for young children.

PARENT INTERVENTIONS

For a host of reasons, both genetic and environmental, early development is closely tied to caregivers' mental health and emotional well-being. When caregivers experience mental health challenges such as depression, they often show disrupted patterns of interactions with children (withdrawing, responding with little energy or emotion, or becoming intrusive and hostile in their interactions), which likely contributes to the higher rates of insecure attachment seen in these relationships.⁴² Within these relationships, children may not be able to view their caregivers as reliable sources of support in times of stress, and may even experience interactions with the caregiver as a *source* of stress, which may contribute to the development of a dysregulated stress response system.

Some interventions directly target caregiver stress and mental health. For example, researchers evaluated an intervention designed to reduce the incidence of major depression in low-income, pregnant women by providing them with stress management techniques and other strategies to manage their mood and health. Mothers and infants participating in this program showed significantly lower cortisol levels than their counterparts in a control group at 18-months postpartum.⁴³ Other interventions address caregiver mental health more indirectly. One study examined a home visiting program focused on reducing mothers' stress by increasing their knowledge about parenting and supporting their problem-solving and information-seeking skills to help them access greater levels of social support and community resources. Participation in the program was associated with changes in parenting practices, which predicted lower basal cortisol levels in infants, which in turn were related to improved cognitive outcomes at age 3.⁴⁴ The programs described in the previous section focused on promoting sensitive and responsive caregiving have also been shown to decrease caregiver stress around parenting and these reductions in stress were related to children's cortisol levels.⁴⁵

COMMON FEATURES *of* EFFECTIVE PRACTICES

REDUCING PARENTS' STRESS and supporting their emotional well-being can increase their capacity to engage in more responsive caregiving interactions with their children. Interventions can support parents' mental health by promoting **problem-focused coping skills** by attempting to reduce the source of stress. For example, helping parents access needed resources such as child care or transportation, or by building their skills and knowledge around parenting practices. Other interventions support **emotion-focused coping skills**, providing parents with strategies to manage their experience of stress. For example, recognizing and modifying maladaptive thoughts, increasing positively reinforcing activities, mindfulness training, and progressive muscle relaxation techniques.

Promoting Caregiver Mental Health

EARLY CARE AND EDUCATION INTERVENTIONS

Recent research has drawn attention to the high levels of stress and associated health and mental health issues among early childhood educators. For example, a recent study found that early childhood educators working in Head Start programs reported significantly higher rates of chronic illness and mental health issues than other professionals of similar age and socioeconomic status.⁴⁶ Notably, 24 percent of over 2,000 teachers surveyed reported clinically significant levels of depression compared to 18 percent of their counterparts in other professions. These findings—likely a reflection of the challenging job demands and relatively low compensation—are particularly concerning given that research has documented pathways from early childhood educator depression to classroom quality to child behavior problems.^{47,48} When teachers experience stressors that affect their psychological functioning and mental health, it likely impedes their abilities to provide responsive, sensitive caregiving that might buffer the effects of toxic stress experienced by young children in their care.

Although the issues of teacher stress and well-being and how these factors can promote or impede the development of sensitive and responsive caregiving relationships with children are highly salient, there is little research to-date exploring potential interventions in this area, particularly in the field of early childhood. However, one study found that early childhood teachers' mindfulness, self-compassion, and personal efficacy, were all associated with teachers' ability to offer emotional support to children in their classrooms, suggesting that these may be potential areas to target in interventions.⁴⁹ It would be informative for further research to examine interventions that aim to improve early childhood professionals' mental health and potentially affect children's stress response system functioning and behavioral health. These interventions might include professional development promoting self-care and stress management, promoting supportive work environments, reflective supervision, and early childhood mental health consultation.

COMMON FEATURES *of* EFFECTIVE PRACTICES

STUDIES WITH elementary school teachers have found that **training teachers in mindfulness** (techniques to stay present in the moment and attend to one's thoughts and emotions without judgment), **stress-reduction practices**, and **being aware of their own emotions** while managing children's challenging behaviors are helpful in reducing stress and symptoms of mental health problems and increasing teacher attitudes that are associated with more positive classroom climates and emotionally supportive interactions with children.^{50,51}

Enhancing the Economic Stability of Caregivers

PARENT INTERVENTIONS

There is extensive evidence that a family's economic security plays a role in the capacity of caregivers to provide consistent, stable, and nurturing environments for young children.⁵¹ Indeed, when caregivers are living in poverty, they are often operating in a crisis-oriented mode with daily stressors such as unstable housing conditions, inconsistent child care arrangements, arduous work schedules, health problems, and experiencing or witnessing violence. These stressors may undermine caregivers' ability to engage in more positive interactions with children on a consistent basis.⁵² Thus, some interventions have focused on improving families' economic stability as a means of reducing caregiver stress. Increased financial resources may also decrease environmental stressors for children, allowing a family to move out of a dangerous neighborhood or out of crowded living conditions, meet the expenses of consistent and predictable child care, or afford adequate nutrition.⁵³

Cash transfer programs in several countries—including the United States (i.e. the Earned Income Tax Credit), Mexico, and Canada—have been associated with reductions in maternal stress, physical and mental health problems, as well as differences in children's achievement, health, and cortisol levels.^{54,55,56} Similarly, a recent study found that changes in the generosity of state child care subsidy policy have been linked to families' child care usage and continuity in the program as well as reductions in unstable employment such as employment loss, job change, and periods of unemployment.⁵⁷ Other intervention approaches take a more comprehensive approach to supporting the economic stability of caregivers. Two-generation models focus on children and parents together by seeking to meet the needs of families and move the whole family toward educational success and economic security.⁵⁸ Although two-generation models have not been evaluated specifically through the lens of mitigating the effects of toxic stress, the premise of these models is strongly aligned with the goal of building the capacity of parents to reduce stressors associated with financial strain and foster conditions that support sensitive and responsive caregiving interactions.

COMMON FEATURES *of* EFFECTIVE PRACTICES

PROMISING TWO-GENERATION models target outcomes such as **enhancing social capital** (e.g., building networks of family, friends, neighbors, and other community resources), **increasing educational opportunities for parents and children** (e.g., postsecondary education and workforce development, high-quality early childhood education, family literacy), **providing economic supports** (e.g., housing, transportation, financial education and asset building, food assistance), and **supporting family health and well-being** (e.g., mental health supports, family planning).⁵⁹

EARLY CARE AND EDUCATION INTERVENTIONS

Early childhood educators in programs that serve children and families living in poverty may experience high levels of stress due to the high demands of working with children whose difficult circumstances may affect their classroom behavior and needs. To compound these stressors, data on the early childhood workforce indicate that teachers themselves may be living at or near the poverty line due to low wages across the profession.⁵⁹ The serious mismatch between the demands and expectations on early childhood educators and their low compensation and workforce supports likely contribute to some of the mental health issues described in the previous section, which in turn likely affect their ability to provide sensitive and responsive care to children. Furthermore, these conditions breed high rates of turnover (employees in fast-food restaurants are one of the few groups with higher rates of annual turnover than child care centers⁶⁰), which impede the consistent, stable relationships necessary to help buffer the effects of toxic stress in young children and these disruptions in caregiver relationships likely create additional stress for children in these programs.

COMMON FEATURES *of* EFFECTIVE PRACTICES

SOME INTERVENTIONS have sought to address issues of teachers' economic stability by supporting increased educational attainment and wages within the early childhood workforce. Both the Child Care WAGES[®] Project and the T.E.A.C.H. (Teacher Education and Compensation Helps) Early Childhood[®] Project offer **supports for early childhood educators to advance their education and earning potential**. Initial data indicate that these programs help reduce financial stress reported by educators, improve classroom quality, and increase teacher retention, thereby sustaining greater continuity in caregiver relationships for children.^{62,63,64}

IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

As knowledge of the mechanisms behind toxic stress and promising approaches to buffer its effects expands, researchers, practitioners, and policymakers gain valuable insight into how best to mitigate the harmful effects of chronic stress and support young children's development. However, research in this area is still in its infancy with a substantial volume of unknowns that should temper the interpretation of the current findings presented and synthesized here. These unknowns also serve to provide guidance for future research and innovation.

An Emerging Body of Research

As is illustrated in Table 1, although all the interventions highlighted in this paper have strong theoretical foundations for ultimately affecting children’s biological functioning, the number of studies that include biomarkers as outcome measures is still extremely limited, with a particular dearth of intervention studies focused on early care and education and other settings. However, the lack of evidence does not necessarily mean that there is a lack of effective interventions that are producing measurable changes in children’s neurobiological functioning. It is anticipated that additional research including biological indicators of stress response system functioning will help elucidate the complex relationships among biology, behavior, and effective interventions.

The Intricacies of Science

The emerging body of studies that do include biological outcome measures, such as cortisol, is complicated by contradictions and inconsistencies that illustrate the complexities of the body’s stress response system and the myriad of ways to measure its functioning. For example, although the studies reviewed in this paper that examined cortisol all showed differences on at least one measure of cortisol activity between intervention and control groups, the direction of these differences varied (i.e., sometimes children in the intervention group showed higher levels of cortisol than the control group whereas sometimes this was reversed). These inconsistencies could be due to variation in how cortisol was measured—researchers use different techniques such as collecting baseline levels, changes in cortisol over the course of the day, and/or examining changes in cortisol as a function of being exposed to a mild stressor such as being asked to complete a challenging task.⁶⁴ Furthermore, studies vary in the age of participating children, prior risk exposure (e.g., children in foster care, children who have experienced maltreatment, children of depressed mothers), intervention design, and follow-up duration.⁶⁵

Moreover, there are nuances to the stress response system that the research community is only beginning to understand. As mentioned previously, some children show overactive stress response systems (i.e., hypercortisolism), whereas some children demonstrate severely underactive stress response systems (i.e., hypocortisolism). It is unclear whether different types of adverse experiences may affect the direction of dysregulation—hypocortisolism tends to be associated with severe disruptions in caregiving such as neglect, removal from caregivers, or institutional care—or if it is possible that chronic stress such as maltreatment may initially evoke hyperactivity followed by a “shut-down” of the system resulting in underactivity.⁶⁶ There are also individual differences in children’s genetic predispositions that may interact with their early experiences in ways that result in varying levels of stress response system functioning for different individuals.⁶⁷ Finally, it should be noted that although cortisol is one of the most frequently used biomarkers in research studies, it is only one of a host

of physiological indicators of stress response system functioning including cardiovascular, metabolic, immunological, and autonomic system indicators.⁶⁸ Future research will be essential to unpacking these complex relationships and informing our ability to design and implement the most effective interventions.

DIRECTIONS *for* FUTURE RESEARCH

A GREAT DEAL of information is still needed to fully understand the characteristics of interventions that are most successful in buffering the effects of toxic stress. As the field attempts to replicate and expand upon current findings, it will be important to understand how factors such as the content of the intervention; method of service delivery; qualifications of intervention staff; characteristics of children and families served; and the timing, dosage, and duration of the program affect outcomes.⁷⁰ Furthermore, it will be informative to compare the effects of the intensity of different types of interventions. For example, do the more intensive capacity-building interventions such as two-generation models have greater effects on child outcomes than the more “low-touch” interventions such as cash-transfer programs? Similarly, do intervention approaches that target multiple points of entry produce substantially stronger child outcomes? For instance, the Incredible Years Teacher Training Program shows stronger effects on child behavioral outcomes when combined with the parent training and/or child-focused component of the Incredible Years series.^{71,72} It would be informative to understand if similar multiplicative effects are seen on biomarker indicators. By continuing to refine our understanding of the characteristics of effective interventions and their long-term effects, we can implement more efficient, consistently beneficial programs for children and caregivers.

CONCLUSION

Despite the significant amount of uncharted territory in understanding the complexities of toxic stress and development, the field is well on its way to developing a strong foundation for a new generation of effective interventions. The growing understanding of the mechanisms behind the harmful effects of toxic stress and the burgeoning body of research examining potential intervention models leads us to a conclusion that is likely unsurprising to many (and perhaps even anticlimactic for those wishing for a new silver-bullet solution)—caregiving practices and relationships matter enormously for children’s development. However, we are refining our understanding of how best to support these relationships, with a movement toward interventions that focus on the *capacity-building* of caregivers.

It is clear that it is important to help parents, teachers, and others caring for young children develop the tools to build warm, sensitive, consistent relationships, but it appears that something more is needed than the simple provision of information and

advice about child development.⁷² Like children, adults need scaffolded experiences in the context of supportive relationships to build new skills, which is likely why the parenting interventions that are promising in mitigating the effects of toxic stress all involve intensive, one-on-one experiences that are tailored to meet families' unique needs. Similarly, research suggests that relationship-based professional development approaches—like early childhood mental health consultation—in which teachers work one-on-one with a highly skilled professional, are more effective than traditional one-day workshops in large groups.⁷³ It is also clear that that caregiving interactions occur within the context of their own experiences and that in order to fully be able to provide caregiving experiences that buffer the effects of toxic stress, other foundational elements such as caregiver mental-health and economic stability may need to be addressed as well.

Perhaps the most exciting aspect of the increasing interest in understanding toxic stress and its effects is that it provides a framework that bridges multiple disciplines and perspectives. Just as the study of early adversity and toxic stress is helping us understand how children's social environments, neurobiological functioning, and developmental outcomes are all intertwined, it is also becoming a common touchstone across classrooms, doctors' offices, and the halls of policymakers. The understanding of how early adversity and toxic stress can affect children's development may give a teacher a new lens through which to think about the roots of the achievement gap or reinterpret a child's aggressive or impulsive behaviors. Health care providers are gaining critical information about how early life experiences affect adult health outcomes and how caregiver mental health treatment may have intergenerational effects. Policymakers are obtaining increasing evidence and understanding about the full impact of programs like the EITC, child care subsidy programs, home visiting programs, and supporting increased compensation for the early care and education workforce. By developing a common language and shared goals across the program, community, and policy levels, it will be possible to move away from a patchwork of siloed efforts to a coordinated, integrated approach to address the causes and consequences of toxic stress. Just as building a house requires the collective contributions of many skilled tradesmen—electricians, contractors, roofers—it will take the coordinated efforts of multiple stakeholders to effectively support the foundations of children's future development, learning, and well-being.

“...it will take the coordinated efforts of multiple stakeholders to effectively support the foundations of children's future development.”

Table 1. Summary of interventions and outcomes included in reviewed studies.

	INTERVENTION	OUTCOMES EVALUATED IN RESEARCH			
		Caregiver Well-Being	Caregiving Behaviors	Child Behaviors	Child Biomarkers
PROMOTING SENSITIVE & RESPONSIVE INTERACTIONS	Attachment & Biobehavioral Catch-up Program		•	•	•
	Child–Parent Psychotherapy	•		•	•
	Multidimensional Treatment Foster Care Program	•		•	•
	Incredible Years Teacher Training Program	•	•	•	
	Early Childhood Mental Health Consultation	•	•	•	
PROMOTING CAREGIVER MENTAL HEALTH	Mothers and Babies: Mood and Health Project	•			•
	Family Thriving Program		•	•	•
	Cultivating Awareness and Resilience in Education (CARE)	•			
	Mindfulness-Based Stress Reduction	•			
ENHANCING CAREGIVER ECONOMIC STABILITY	Oportunidades Program				•
	Earned Income Tax Credit	•			
	Child Care WAGE\$ Project	•			
	T.E.A.C.H. Early Childhood Project		•		

 = EARLY CARE AND EDUCATION

 = PARENT INTERVENTION

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