Biological Poverty Line for Infants—Evidence and Implications

Decades of behavioral and educational research have clearly demonstrated the powerful detrimental effects of exposure to poverty on child development. Building on this, a burgeoning body of literature has also demonstrated adverse effects on brain development. Together such findings suggest that exposure to poverty very early in life alters the structure and function of the developing brain. This may be one mechanism by which poverty negatively affects developmental outcomes, often with lifelong consequences. Biological mechanisms underlying the effects of experience (eg, exposure to poverty) on brain development have been elucidated; these mechanisms include impacts on gene expression (epigenetic) and modification of stress systems, as well as influences on inflammatory and gut microbiome systems that directly communicate with the brain. Data suggest that the negative effects of these exposures may be uniquely powerful during periods of highest neuroplasticity (ie, when the brain is most shaped by experience) during fetal and infant brain development. Such findings underscore the importance of further investigation of the impact of poverty on development in pregnancy and early childhood to guide protective and promotive interventions during this period.

Crucially, findings from a longitudinal study of the effects of adversity on infant and early childhood brain and behavioral development suggest that some of the biological mechanisms by which experience affects brain development operate differently in infants living in high- vs low-resource environments. For example, the association of maternal inflammatory cytokines with neural tract development has been shown in the context of promotive factors, with positive outcomes evidenced only above certain socioeconomic resource thresholds. For example, the positive association between increasing maternal support and toddler cognitive outcomes are seen only in those living well above the poverty line. Similarly, the positive outcomes of a “thrive factor,” a composite of basic resources and conditions in the first year of life (sleep, nutrition, caretaking, environmental stimulation, and safety) hypothesized to be necessary to support thriving, are evidenced in child cognitive function only for those living above a minimum adversity threshold. Such data on the differential associations of risk and promotive factors with child development as a function of socioeconomic resources point to the crucial need to identify the level of family economic resources above which children can benefit from promotive factors or below which they are less likely to have a significant positive impact. The official poverty line has been the metric by which the provision of these essential social resources are allocated to families. However, the US measure of poverty has been widely criticized as outdated and may not be a useful indicator of the need for and threshold at which children reap maximal benefit from these social supports. The current official poverty measure (OPM) was developed in the 1960s and was based on family structures and necessary resources that made sense during that period. However, in the modern era, the OPM fails to account for significant geographic differences in the cost of living or increasing expenses in the current economy such as childcare or health care costs. As a result, the US Census Bureau has developed an alternative measure of poverty known as the Supplementary Poverty Measure (SPM). It is designed to address some of the shortcomings found in the OPM. However, both the OPM and the SPM fail to account for the age of children living in the household when calculating a poverty line. This is particularly pertinent with respect to infants and very young children. Infants who are living just above either the OPM or SPM poverty line may still be at significant risk for biological damage from the stressors associated with low resources. A poverty line that does not adjust for the specific needs of very young children and their families grossly underestimates the number of children experiencing the detrimental effects of low resources.

Further, compelling evidence demonstrates that exposure to poverty in early childhood may have powerful detrimental effects on future outcomes, suggesting that to meaningfully address the long-term impact of poverty in early childhood, developmentally informed poverty thresholds that address these age-specific effects and consider developmentally sensitive periods are indicated. The findings discussed above, coupled with the call to recalibrate the US poverty line, suggest that it may be useful to identify a “biological poverty line” during the infancy and toddler period above which the brain is informed and enhanced by experience in positive ways. Below this line, adverse experiences may inform the brain to develop along a different trajectory, perhaps to ready the infant to adapt to expected adverse conditions. The differential impacts of the thrive factor as a function of low vs sufficient income to needs ratios provide empirical support for the idea of a biological poverty line in infancy with significant public health relevance. Cytokine findings showing unique effects on brain in those who experience high vs low resources might also suggest that for those living above compared with below this putative biological poverty line, brain development is informed by exposure to cytokines for adaptation to different future expected con-
ditions. While many of these adaptations for expected adversity (eg, high-stress reactivity) may be beneficial in the short run, there is ample evidence that they do not support long-term health trajectories.

Findings that the thrive factor benefits development in several domains only for children living above a certain resource threshold (the presumptive biological poverty line) support the notion that there may be a minimum level of resources necessary to support healthy development in infancy, a foundational period across numerous health domains. Future studies are needed to test whether similar moderating effects are evident in other biological systems, such as gut microbiome alterations, gene expression changes through epigenetic signatures, and immune phenotypes to support health. If similar effects are seen in these basic health domains, in addition to those detected in brain, behavior, and cognition, it would lend significant support for the broad validity of a biological poverty line and contribute to efforts to recalibrate the official US metrics that determine whether a family is below the poverty line and thus eligible for social safety supports.

The goal of preventing childhood poverty is among the most serious public health issues for which there has been much attention but limited sustained public policy solutions. Furthermore, recent estimates indicate that the economic cost of US childhood poverty exceeds $1 trillion on an annual basis.7 Advances in our understanding of the effects of experience on neurodevelopment and several other key developmental domains during infancy and early life suggest that addressing poverty in the first year of life, guided by emerging evidence of a biological inflection point, might be the best next-step investment in health prevention and enhancement. Such an empirically informed and developmentally specific biological poverty line in infancy could bring greater precision to this federal definition to inform the delivery of key necessary public services during the period when they may be most necessary, have the most powerful impact, and, therefore, be most cost-effective.

ARTICLE INFORMATION
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REFERENCES