

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD
NATIONAL FORUM ON EARLY CHILDHOOD POLICY AND PROGRAMS

The Foundations of Lifelong Health Are Built in Early Childhood



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Introduction

A VITAL AND PRODUCTIVE SOCIETY WITH A PROSPEROUS AND SUSTAINABLE FUTURE IS BUILT ON A FOUNDATION OF HEALTHY child development. Health in the earliest years—actually beginning with the future mother’s health before she becomes pregnant—lays the groundwork for a lifetime of well-being. When developing biological systems are strengthened by positive early experiences, healthy children are more likely to grow into healthy adults. Sound health also provides a foundation for the construction of sturdy brain architecture and the associated achievement of a broad range of abilities and learning capacities.

Health is more than merely the absence of disease—it is an evolving human resource that helps children and adults adapt to the challenges of everyday life, resist infections, cope with adversity, feel a sense of personal well-being, and interact with their surroundings in ways that promote successful development. Nations with the most positive indicators of population health, such as longer life expectancy and lower infant mortality, typically have higher levels of wealth and lower levels of income inequality. In short, children’s health is a nation’s wealth, as a sound body and mind enhance the capacity of children to develop a wide range of competencies that are necessary to become contributing members of a successful society.^{1,2}

Adverse events or experiences that occur early in childhood can have lifelong consequences for both physical and

of disturbing the neurobiological systems that guide physiological and behavioral responses to stress, potentially for the remainder of an individual’s life. Altering these regulatory mechanisms (e.g., setting the stress response system on a “short fuse”) can permanently increase the risks of acute and chronic disease, and even a shortened life span, by undermining the normally adaptive response of the body to the challenges and stressors of everyday life. These alterations to developing biological systems can lead to greater susceptibility to a wide range of illnesses well into the adult years, even in the absence of any conscious memory of early trauma.

Beyond its effect on individuals, poor health early in life also imposes significant societal costs that are borne by those who remain healthy. For example, when large numbers of children become ill because they did not receive their immunizations, the entire population becomes vulnerable to epidemics of infectious diseases. Similarly, the consequences of adversity and poor health in childhood can lead to higher rates of chronic diseases in adults, such as diabetes, hypertension, cardiovascular disease, and various forms of cancer, as well as depression, anxiety disorders, addictions, and other mental health impairments. These conditions affect all of society by reducing the productivity of the workforce and increasing the incidence of disability,

the demand on medical facilities, and the costs of medical care. Thus, a focus on health promotion in the early childhood period—where an extensive body of evidence supports the promise of effective prevention programs that can change the trajectory of children’s lives—can help reduce the social and economic burdens of illness, not only in childhood but also throughout the adult years. This connection between early life experiences and the health of a nation underscores the importance of strategic investments in the care and protection of pregnant women, infants, and young children, and it suggests that most current attempts to prevent adult disease and create a healthier workforce may be starting too late.

Health in the earliest years—actually beginning with the future mother’s health before she becomes pregnant—lays the groundwork for a lifetime of well-being.

mental well-being. That is to say, developmental and biological disruptions during the prenatal period and earliest years of life may result in weakened physiological responses (e.g., in the immune system), vulnerabilities to later impairments in health (e.g., elevated blood pressure), and altered brain architecture (e.g., impaired neural circuits). For example, exposure of expectant mothers to highly stressful environments can influence the birth weight of their babies, and lower birth weight has been linked to substantially increased risk for obesity, diabetes, and cardiovascular disease later in life. Traumatic experiences during childhood, such as physical abuse or the adversities that accumulate for children reared in deep and persistent poverty, are also capable

Reconceptualizing the Health Dimension of Early Childhood Policy

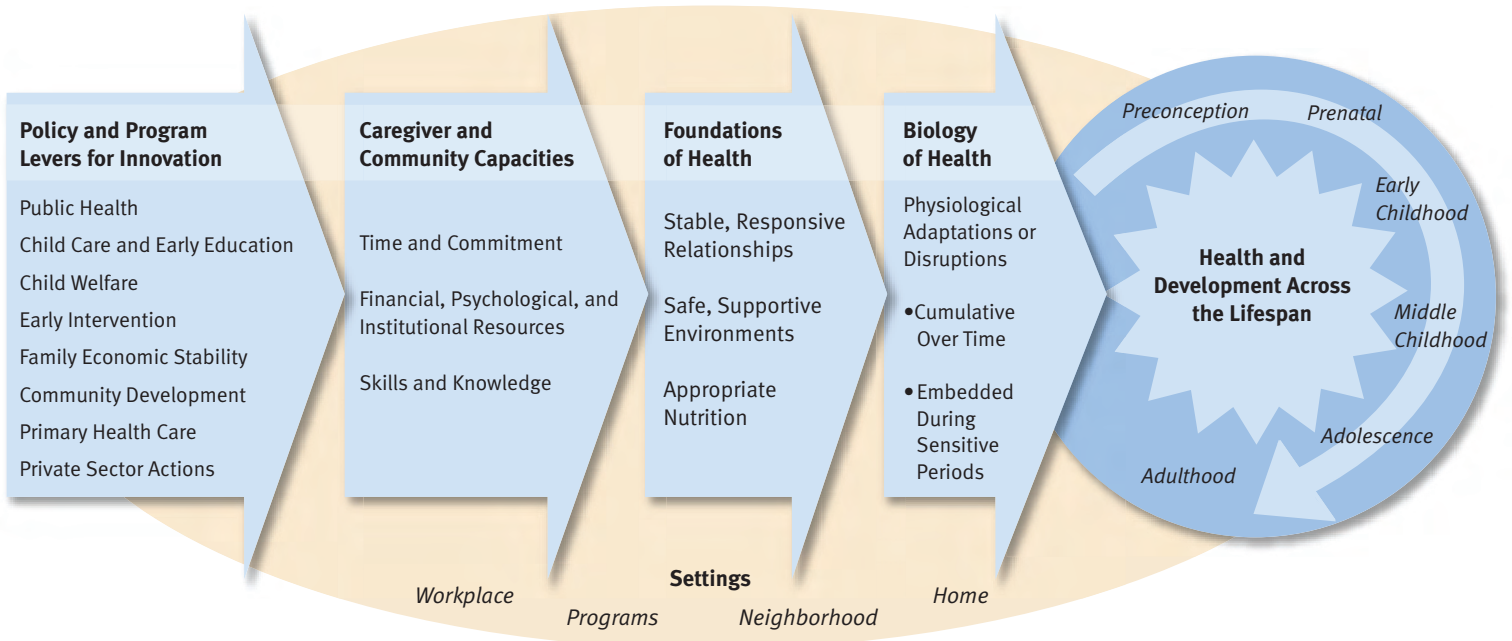
THE KNOWLEDGE BASE SUMMARIZED IN THIS DOCUMENT presents a compelling rationale for fundamentally rethinking the health dimension of early childhood policy. Science tells us that meeting the developmental needs of young children is as much about building a strong foundation for lifelong physical and mental health as it is about enhancing readiness to succeed in school.³ This insight points to the importance of viewing a broad array of policies and programs—beyond the provision of medical services—as potentially important vehicles for reducing the social burdens, human capital consequences, and medical-care costs of health impairments in the adult years.⁴ In other words, significant progress in lifelong health promotion and disease prevention could be achieved by reducing the burden of significant adversity on young children—and this progress could be accelerated through science-based enhancements in a wide range of policy domains, including child care and early education, child welfare, public assistance and employment programs for low-income parents, housing policies, and community development initiatives, to name just a few.

Driven by converging evidence from neuroscience, molecular biology, genomics, and advances in the behavioral and social sciences, this call for a broader perspective on health promotion and disease prevention is guided by the following three overarching concepts:

- Experiences are built into our bodies (for better or for worse) and significant adversity early in life can produce physiological disruptions or embedded biological “memories” that persist far into adulthood and lead to lifelong impairments in both physical and mental health.
- Genes and experiences interact to determine an individual’s vulnerability to early adversity and, for children experiencing severe adversity, environmental influences appear to be at least if not more powerful than genetic predispositions in their impact on the odds of having chronic health problems later in life.
- Health promotion and disease prevention policies focused on adults would be more effective if evidence-based investments were also made to strengthen the foundations of health and mitigate the adverse impacts of toxic stress in the prenatal and early childhood periods.

This new scientific knowledge compels us to think and act creatively to enhance the healthy development of young children by reducing the disruptive effects of significant adversity on developing biological systems. Progress toward this goal will be most effective if innovative actions are guided by an understanding of four interrelated dimensions that together comprise a new framework for improving physical and mental well-being: (1) the biology of health; (2) the foundations of health; (3) caregiver and community

A Framework for Reconceptualizing Early Childhood Policies and Programs to Strengthen Lifelong Health



capacities to promote health and prevent disease and disability; and (4) public and private sector policies and programs that can influence health outcomes by strengthening caregiver and community capacities.

The biology of health is defined by advances in science that explain how experiences and environmental influences “get under the skin” and interact with genetic predispositions, which then result in various combinations of physiological adaptation and disruption that affect lifelong outcomes in learning, behavior, and both physical and mental well-being. These

Experiences are built into our bodies and significant adversity early in life can produce biological “memories” that lead to lifelong impairments in both physical and mental health.

findings call for us to rethink current, adult-focused approaches to health promotion and disease prevention by incorporating an understanding of the early childhood origins of lifelong illness and disability.

The foundations of health refer to three domains of influence that establish a context within which the early roots of physical and mental well-being are either nourished or disrupted:

- *A stable and responsive environment of relationships.* This domain underscores the extent to which young children need consistent, nurturing, and protective interactions with adults that enhance their learning and behavioral self-regulation as well as help them develop adaptive capacities that promote well-regulated stress response systems.
- *Safe and supportive physical, chemical, and built environments.* This domain highlights the importance of physical and emotional spaces that are free from toxins and fear, allow active exploration without significant risk of harm, and provide supports for families raising young children.
- *Sound and appropriate nutrition.* This domain emphasizes the foundational importance of health-promoting food intake,

beginning with the future mother’s pre-conception nutritional status and continuing into the early years of the young child’s growth and development.

Caregiver and community capacities to promote health and prevent disease and disability refer to the ability of family members, early childhood program staff, and the social capital provided through neighborhoods, voluntary associations, and the parents’ workplaces to play a major supportive role in strengthening the foundations of child health. These capacities can be grouped into three categories: (1) time and commitment; (2) financial, psychological, and institutional resources; and (3) skills and knowledge.⁵

Public and private sector policies and programs strengthen the foundations of health through their ability to enhance the capacities of caregivers and communities in the multiple settings in which children develop. Relevant policies include both legislative and administrative actions that affect systems responsible for public health, child care and early education, child welfare, early intervention, family economic stability (including employment support for parents and public assistance), community development, housing, and primary health care, among others. It is also important to underscore the role that private-sector practices as well as government-sponsored programs can play in strengthening the capacities of families to raise healthy and competent children. Workplace policies related to parental leave, flexible working hours, and time off to care for a sick child or attend a parent-teacher conference are a few examples.

This framework suggests a new way of conceptualizing policies and practices in multiple sectors, all of which affect the early childhood origins of lifelong health. The goal is to catalyze informed investments and creative innovations that build on a shared scientific base to achieve significantly improved outcomes for children and society above and beyond the impacts of existing efforts. Although the framework can be adapted to address challenges facing all nations, the policy and program context for this document is focused on current circumstances and opportunities in the United States.

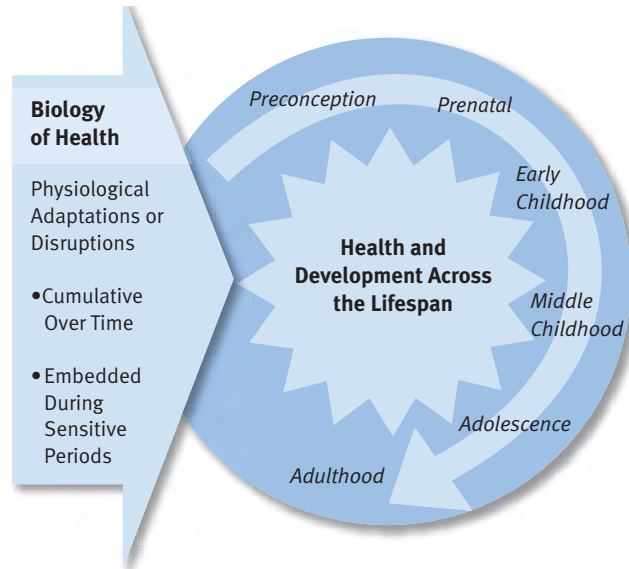
Understanding the Biology of Health in the Early Years of Life

IN ORDER TO UNDERSTAND HOW POLICIES and programs strengthen the capacities of families and communities to promote the foundations of health, it is essential to begin with an understanding of how personal experiences, environmental conditions, and developmental biology work together in early childhood to influence the roots of lifelong physical and mental well-being. Early childhood is a time of rapid development in the brain and many of the body's biological systems that are critical to sound health. When these systems are being constructed early in life, a child's experiences and environments have powerful influences on both their immediate development and subsequent functioning. These effects may appear early and be magnified later as children grow into adolescence and adulthood. Some have compared a child's evolving health status in the early years to the launching of a rocket, as small disruptions that occur shortly after take-off can have very large effects on its ultimate trajectory.⁶ Thus, "getting things right" and establishing strong biological systems in early childhood can help to avoid costly and less effective attempts to "fix" problems as they emerge later in life.

PHYSIOLOGICAL ADAPTATIONS OR DISRUPTIONS IN EARLY DEVELOPMENT

An extensive body of scientific evidence now shows that many of the most common chronic diseases in adults—such as hypertension, diabetes, cardiovascular disease, and stroke—are linked to processes and experiences occurring decades before, in some cases as early as prenatally.^{3,7} For example, longitudinal studies have demonstrated that lung disease in adulthood is commonly associated with a history of respiratory illness in childhood, particularly among premature infants and young children exposed to tobacco smoke.⁸ Chronic, life-threatening cardiovascular disease in adulthood can also be linked to nutritional deficits and growth impairments occurring as early as the prenatal period.^{9,10}

Early experiences or exposures can affect adult health in two ways—by the chronic wear



and tear of repeated damage over time or by the biological embedding of specific physiological disruptions during sensitive developmental periods.^{11,12} If a physiological maladaptation occurs in response to cumulative exposure to adverse social and/or physical conditions, then an ensuing chronic disease can be seen as the consequence of repeated encounters with psychologically or physically toxic environments. When damaging exposures occur during sensitive periods in the early development of specific biological processes, the resulting disruptions can become biologically embedded and subsequent adult diseases appear as the latent (or delayed) outcomes of early environmental assaults. In either case, science shows that there can be a lag of many years, even decades, before early harm is expressed in the form of overt disease.

CUMULATIVE EXPOSURES TO ADVERSE CHILDHOOD EXPERIENCES

An extensive and growing body of research demonstrates multiple linkages between childhood adversity and health impairments in the adult years. The Adverse Childhood Experiences (ACE) Study, for example, documents strong associations among multiple instances of traumatic or abusive childhood events (as recalled

in adulthood) and an extensive array of conditions later in life, including cardiovascular disease, chronic lung disease, cancer, depression, alcoholism, and drug abuse.^{13,14} Individuals reporting more adverse childhood experiences also had substantially greater risks for life-threatening psychiatric disorders,¹⁵ overlapping mental health problems,¹⁵ teen pregnancies,¹⁶ obesity, physical inactivity, and smoking.¹⁷ Other longitudinal studies have found comparable linkages between early stressful life events and adult disease.^{18,19,20} In all cases the pattern has been the same—the greater the number of adverse experiences in childhood, the greater the likelihood of health problems later in life.

Research on the biology of adversity illustrates how the body's physiological equilibrium breaks down under cumulative conditions of chronic stress (or what has been called “allostatic load.”)²¹ The activation of stress management systems in the brain results in a tightly integrated repertoire of responses involving the secretion of stress hormones, increases in heart rate and blood pressure, elevation in blood sugar and inflammatory protein levels, protective mobilization of nutrients, redirection of blood flow to the brain, and the induction of vigilance and fear.²² The normal, healthy, temporary activation of these systems represents a “positive stress response” and is protective, even necessary, in the face of an acute threat. A “tolerable stress response” is a more serious and sustained activation that is mitigated by supportive adults, who help the child develop adaptive coping responses. A “toxic stress response” in early childhood can weaken developing brain architecture and recalibrate the threshold for activating the stress response system for life. It occurs under circumstances of chronic or overwhelming adversity without the buffering support of caring, consistent, and supportive relationships.^{3,23} Animal studies indicate that toxic stress also can have direct, negative, and persistent effects on brain circuits that control reward and motivation. For example, research on rodents has demonstrated that profound neglect during early development increases drug-seeking behavior in adult rats.²⁴

Recently documented patterns of allostatic load that parallel racial disparities in health outcomes suggest that chronic physiological stress may play a role in the premature and disproportionate burden of physical and mental

illness experienced by African-Americans and other groups that experience discrimination.²⁵ African-Americans, for example, sustain earlier deteriorations of health compared with whites, leading to racial health disparities that increase with age and resulting in a life expectancy for blacks in the United States that is four to six years less than for whites.²⁶ This finding is consistent with research suggesting that the “weathering” of the body under conditions of chronic stress reflects an acceleration of normal aging processes.^{25,27,28}

BIOLOGICAL EMBEDDING DURING SENSITIVE PERIODS OF DEVELOPMENT

During sensitive periods of early growth and development, the evolving architecture of the brain (as well as the maturation of other organ systems) is highly receptive to a wide range of environmental signals or cues, whether positive or negative.²⁹ A considerable body of research suggests that adult disease and risk factors for poor health can be biologically embedded in the brain and other organ systems during these sensitive periods, with resulting health impairments appearing years, or even decades, later. Biological embedding as a function of malnutrition, toxic stress response, or exposure to damaging chemicals can occur in various ways, including mechanisms that change the regulation of genes that affect brain and body development.³⁰ For example, poor living conditions in early life (e.g., inadequate nutrition or recurrent exposure to infectious diseases) are associated with increased rates of chronic cardiovascular, respiratory, and psychiatric diseases in adulthood.^{10,31,32} Also, lower birth weight is associated with several risk factors for later heart disease, such as hypertension, central body fat distribution, insulin resistance, metabolic syndrome, and diabetes.^{9,33,34}

These findings are supported by evidence from a variety of animal and human studies. For example, lower birth weight in rats has been associated with higher blood pressure,³⁵ and studies in humans have linked poor growth *in utero* to later problems with heart disease³⁶ and hypertension.³⁷ Research investigating the underlying mechanisms that explain these associations have found linkages between early experiences of child maltreatment and evidence of heightened inflammatory responses in

adulthood that are known risk factors for the development of cardiovascular disease, diabetes, asthma, and chronic lung disease^{38,39} as well as new evidence of elevated inflammation as early as age 12 in children experiencing maltreatment and depression, regardless of their socioeconomic status.⁴⁰

THE PHYSIOLOGICAL CONSEQUENCES OF SOCIAL AND ECONOMIC DISADVANTAGE

Children who grow up in families or communities of low socioeconomic status appear to be particularly vulnerable to the biological embedding of disease risk. Researchers have hypothesized that this association may be the result of excessive stress related to high rates of neighborhood risk factors such as crime, violence, boarded-up houses, abandoned lots, and inadequate municipal services.⁴¹ Economically disadvantaged children also tend to live in housing that is crowded, noisy, and characterized by structural defects, such as leaky roofs, rodent infestation, and inadequate heating,⁴² and they are exposed to greater air pollution from traffic, industrial emissions, and caregiver smoking.⁴¹ Children raised in low-income environments, on average, also experience less and

lower-quality parental responsiveness,⁴³ and are more likely to experience conflictive and punitive parenting behavior.^{41,44,45} Together, these adverse conditions create repeated physiological and emotional disruptions that can have long-lasting effects on health and development.

Socioeconomically patterned differences in children's emotional, cognitive, and social experiences have been linked to several aspects of brain development, particularly within those areas of the brain that are tied most closely to the regulation of emotion and social behavior, reasoning capacity, language skills, and stress reactivity.⁴⁶ Children from lower socioeconomic backgrounds are more likely to show heightened activation of stress response systems,^{47,48} and some emerging research suggests that differences in caregiving related to income and education—such as responsiveness in parent-child interaction—can alter the maturation of selected brain areas such as the prefrontal cortex.⁴⁹ Animal models of early, stress-related changes in brain circuitry show that such modifications can persist into adult life, altering emotional states, decision-making capacities, and bodily processes that contribute to substance abuse, aggression, obesity, emotional instability, and stress-related disorders.^{50,51}

Promoting the Foundations of Healthy Development

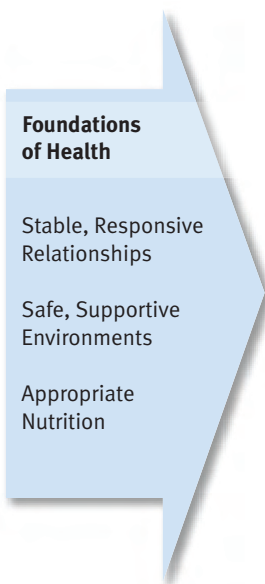
THE BIOLOGY OF EARLY HEALTH AND development illustrates how complex interactions among genes, environmental conditions,

and experiences produce either positive adaptations or negative disruptions in basic biological systems—with life-long consequences for both physical and mental health. There is much that society can do to ensure that children's environments provide the conditions that their biological systems need to produce positive health

outcomes. Three critically important foundations invite careful scrutiny: a child's environment of relationships; the physical, chemical, and built environments; and sound and appropriate nutrition.

CREATING A STABLE AND RESPONSIVE ENVIRONMENT OF RELATIONSHIPS

Human infants are unique among all species in their prolonged period of extreme dependence on adult care and protection for their survival and healthy development. The care that infants receive, whether from parents, extended family members, neighbors, or child care professionals, lays the groundwork for the development of a wide range of basic biological processes that support emotion regulation, sleep-wake patterns, attention, and ultimately all psychosocial functioning.^{52,53} Stable, responsive, and



nurturing caregiving early in life is also associated with better physical and mental health, fewer behavior problems, higher educational achievement, more productive employment, and less involvement with social services and the criminal justice system in adulthood.^{54,55} In biological terms, a child's environment of relationships can affect lifelong outcomes in emotional health, regulation of stress response systems, immune system competence, and the early establishment of health-related behaviors.

A child's environment of relationships can affect lifelong outcomes in emotional health, regulation of stress response systems, immune system competence, and the early establishment of health-related behaviors.

Thus, supports for families and appropriate training for providers of early care and education across all types of care, including informal arrangements as well as established centers, can improve health outcomes throughout the life course as well as enhance the current quality of life for young children and the adults who care for them.

Secure attachments. One important way in which responsive caregiving has long-lasting effects on physical and mental well-being is through the formation of strong, positive bonds between young children and the important adults in their lives. Securely attached infants show more positive emotion and less anxiety in early childhood and have an easier time establishing relationships with teachers and peers at school.^{56,57} Attachment patterns develop over the first few years of life and can influence mental health and psychological functioning throughout childhood and the adult years.^{56,58,59} Caregivers struggling with overwhelming problems such as depression may be unable to be sufficiently responsive to a young child during that early period when the foundations of attachment relationships are developing.^{60,61} This lack of consistent responsiveness disrupts what has been called the “serve and return” interaction between infants and adults that is fundamental to the development of healthy brain

architecture. When appropriate responses are missing, this can lead to a range of poor outcomes, including physical and mental health problems later in life.⁶²

Effective self-regulation and sleep cycles. Another way in which the caregiving environment affects the health of young children is the extent to which the consistency, quality, and timing of daily routines shape their developing regulatory systems. Beginning in the earliest weeks of life, the predictability and quality of these experiences influence the most basic biological rhythms related to waking, eating, eliminating, and sleeping.^{63,64} For example, infants who are exclusively breast-fed through about 3 months of age ingest levels of nutrients and hormones that reflect the mother's circadian rhythm (i.e., her 24-hour sleep-wake cycle) and appear to assist in establishing better sleep patterns and sleep efficiency.⁶⁵

Early experiences stimulate a wide variety of nerve transmissions that activate different parts of the brain and other body systems. When positive experiences are repeated regularly in a predictable fashion, the complex sequences of neural stimulations create pathways that become more efficient (i.e., “neurons that fire together wire together.”) For example, infants who learn that being soothed and comforted occurs shortly after they experience distress are more likely to establish more effective physiological mechanisms for calming down when they are aroused and are better able to learn to self-soothe after being put down to sleep.^{63,66} In contrast, when eating and being put to bed occur at different times each day and when comforting occurs unpredictably, the organization and consolidation of sleep-wake patterns and self-soothing responses do not develop well, and biological systems do not “learn” healthy routines and self-regulation.⁶⁷

This finding highlights the importance of secure, stable housing with quiet and predictable sleeping areas for babies. Although children differ in how much sleep they require, inadequate amounts lead to disruptive behavior problems, diminished cognitive performance, and greater risk for unintentional injuries.^{68,69} Growing evidence also suggests that poor sleep is associated with obesity in later childhood and early adulthood.^{70,71,72} Given that babies' internal clocks do not initially differentiate day from night, how

and when they are put to sleep shapes their development of sleep-wake rhythms.^{63,73}

Healthy stress response systems. Just as early experiences affect the architecture of the developing brain, they also shape the development of other biological systems that are important for health. For example, responsive caregiving plays a key role in the normal maturation of the neuroendocrine system.^{74,75,76} A wealth of animal research that is now being replicated in humans demonstrates that caregiving behavior also shapes the development of circuits that regulate how individuals respond to stressful situations.^{77,78} Specifically, variations in the quality and quantity of maternal care that a mother received in her own early life can affect how genes are turned on or off in her own offspring.^{79,80} Genes involved in regulating the body's stress response are particularly sensitive to caregiving, as early maternal care leaves a signature on the genes of her offspring that carry the instructions for the development of physiological and behavioral responses to adversity. That signature (known as an epigenetic marker) is a lasting imprint that affects whether the offspring will be more or less likely to be fearful and anxious later in life.⁸¹ Consequently, early overloading of the stress response system can have a range of adverse, lifelong effects on learning, behavior, and both physical and mental health. That said, effective programs are available that prevent specific types of stress-inducing events, such as physical or sexual abuse, and that provide successful treatments for children experiencing high levels of anxiety or chronic fear.⁸²

Immunologic responsiveness. Regulatory mechanisms that manage stress also influence the body's immune and inflammatory responses, which are essential for defending against disease. Young children cared for by individuals who are available and responsive to their emotional and material needs develop well-functioning immune systems that are better equipped to deal with initial exposures to infections and to keep dormant infections in check over time.⁸³ Some protections, such as maternal antibodies, are passed directly from mother to fetus through the placenta or from mother to infant through breast milk. These protections confer important passive immunity until the infant's own antibody response is developed.⁸⁴ Thus,

caregiving practices such as breastfeeding not only provide important opportunities for social bonding but also help the baby develop a more competent immune system.⁸⁵ Conversely, inadequate caregiving and limited nurturance very early in life can have long-term (and sometimes permanent) effects on immune and inflammatory responses, which increase the risk of chronic impairments such as asthma, respiratory infections, and cardiovascular disease.^{38,39}

Learned health-promoting behaviors. Another way in which early caregiving practices matter is the extent to which young children develop behavioral routines and patterns that influence long-term health trajectories. These early behaviors include a wide variety of domains: tooth brushing, television viewing, routine levels of physical activity, and risk-taking behaviors, among many others. One example is the type, amount, and frequency of foods offered to infants and toddlers, which together shape the processes that affect their taste and texture preferences and their developing dietary likes and dislikes.^{86,87} Increasingly persuasive scientific evidence shows that early learning of both food preferences and routine levels of physical activity affect the risk for obesity.⁸⁸

SAFE AND SUPPORTIVE CHEMICAL, PHYSICAL, AND BUILT ENVIRONMENTS

Unsafe environments are not only a threat to the immediate physical well-being of young children but also jeopardize their future health and development. These threats can manifest themselves in a variety of forms, many of which are amenable to effective preventive actions that simply await the political will required for widespread implementation.

Chemical exposures. Environmental toxins pose a significant threat to immature biological systems, as low-level exposures before or shortly after birth often produce more damaging and longer-lasting harm than exposures at higher levels in later childhood or adult life.⁸⁹ At the same level of exposure, embryos, fetuses, and children absorb much larger doses of toxins relative to their body weight than adults, which is another reason why the adverse impacts are greater in the prenatal period and early in life, when important developmental processes are

underway. Of all the body's organ systems, the brain is especially vulnerable to environmental toxicity, as even small injuries can produce significant effects on future health, learning, and behavior. Early chemical exposures also may prompt changes in other organs and tissues, resulting in structural malformations or greater susceptibility to diseases that may even be passed on to subsequent generations.⁹⁰ For example, prenatal exposure to diethylstilbestrol (DES), a drug prescribed for many pregnant women until the 1970s, has been linked to reproductive cancers in young women whose mothers were medicated while pregnant.⁹¹

In contrast to the long latency of adverse effects for many chemical exposures, the health impacts of some toxins are apparent much sooner. For example, lead ingestion is a well-established risk factor for cognitive deficits across the life course, largely because lead disrupts neurotransmitter regulation of synaptic development in the brain.⁹² Although most lead exposure is related to lead-based paint, soil, and dust,⁹³ recent problems have been detected from contaminated consumer products, including toys.⁹⁴

Physical and built environments. The danger of toxic chemical exposures as an environmental threat to child health is easy to understand. Less immediately apparent is the growing evidence that the way a child's physical environment is designed, built, and maintained can also significantly affect the risk of disease, disability and injury.⁹⁵ Beyond the safety of homes and child care settings, the "built" environment offers multiple opportunities to influence health-related behaviors. The availability of food choices and options for healthy eating illustrates one important example. This can be seen in many low-income, urban communities that are less likely to have grocery stores that stock healthy foods such as fresh fruits or vegetables and more likely to have multiple fast-food outlets and liquor stores, all of which undermine good nutrition.⁹⁶

Neighborhoods designed with parks, green space, sidewalks, and playgrounds away from traffic offer children and their families an opportunity to play and socialize with friends and other caregivers, as well as encourage greater physical activity, reduce child pedestrian injuries, and increase social ties.⁹⁷ Children living in such communities tend to be more physically active and have a lesser risk for obesity

than those who live in neighborhoods with fewer recreational facilities.^{98,99} Neighborhood features such as parks and sidewalks also influence social interactions: people can come together and develop a sense of mutual trust and responsibility for the community and its inhabitants, which often leads to a willingness to intervene on behalf of the common good.^{100,101} This neighborhood-level phenomenon, called "collective efficacy" or social capital, has been linked to lower rates of childhood obesity,¹⁰² better adult mental health,¹⁰³ and reduced crime rates.¹⁰⁴ Thus, zoning laws and regulations that influence the built environment can have an important influence on the well-being of children and caregivers, which contributes to the overall health of a community.

SOUND AND APPROPRIATE NUTRITION

Health at every stage of the life course is influenced by nutrition, beginning with the mother's pre-conception nutritional status, extending through pregnancy to early infant feeding and weaning, and continuing with diet and activity throughout childhood and into adult life. Adequate intake of both macronutrients (e.g., protein, carbohydrates, and fats) and micronutrients (e.g., vitamins and minerals) is particularly important in the early months and years of life, when body growth and brain development are more rapid than during any other period. In this context, nutrition serves as an important example of how early influences contribute to developmental patterns of health over time.

Although levels of severe hunger and malnutrition that persist in many of the world's poorest countries are rarely found in the United States, food insecurity remains a problem for a subset of the population that lacks access to sufficient food to meet their basic needs because of inadequate financial resources. That said, the growing epidemic of both childhood and adult obesity in the United States is receiving far more public attention than concerns about poor growth.

The relation between nutrition and health in childhood is broadly understood. The extent to which the nutritional status of a pregnant woman can influence the long-term growth and health of her child is less well appreciated. Inadequate maternal nutrition during pregnancy is associated with a range of undesirable

outcomes in the offspring, including obesity in childhood and adulthood as well as subsequent hypertension and cardiovascular disease.^{9,33} When mothers do not receive adequate calories and nutrients while pregnant, their fetuses develop in anticipation of “making do” with fewer nutritional resources. This response is beneficial if the post-natal environment provides minimal calories. However, if the post-natal environment offers access to sufficient nutrients, the infant’s prior adaptation becomes a liability, predisposing children to obesity and other diseases of excess because they were prepared for a world of scarcity.³³ Children born at very low birth weight also show marked insulin resistance and other changes that put them at risk for diabetes.³⁴

Maternal nutrition also affects the development of the fetal and infant immune system, as the adversity of under-nutrition can stimulate the release of maternal stress hormones that impair thymus development in the fetus.¹⁰⁵ The thymus gland is important, because it plays a key role in the development of the immune system by incubating immature immune cells, and decreased thymus size in infancy is associated with higher rates of infection and mortality.¹⁰⁶

Indeed, a smaller thymus has been linked to poor immune responsiveness from the neonatal period through adolescence.^{105,107} As a result, adults who experience prenatal and early childhood under-nutrition are 10 times more likely to die from an infection than others.¹⁰⁶

Successful public health efforts to improve maternal nutrition, even prior to conception, have had beneficial effects on the health of both expectant mothers and their children. For example, maintaining adequate levels of folate for women in their child-bearing years has important implications for both pregnancy and the health of the newborn,¹⁰⁸ with folate fortification of foods leading to a 20 to 30 percent reduction in neural tube defects.^{109,110} Nevertheless, iron deficiency and inadequate levels of vitamins A and D remain significant health concerns for many children, who need increased levels of these nutrients to support the rapid growth of blood cells, bones, and other tissues. These types of deficiencies early in life can have adverse impacts on a wide range of cognitive, motor, social-emotional, and neurophysiological development and behavioral outcomes as well as lead to chronic medical conditions such as osteoporosis, asthma, and diabetes.^{111,112,113}

Strengthening the Capacities of Caregivers and Communities to Promote the Health of Young Children

THE MULTIPLE, INTERRELATED CAPACITIES OF caregivers and communities are essential promoters of the foundations of child health. Thus, policies and programs designed to promote the well-being of young children will be more effective if they bolster these capacities. The influences of caregivers and communities are played out in a wide variety of settings and contexts, including neighborhoods, parents’ workplaces, early care and education settings, health care facilities, and, of course, in the home. When caregiver and community capacities reinforce each other in positive ways, the

foundations of health are strong. When they function at cross purposes, or collectively in the wrong direction, child health is threatened and society’s future is at peril.

Caregiver and Community Capacities

Time and Commitment
Financial, Psychological,
and Institutional Resources
Skills and Knowledge

CAREGIVER CAPACITIES

Because young children develop in an environment of relationships, it is critically important that adult caregivers interact with them in a consistent and responsive manner. All parents and other adults (both within and outside of the family) bring a range of capacities to the care and support of young children. These include

(1) *time and commitment* (i.e., the nature and quality of time spent with children and on their behalf); (2) *resources*—both *financial* (i.e., economic ability to purchase goods and services) and *psychological, emotional, and social* (i.e., physical and mental health and parenting style); and (3) *skills and knowledge* (i.e., human capital acquired through education, training, interactions with child-related professionals, and personal experiences).⁵ Extensive documentation of the important impacts of these capabilities on child health and development is provided throughout this paper.

The fact that the majority of young children in the United States currently live in families with working parents provides a clear illustration of the importance of this issue. The pressures and demands of balancing parenting and work responsibilities, along with other changes in family structure and social roles, lead to considerable strain on time for parenting and other caregiver capacities across the socioeconomic spectrum.¹¹⁴ That said, most policies and programs for families with young children in the United States are focused on either parenting education or financial support for those with limited income. The fact that relatively limited attention is focused on addressing the shortfalls in time and/or psychological resources that overwhelm many parents across all social classes threatens the healthy development of many children, with the greatest burdens on those whose families and communities are impoverished and those whose children have special needs.

COMMUNITY CAPACITIES

Just as children develop in an environment of relationships, families function within a physical and social environment that is influenced by the conditions and capacities of the communities in which they live. In the context of community capacities, *commitment* is evident when child health and developmental outcomes are monitored, and responsibility for their promotion is assigned and accepted, such as through enforcement of legislation and regulations that affect child well-being. *Resources* at the community level include services and organizations dedicated to the promotion of children's healthy development as well as the availability of supportive structures such as parks, child

care facilities, schools, and after-school programs. Finally, *skills* comprise both political and organizational capabilities that can be leveraged to accomplish strategic goals.¹¹⁵ Thus, community capacities can range from enforcement of standards for child safety seats to the availability of high-quality markets selling affordable fresh fruits and vegetables and the presence of local leaders and organizations that can mobilize collective action.

Communities vary widely in their collective commitment, resources, and skills. For example, while there is strong evidence regarding the link between quality child care and positive child health and developmental outcomes, not all communities have the same level of resources to ensure access to affordable, quality options. Moreover, although problems in affordability and access to quality child care are an important issue for low-income neighborhoods, they also present significant challenges for middle-income communities where parents are employed but do not qualify for public subsidies.¹¹⁶

To summarize, although both individual caregivers and communities as a whole can influence the foundations of child health, not all have the same capacities. When necessary resources are not available, effective policies and programs can fill the gaps by building those under-developed or missing capacities. Healthy children are raised by people and communities, not by government and professional services—but public policies and evidence-based interventions can make a significant difference when caregivers and neighborhoods need assistance. It is also important to note the potential impacts of private-sector actions, above and beyond the effects of public policies, to address unmet needs. Creative, new strategies from multiple sources represent vital and highly promising contributions to community-wide health that are likely to produce substantially greater returns across the lifespan.

Rethinking the Health Implications of a Broad Range of Policies and Programs in the Public and Private Sectors

BUILDING ON THE FRAMEWORK presented in this document, a science-based approach to the promotion of health and prevention of disease would be well served by strategic investments that build the capacities of communities and families to strengthen the foundations of healthy development in young children. This broader focus does not in any way diminish the importance of primary health care for all children and high-quality medical treatment for those who are ill. It does, however, underscore extensive and growing evidence that many of the major threats to the health of children cannot be addressed effectively in a hospital or a physician's office. In fact, the origins of health-related behaviors and many adult diseases can be found in the environments and experiences of early childhood.

The time has come to view primary health care as one important component of a multi-dimensional approach: building the capacities of communities and caregivers to strengthen the foundations of lifelong health during the prenatal period and early childhood years. With this goal in mind, two strategies for investment are worthy of attention. First, sufficient resources should be allocated to assure that all eligible children and families are served by existing policies and programs with demonstrated effectiveness factors that strengthen each of the three foundations of health. Second, a consistent portion of expenditures should be invested in the design and evaluation of new approaches to health promotion and disease prevention that are grounded in rigorous science. The need for innovative interventions across a wide range of sectors is particularly important for young children who are at greatest risk for early physiological disruptions that lay a foundation

Policy and Program Levers for Innovation

- Public Health
- Child Care and Early Education
- Child Welfare
- Early Intervention
- Family Economic Stability
- Community Development
- Primary Health Care
- Private Sector Actions

for later stress-related physical and mental health impairments.

Examples of policies and programs that focus on each of the three foundations of health—stable and responsive relationships; safe and supportive environments; and sound nutrition—are described below. Collectively, they cover a range of informal family supports, voluntary community efforts, private sector actions, and publicly funded policies and programs. Some are well-documented initia-

tives that deserve broader implementation. Others represent promising new directions that are grounded in sound scientific reasoning yet await formal testing and evaluation. Both strategies are worthy of investment.

POLICIES AND PROGRAMS THAT PROMOTE STABLE AND RESPONSIVE RELATIONSHIPS

The goal of strengthening parent-child relationships is central to many existing policies and services for families with young children. Parents who are raising children in environments with multiple stressors and few supports comprise a critical constituency for such assistance. Working parents in well-functioning families with low incomes constitute another important target group. The need for relationship-strengthening support is particularly compelling for families whose economic security depends on low-wage jobs, often during non-standard working hours, and for working parents whose children have chronic health problems or special developmental needs that require multiple medical and therapeutic appointments, skilled child care, and a variety

of specialized interventions. In the absence of sufficient support for families facing such circumstances, many young children are subjected to excessive stresses that can have lifelong effects on their physical and mental health. These adverse effects incur substantial costs, for affected individuals personally and for society as a whole, that could be reduced by more timely and appropriate intervention early in life.

The following four policy/program domains are excellent candidates for re-examination through this new lens of health promotion and disease prevention.

Parenting education and home visiting programs, with their origins in public health nursing, occupy a growing niche within the broad array of existing programs designed to ensure that primary caregivers have the knowledge and skills required to provide the kinds of safe environments and learning experiences that young children need. Research has demonstrated the extent to which higher levels of staff training and expertise predict the effectiveness of these kinds of services in such areas as developmental progress and reduction of child maltreatment.¹¹⁷ Even so, an important subgroup of families who face considerable hardship needs more assistance than parenting education and social support alone can provide. Science suggests that highly skilled personnel with the training and programmatic resources needed to reduce the impacts of these specific stressors on the home environment (whether related to severe poverty, maternal depression, substance abuse, or family violence) will improve the long-term physical and mental health of the children.

Parental leave policies are designed to promote the enhanced bonding and responsive caregiving needed to build a strong foundation for healthy development by providing families with sufficient time to adjust to the birth or adoption of a new child. Although universal family leave arrangements with varying levels of income replacement are part of the policy environment in virtually all economically developed nations in the world, the United States remains a highly conspicuous outlier.¹¹⁸ Continuing debate on this issue in both the public and private sectors could be informed by a greater understanding of its implications for child well-being and long-term human capital development.

Although relevant empirical evidence on the merits and costs of paid leave is limited because of the paucity of studies that have been conducted in the United States, we do know that children of mothers who have the financial support to delay their return to work receive more timely well-child care and are more likely to be breastfed and for longer durations.^{119,120,121} Job-protected, paid leave also has also been shown to be associated with lower rates of infant mortality and low birth weight.^{122,123} Although several states have begun to implement parental leave initiatives, evaluation data are currently limited. Both government and the private sector continue to face the important responsibility of determining how to respond to the reality that all parents need time to adjust to the arrival of a newly born or adopted child.

Income supports and “make work pay” programs are designed to augment the capacity of low-income families to provide basic necessities and positive learning environments for their children, thereby enhancing their developmental outcomes,¹²⁴ and a growing body of program evaluation research has confirmed this expectation.¹²⁵ While the effects of these programs on health have not been studied, research on the biology of adversity suggests that reducing serious, sustained stress in the lives of families with young children should in theory help to reduce the higher rates of stress-related chronic diseases that are consistently documented in low-income populations.

Expanded professional development for early care and education providers offers another strategy for strengthening the relationships that young children have with the important adults in their lives. This is particularly important for children who exhibit emotional difficulties or behavioral problems that present a challenge in out-of-home settings.¹²⁶ Expanded access to expert assistance in identifying and treating emergent mental health problems could provide much-needed support for program staff to strengthen their capacity to help young children who exhibit excessive fear, withdrawal, aggressive behavior, or difficulties with attention, impulsivity, and hyperactivity—all common problems for which considerable new knowledge has been generated but access to evidence-based services remains markedly limited.^{127,128}

POLICIES AND PROGRAMS THAT ASSURE SAFE AND SUPPORTIVE CHEMICAL, PHYSICAL, AND BUILT ENVIRONMENTS

Two major studies by the Institute of Medicine have reviewed evidence on the influences of biology and the environments in which children spend most of their time.^{1,129} Both reports agree on the following clear and consistent conclusions. First, health outcomes are profoundly influenced by a range of factors beyond children's biological endowment and the medical care they receive. Second, since these influences are rooted in the social and physical environments in which families and children live, learn, work, and play, enhancing these environments is necessary to both improve child health generally and to reduce disparities in outcomes related to socioeconomic disadvantage.

Health and safety requirements for early care and education programs represent an important reference point for measuring the extent to which a community takes responsibility for protecting the well-being of its children. This issue is broadly relevant to the nearly 75 percent of children under the age of 5 in the United States who are enrolled in early child care and education programs in a variety of settings (including center-based and family child care as well as informal care provided by family members, friends, and neighbors). Recent reviews of state regulations show that one-half to two-thirds of the states fail to require even minimally acceptable care¹³⁰ and that many care providers operate legally beyond the purview of state licensing laws.¹³¹ Children who attend child care facilities of poor quality receive less of the individualized attention that is necessary for healthy development, and they incur increased risk of exposure to multiple communicable diseases and a variety of potential injury hazards, including unsafe playground surfaces and equipment, missing or broken child safety gates, unattended window-blind cords, and a variety of equipment (such as cribs and bedding) and toys that do not meet current safety codes.¹³² In the absence of national standards for monitoring the quality of the child care environment, each state currently formulates its own regulations and criteria. Although some guidance is available from professional organizations, such as the American Academy of Pediatrics' National Health and

Safety Performance Standards,¹³³ widespread deficiencies in this highly fragmented diversity of settings are well known to child care directors and program staff.

Physical features of a community (e.g., sidewalks, bicycle trails, and parks that are safe from crime¹³⁴ and neighborhood resources (e.g., grocery stores that sell fresh fruits and vegetables)) are selected examples of what is meant by the "built" environment. These features are heavily influenced by community zoning laws and land use policies, which provide a promising vehicle to facilitate the development of health-enhancing characteristics and to limit the proliferation

Health outcomes are profoundly influenced by a range of factors beyond children's biological endowment and the medical care they receive.

of those that are health-endangering. Examples of the former include parks that provide a place for physical activity and for parents to engage in positive interactions with their children as well as opportunities for caregivers to meet and interact with other adults to enhance their network of social support and thereby facilitate positive mental health.¹⁰³ Examples of the latter include pollution-generating factories, an abundance of fast-food restaurants and liquor stores, and congested, unsafe walkways. Zoning laws and land use policies that protect green space and limit the density of fast-food outlets also encourage neighborhood awareness of the health-related benefits of these decisions, and thus embed health-enhancing behaviors in the fabric of the community. Together, these kinds of policies strengthen the capacities of caregivers and communities to support the foundations of child health and improve well-being across the lifespan.

Laws and safety regulations for commercial products provide another illustration of how state policies and standards can not only protect the healthy development of children directly but can also build caregiver and community capacities to assure a safer physical environment. For example, motor vehicle injuries are the leading cause of death among children in the United

States, and both serious injuries and fatalities can be reduced by more than half through the use of age-appropriate and size-appropriate child safety and booster seats.^{135,136} Standards for child restraints serve to strengthen individual caregiver capacity by increasing awareness about the importance of safety measures. At the state level, the establishment and enforcement of standards can increase community capacity by creating a marketplace for child seats and boosters, implementing hospital discharge policies requiring approved safety seats, and supporting child restraint checks by law enforcement officials. The enforcement of regulations mandating maximum temperatures on residential hot water tanks is another example of a characteristic of the built environment that reduces threats to child health, as scald burns represent one of the more common household injuries.

Policies that regulate the chemical environments in which children grow and develop include lead paint laws, emissions restrictions that require filtering of mercury, guidelines on the use of bisphenol A (BPA) in plastic baby bottles, and restrictions on the use of toxic insecticides near playgrounds, schools, and child care centers. As described in greater detail in a previous working paper,¹³⁷ the decreased prevalence of lead poisoning is an example of an effective public policy that has reduced exposure to one of the most widely recognized neurotoxins.^{138,139} Another example is the use of organophosphate pesticides, on which the U.S. Environmental Protection Agency imposed new restrictions in 1999-2000, largely because of concerns about the potential exposure of young children. Subsequently, the percentage of food samples with detectable residues of these pesticides declined from 29 percent in 1996 to 19 percent in 2001.¹³⁹ Although progress has been made in reducing environmental levels of some toxins, policies that could restrict the exposure of embryos, fetuses, and infants to other chemicals whose neurotoxicity is well documented, such as mercury and other industrial organic compounds, have fared less well.^{139,140,141,142,143} Beyond the compelling moral responsibility to reduce known threats to the health of young children, there are also persuasive economic arguments for greater attention to the value of prevention, both as a strategy for reducing

the continuously escalating treatment costs of disease and disability and as an investment in human and economic development.^{141,144,145} Specifically, one study, using a widely accepted measure of basic cognitive skills, calculated that, for every decrease equivalent to a 15-point drop on an IQ test, an individual's earnings were 20 percent lower a decade later.¹⁴⁶

Among the most significant environmental toxins that affect lifelong health, the exposure of pregnant women, fetuses, and young children to tobacco smoke, is particularly important.¹⁴⁷ Maternal smoking during pregnancy continues to expose about half a million newborns to this toxic substance.¹⁴⁸ Although exposure of nonsmokers to environmental smoke decreased substantially beginning in the 1990s, due in large part to policies affecting workplaces and commercial and public spaces, the median exposure level of children age 4 to 11 years has remained twice as high as that of adults.¹⁴⁹ Numerous reports conclude that between one-quarter and one-half of all preschool age children are exposed to smoke.⁷ The health consequences of these exposures include increased risk of low birth weight, increased hospitalization, and serious respiratory disease,¹⁵⁰ and the direct medical costs of all pediatric diseases attributable to parental smoking is estimated to be \$7.9 billion (in 2006 dollars).^{7,151}

POLICIES AND PROGRAMS THAT PROMOTE SOUND AND APPROPRIATE NUTRITION

Community actions that affect child nutrition range from zoning laws that favor stores selling nutritious foods over fast-food restaurants, to guidelines for healthful snacks and lunches that are served in early care and education programs. Until recently, the health-related nutritional problems facing children living in low-income families were largely manifested in iron deficiency anemia and poor growth. Currently, the major problem facing U.S. children across all social classes (with low-income populations still affected disproportionately) is the phenomenon of increasing obesity and its associated health complications, most prominently in the form of increasing rates of type 2 diabetes. Given what science now shows about how early experiences can biologically embed vulnerability to diseases later in life, much greater attention to maternal and prenatal health is clearly needed

in order to address the early childhood roots of obesity. Other public and private sector policies that affect nutrition and health include the following examples.

The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) is a good example of a long-standing federal-level program (implemented at the state and local levels) that is designed to build the capacities of families to provide appropriate nutrition for their children by providing financial support (i.e., cash for food purchases) and strengthening knowledge and skills (i.e., health education and nutrition counseling, including the promotion of breastfeeding). Since 1972, WIC has grown to serve about 45 percent of all pregnant women in the United States and over 25 million children annually.¹⁵² Concerns about the quality and appropriateness of the WIC food package have been addressed in recent years by including fresh fruits and vegetables, legumes and alternative proteins, and culturally appropriate foods. Conflicting claims have been made about the health benefits of the program, with good evidence that it prevents iron deficiency anemia in low-income infants but conflicting data on its effectiveness in reducing low birth weight.^{153,154,155,156} Despite these differences, a Congressional report found that, for every dollar spent on WIC, the government saved \$3.50 on reduced payments for Medicaid, Supplemental Security Income, special education, and unneeded medical costs in the first year of life.¹⁵⁷

Private sector policies that support breastfeeding by working mothers represent a promising, non-governmental example of promoting community and caregiver capacities that enhance infant nutrition and strengthen mother-infant relationships. Approximately 60 percent of the mothers of children under the age of 6 are employed full- or part-time.¹⁵⁸ Research shows that full-time work has a significant negative effect on breastfeeding initiation and duration,^{159,160,161} as many women wean their babies early in anticipation of returning to work or dealing with the difficulties of balancing work and breastfeeding.¹⁶² Preliminary evidence suggests that corporate lactation programs—including the provision of worksite lactation rooms and lactation counselors—bolster caregiver and

community capacities and enable women to maintain breastfeeding for at least 6 months, with rates equivalent to those of mothers not employed outside the home.^{163,164} The potential health benefits of breastfeeding include fewer

Reducing the number and severity of early adverse experiences and strengthening relationships that mitigate the effects of toxic stress on young children will decrease the prevalence of a wide range of stress-related physical and mental health problems.

and less severe illnesses in general among young children¹⁶⁵ and indications of potential protection against obesity in childhood and later in life.^{166,167}

BUILDING A BROADER, MULTI-SECTOR PERSPECTIVE ON THE EARLY CHILDHOOD ROOTS OF LIFELONG HEALTH

Although public interest in health promotion and disease prevention programs for adults is high, public understanding of the relation between early childhood experiences and adult illnesses remains low. Even expert understanding of the broad array of factors and conditions that either support or compromise child health is constrained by the “silos” of existing domains of policy and practice that make it difficult to test creative, new ideas that cross sectors.

A rich and growing body of epidemiological evidence and research in neuroscience, molecular biology, and genomics indicates that reducing the number and severity of early stressful and traumatic experiences, such as child maltreatment, family violence, parental mental illness and substance abuse, and the adversity associated with significant economic hardship, will decrease the prevalence of a wide range of stress-related physical and mental health problems. Guided by this scientific knowledge, multiple policies and programs outside the jurisdiction of the medical sector offer promising opportunities to improve health outcomes by mitigating the impact of adversity on young children. The examples presented in each of the

following policy sectors illustrate some of many potential options.

Public Health. The time has come in the continuing debate over spiraling health care expenditures to look beyond strategies for limiting the costs of hospitalization and medication and to invest in policies that keep people healthy. The impacts of current health promotion and disease prevention efforts that begin in the adult years are limited by three important constraints.³ First, they are burdened by the increasing difficulty of changing behavior and lifestyles as people get older. Second, they face the difficult challenge of overcoming the biological vulnerabilities that remain from early

Early care and education programs that incorporate efforts to reduce toxic stress offer the possibility of considerable returns, not only in stronger academic gains but also in better health well into the adult years.

adverse experiences, which could have been prevented by intervening earlier to change the environments in which children live. Third, by addressing adult behaviors only, without also addressing the conditions faced by families of young children, they shift the focus toward individuals whose health risks have been shaped already and away from the circumstances that shaped them. Thus, science suggests that a more effective approach to health promotion would invest more resources in the reduction of significant adversity during the prenatal and early childhood periods, in contrast to the current disproportionate emphasis on campaigns to encourage more exercise and better eating habits in middle-aged adults.

Early Care and Education. Programs designed to promote readiness to succeed academically in school (such as Early Head Start, Head Start, and pre-kindergarten) serve large numbers of young children and their families and offer a rich infrastructure for testing innovative approaches to address the stress-related roots of disparities in learning, behavior, and health. As child development experts work

on new teaching strategies to enhance learning outcomes for vulnerable young children, neuroscience and genomics suggest that further decreases in disparities in educational achievement will require *both* the provision of rich learning experiences *and* the reduction of significant adversity that disrupts the developing architecture of the brain. Research on the biology of stress further demonstrates that such adversity also threatens the function of other organ systems, leading to higher rates of hypertension, obesity, and diabetes. Thus, early care and education programs that incorporate efforts to reduce toxic stress in the service of promoting healthy brain circuitry—for example, by addressing sources of serious family stress, including economic instability, maternal depression, or family violence—offer the possibility of considerable returns, not only in stronger academic gains but also in better health well into the adult years. In this context, the current approach to funding child care of variable quality through the Temporary Assistance for Needy Families (TANF) program illustrates a striking example of an important gap between what we know from research and what we do in policy and practice. Despite persistent resistance to the enforcement of quality standards, science indicates that TANF funds for child care should be viewed as an opportunity to invest in high-quality programs that promote the healthy development of vulnerable, young children and not simply as an obligatory expense to facilitate mandated maternal employment.

Child Welfare. For more than a century, child protective services have focused on issues related to physical safety, reduction of repeated injury, and child custody. Now, recent scientific advances are increasing our understanding of the extent to which the toxic stress of abuse, neglect, or exposure to family or community violence can produce physiological changes in young children that increase the likelihood of mental health problems and physical disease throughout their lives. Based on this heightened risk of stress-related illness, science suggests that all investigations of suspected child abuse or neglect should include a comprehensive assessment of the child's cognitive, language, emotional, social, and physical development, followed by the provision of effective therapeutic services as needed. This could be accomplished

through regularized referrals from the child welfare system (which is a mandated service in each state) to the early intervention system for children with developmental delays or disabilities (which provides services under an entitlement established by federal law). Although the most recent federal reauthorizations of the Keeping Children and Families Safe Act and the Individuals with Disabilities Education Act both included requirements for establishing such linkages, sufficient funding has not been provided, and the implementation of these requirements has moved slowly. The availability of new, evidence-based interventions that have been shown to improve outcomes for children in the child welfare system¹⁶⁸ underscores the compelling need to transform “child protection” from its traditional concern with physical safety and custody to a broader, more science-based focus on health promotion and disease prevention. The Centers for Disease Control and Prevention has taken an important step in advancing this issue by promoting the prevention of child maltreatment as a public health concern.^{169,170}

Mental Health. In view of the many advances that have been made in the development of evidence-based treatments for a range of child mental health problems, the limited availability of appropriate therapeutic services for young children and families dealing with toxic stress requires urgent attention. Reports of youngsters with disruptive behaviors being expelled from preschool programs^{171,172} and the dramatic rise in off-label prescription of antipsychotic medications for very young children¹⁷³ underscore the extent to which this situation has reached crisis proportions. Timely access to specialists in the identification, assessment, and clinical treatment of young children with serious mental health problems within existing early childhood programs could enhance their capacity to address unmet needs without creating a separate mental health system for young children. Because of the close association between children’s emotional well-being and the mental health of their caregivers, mental health services for parents would have a broader impact if they routinely included attention to the needs of their children as well.¹²⁶ Finally, more effective treatment of stress-related problems in early childhood is likely to

reduce the prevalence of a wide range of stress-related health disorders later in adulthood.

Primary Health Care. The association between an expectant mother’s preconception health and the subsequent well-being of her baby is well documented, but there are few policies or programs that connect these periods explicitly in the delivery of primary health services. The absence of attention to the mother-child relationship in the treatment of depression in women is another striking example of the gap between science and practice, given extensive evidence of the negative impact of diminished maternal responsiveness on the development of young children.⁶² Payment mechanisms that provide incentives for coordinating child and parent medical services (e.g., automatic coverage for parent-child intervention linked to reimbursement for the treatment of maternal depression) offer one promising strategy for addressing this problem.

The most striking challenge related to the role of primary health services in promoting child well-being is reflected in a longstanding debate within the pediatric health care community about the possibilities and limitations of well-child care within a comprehensive health system.^{174,175} For at least half a century, this debate has focused on the need for family-centered approaches to address the concerns of children with developmental impairments, behavioral difficulties, and chronic health problems, along with the complex challenge of providing more effective interventions for children living in highly adverse environments.¹⁷⁶ Despite longstanding calls for an explicit community-focused, primary care strategy, a recent national study of pediatric practices identified the persistent inability to achieve better linkages with community-based resources as a major challenge.¹⁷⁷ A parallel survey of parents also noted the limited communication that exists between pediatric practices and community-based services such as WIC programs, child care providers, and schools.¹⁷⁸ Moreover, both groups agreed that pediatricians cannot be expected to meet all of a child’s needs.

Notwithstanding this broad accord, history tells us that continuing calls for reduced fragmentation among community-based services will have little impact. The time has come for bold and innovative leadership to develop new

strategies for coordination that are:

- grounded in a shared science base;
- able to leverage the benefits of new information technologies for sharing information more effectively while protecting confidentiality; and
- genuinely committed to trying new models of working collaboratively across disciplines and sectors.

Recommendations for providing a “medical home”¹⁷⁹ for all children within the provisions of the Patient Protection and Affordable Care Act of 2010 offer a promising starting point.

However, successful transformation to a more effective model of primary health care will require deeply committed attention to a wide range of factors, including strong leadership, financial resources, personal and organizational relationships, engagement with families, management expertise, health information technology, support for care coordination, and staff development¹⁸⁰ as well as the extent to which practitioners in the medical, educational, and social services worlds are truly ready to work together (and to train the next generation of practitioners) in new ways.

A Call for Innovation

THE STABILITY, PROSPERITY, AND SUSTAINABILITY of a society depend on the healthy development of its population. Knowing this, a recent analysis of data from the United States and six other countries (Australia, Canada, Germany, the Netherlands, New Zealand, and the United Kingdom) raises serious concerns that require thoughtful attention. In addition to noting that the U.S. health care system ranks last or next-to-last on four dimensions associated with high performance (quality, access, efficiency, and equity), the report also indicated that the United States ranks last on mortality amenable to health care, last on infant mortality, and second-to-last on healthy life expectancy at age 60.¹⁸¹ The fact that the U.S. spends more money per capita on medical care than any other industrialized nation¹⁸² makes these findings particularly problematic. Extensive evidence that effective health promotion and disease prevention depend on more than simply assuring the availability and affordability of high-quality medical care further underscores the need for creative, new strategies to improve our nation’s health.

As we look to the scientific community for new ways to address this challenge, advances in neuroscience, molecular biology, and genomics are converging on three compelling conclusions: (1) early experiences are built into our bodies; (2) significant adversity early in life can produce physiological disruptions or embedded biological “memories” that undermine the development of the body’s stress response systems and affect the developing

brain, cardiovascular system, immune system, and metabolic regulatory functions; and (3) these physiological disruptions can persist far into adulthood and lead to lifelong impairments in both physical and mental health.

These broadly accepted scientific principles send two clear and powerful messages to decision-makers who are searching for more effective ways to improve the health of the nation. First, health promotion and disease prevention policies focused on adults would be more effective if evidence-based investments were also made to strengthen the foundations of health in the prenatal and early childhood periods. Second, the increasing prevalence of chronic disease across the life course could be lowered by reducing the number and severity of adverse experiences threatening the well-being of young children and by strengthening the protective relationships that help mitigate the harmful effects of toxic stress.

Although much important research still remains to be done, sufficient knowledge to address these challenges more effectively is already available. Disjointed medical care in the crucial periods of preconception, pregnancy, and early childhood demands better coordination, as do a broad range of policies that affect families with young children who are facing significant adversities that threaten their physical and mental well-being. These policies include early care and education, child welfare, early intervention, workforce development, housing, urban planning, economic development, and environmental protection, among many others.

Simply calling for a more comprehensive approach to the challenges facing disadvantaged young children and their parents, however, offers nothing new. Equally important, enhanced coordination across systems that are guided by disparate values and disconnected bodies of knowledge is unlikely to produce sufficiently greater impact. What is needed instead is creative new thinking about how to apply a unified science base about the early childhood origins of health, learning, and behavior across multiple sectors.¹⁸³

The framework presented in this document is offered in the spirit of attempting to catalyze such innovative policymaking and creative interventions. Promising ideas include the following:

- Child welfare agencies can help prevent long-term adult impairment, not just provide immediate child protection.
- Zoning laws and land development policies can facilitate healthy lifestyles, not just generate commercial profit.
- Alternative child care arrangements for young children whose mothers are mandated to work as a condition of receiving public assistance provide an opportunity to build foundations for healthy development, not just support maternal employment.
- High-quality early care and education programs can promote health and prevent disease, not just prepare children to succeed in school.

Dramatic advances in the biological sciences are transforming the diagnosis and treatment of illness—and the products of these efforts will undoubtedly improve the effectiveness of medical care as well as increase its cost. It is equally important to note that these same advances could also be mobilized to transform the way

Every system that touches the lives of children offers an opportunity to strengthen the foundations and capacities that make lifelong healthy development possible.

we address the promotion of health, prevention of disease, and reduction of disparities related to social and economic disadvantage. Every system that touches the lives of children—as well as mothers before and during pregnancy—offers an opportunity to strengthen the foundations and capacities that make lifelong healthy development possible. Investments in the early reduction of significant adversity are particularly likely to generate strong returns.

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