Public Policy Implications of Promoting Growth

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Abstract
Translating the new science of growth into constructive policy will not happen naturally. Rather, the emerging science will need to be reframed to address certain core policy requirements. First, the complexity of early genetic and environmental interactions should be respected as their impact may vary in different, real-world settings. Second, the scale of impact is important to gauge as early-life interactions, while real, may not account for a large portion of later outcomes. Third, judgments regarding critical periods and the amenability of early-life influences to later intervention should be made cautiously as the etiologic nature or timing of early-life interactions do not, per se, determine if their life course effects are amenable to later interventions. Fourth, there is a need for incremental efficacy, such that the new science significantly enhances the impact of extant policy-based interventions. Finally, the translation of the new developmental science into policy should be viewed in a historical context and responsive to social and cultural needs. This provides a basis for reframing the new science of growth in a manner that best ensures that the science receives the constructive policy response it so urgently demands.

Although policy can be defined in many ways, it is inherently a pragmatic enterprise, and can be framed as the transformation of societal intent into societal action. For a scientific audience, it would be affirming to suggest that this process of transformation is rooted in scientific discovery, proceeds logically to carefully evaluated pilot programs, and ultimately to broad policy initiatives. The reality of policy development, however, is far more complex and involves the representation of scientific insight in a manner that supports collective action which, at some level, requires consensus, and consensus is not discovered but created.
This discussion does not make sharp distinctions between industrialized and developing countries as such broad categories tend to obscure shared policy challenges and the considerable heterogeneity that exists among low- and mid-income settings. Rather, the primary consideration is the speed of societal change, particularly the dynamics of nutritional status, patterns of growth, and the rise of chronic diseases. Of central concern are rapidly growing rates of obesity and related chronic conditions in societies still plagued by persistently high levels of chronic undernutrition, including stunting, micronutrient deficiencies, and elevated rates of infectious diseases. This juxtaposition of obesity and undernutrition, while increasingly common among many countries undergoing rapid urbanization and social change, presents a dual challenge to policy development. First, policies must be capable of implementing effective strategies to combat both ends of the malnutrition spectrum, a task that likely requires dramatic reframing of traditional nutritional and public health strategies. Second, the juxtaposition of persistent undernutrition and growing rates of obesity also generally occurs in highly stratified societies, which are often characterized by complex political environments.

Over the past two decades, the social fabric of daily life in transitional societies has been dramatically affected by rapid urbanization, shifts in the availability and pricing of nontraditional foods, and expanded access to technology and mass media. These trends have resulted in profound changes in patterns of consumption such that traditional diets and work-related exercise have been replaced by calorie-dense, nutrient-poor foods and largely sedentary lifestyles. As a consequence, these societies have experienced a dramatic increase in rates of obesity and associated conditions, including diabetes and cardiovascular disease. It is possible that in some settings the juxtaposition of undernutrition and obesity represents only a transitional period in which undernutrition is ultimately replaced by overnutrition and obesity. However, there are troubling signs that undernutrition is not in fact declining rapidly but is stagnating at disturbingly high levels or falling far more slowly than obesity rates are growing.

Recent evidence has underscored the deeper concern that early undernutrition can predispose populations to later obesity in settings of major changes in dietary and activity patterns. It seems clear that undernutrition during gestation and in early life can have long-term consequences for adult health. The concern is that these early exposures to undernutrition create metabolic states that can generate later rapid weight gain in high caloric environments, like those associated with rapid urbanization. This erroneous anticipation of a later nutritional environment has been cogently described as a kind of 'mismatch' between early adaptive mechanisms and a later obesogenic environment, and reflects a more general awareness of the developmental origins of health and disease. Although the precise mechanisms driving these relationships remain relatively unexplored, it is likely that they involve complex gene-environment interactions, including epigenetic pathways. In this manner, rather than representing two
distinct nutritional problems, undernutrition and obesity could be intimately related and reflect merely two diverse manifestations of a linked continuum of malnutrition states.

The challenge to policy therefore, must not only address both undernutrition and overnutrition but also respond to the rapidly emerging science that binds them together. There can be no doubt that these scientific insights into human growth and development have been remarkable and are leading to a variety of new directions for research. However, this science is also decidedly complex and may not translate well to the policy arena. Indeed, while the role of early exposures should not be underestimated, this role can also be misinterpreted, and without some caution can ultimately undermine constructive frameworks of clinical and policy-based interventions. This discussion therefore, is not intended as a comprehensive review of the many policy options available to address recent trends in nutrition and health. Rather, it is directed at critically assessing those elements of recent growth and nutrition science that demand special attention in formulating a set of constructive and pragmatic public policies.

**Complexity and Norms of Reaction**

While a variety of studies have documented associations between early nutritional exposures and later health outcomes, the nature and intensity of these relationships is highly complex and not likely to conform to any singular finding. The clinical or phenotypic expression of any genetic or epigenetic influence can vary profoundly under different environmental exposures. These patterns of variation, or ‘norms of reaction’, can be quite dramatic, changing a given influence from beneficial to deleterious at different levels of given exposure [1, 2]. Because it is very difficult to assess these patterns in real-world settings, great care should be taken in interpreting analyses that assess main or ‘average’ effects of any particular predisposition on later outcomes. Nonlinear or crossover patterns may make average or main effects misleading and render any findings generated under one set of exposures difficult to extrapolate to others. Findings dominated by small changes around the mean may say little about the impact of more extreme exposures. Similarly, experiences at the margins of risk, such as for severely starved infants, may not provide much insight into risk-outcome relationships occurring in the mainstream of exposures. Such nonlinear relationships may also extend to proxy linkages among important, policy-relevant variables. For example, linear growth in small children has been used as a proxy for other outcomes that are more difficult to measure, such as cognitive capabilities. However, these proxy relationships should be viewed as potentially elastic over a spectrum of exposures, such that cognitive effects may be more tightly tied to linear growth at the extremes. This complexity may be
even more apparent when risk-phenotype relationships differ at distinct developmental stages. More broadly, a reliance on statistical strategies based on the analysis of variance may be poorly suited to convey the strength or complexity of gene-environment interactions, particularly if norms of reaction are highly nonlinear or are operating in highly dynamic environments. Overall, the complexity of these relationships suggests that any responsive policy initiative should be fairly comprehensive in its approach and be directed to interventions likely to enhance outcomes over a range of exposures.

Predictive Utility and the Scale of Impact

While a number of studies have documented statistically significant associations between early exposures and later health outcomes, policy requires that the scale of these relationships attain public relevance. The basis of such public relevance can take several forms, but generally relates to the prevalence or predictive utility of the relationship in the general population. There may be a variety of significant associations, often viewed as relative risks, for a particular outcome. However, it is quite common for such risks to occur relatively rarely in large populations. For example, adolescent childbearing has been shown to be associated with an elevated risk for infant mortality in the offspring. However, the elimination of the risk associated with adolescent pregnancy would not have a substantial impact on general infant mortality rates as such pregnancies account for a relatively small portion of all births in most populations [3]. There are many justifications for policies designed to reduce adolescent pregnancies; however, the reduction of infant mortality rates is not one of them. While the relative risk was significant, the prevalence-sensitive ‘attributable risk’ was small.

In addition to the attributable scale of an early developmental process, policy must critically consider the predictive utility of identified risk, an issue that is also sensitive to the prevalence of the risk in question. A significant relative risk does not mean that the risk is highly predictive or deterministic of later outcomes. For example, while obesity in 3-year-olds is associated with an elevated risk of obesity as a young adult, the vast majority of obese 3-year-olds are not going to be obese young adults and the vast majority of obese young adults were not obese at the age of 3 years. Indeed, while important recent evidence has emerged suggesting that early developmental processes may prove substantially predictive of a major adult-onset disease process [4], many examined early risks for adult-onset diseases, while real, have not proven to be highly predictive of these later outcomes [5]. Intense interaction with other influences or the likelihood that the outcome in question may represent a condition with heterogeneous etiologic pathways can also undermine the predictive utility of an early developmental risk and therefore, reduce its relevance to policy and public action.
Amenability to Intervention

Policy is concerned with public action, and therefore requires some perception that a capacity exists to actually improve outcomes. Without a belief in the efficacy of a particular intervention, there will be little justification for strong public action. This is why advocacy for a particular intervention or service is always tied to perceptions of efficacy. In the case of early influences on growth and adult health, the appraisal of efficacy takes on a decidedly developmental character. Inherent in arguments that longstanding or permanent risks are determined during confined ages or developmental periods can imply that windows of efficacy are opening and closing during different developmental stages. This notion of confined efficacy is a critical challenge to policy and should, therefore, be examined in detail.

It is useful to note that the nature of a risk, be it genetic, epigenetic, or environmental, has little to do with its relative amenability to intervention. Genetic diseases, such as phenylketonuria, are highly amenable to effective intervention. Similarly, outcomes generally attributed to environmental determinants, such as injuries, are also highly amenable to both preventive and therapeutic interventions. Conditions likely caused by complex gene-environment interactions, such as asthma or type 2 diabetes, are also highly responsive to effective interventions. The concern for policy is whether an efficacious intervention exists, not the nature of the causal pathway per se.

The central focus on amenability also raises questions regarding the invocation of ‘critical periods’ in the generation of life course risk. These developmental stages are generally defined as having increased sensitivity to biologic and environmental influences that result in permanent physiologic or anatomic alterations capable of influencing later health and behavior [6]. However, while such developmental windows of differential sensitivity may exist, there is no reason to believe that their ultimate impact on outcomes is inherently less amenable to intervention than any other category of influence. Experiments by Meaney and Szyf [7] have documented in rats that maternal nurturing practices occurring at a particular time in early development can influence later behavior in offspring through epigenetic mechanisms. However, they have also been able to reverse these effects through the administration of pharmaceuticals [8]. Similarly, from a policy perspective, the advent of human growth hormone treatment has forced a reconsideration of the longstanding perception of critical periods in linear growth. Drugs are merely a manipulated environment and therefore, these illustrations represent examples of a later environmental influence on what had previously been considered fixed outcomes generated by a confined critical period. Sensitive or critical periods, though at some level rooted in developmental processes, are, for the purposes of policy, actually dependent upon whether a later influence or efficacious intervention exists. In this manner, notions of critical periods must be seen as inherently contingent and potentially
dynamic not because of underlying developmental processes but because these processes may be sensitive to the new, efficacious interventions [9]. It may be argued that certain developmental processes or outcomes are better prevented than addressed after the fact. This, indeed, may be true in many current circumstances. However, such an argument is inherently pragmatic in nature, reflecting what is actually a comparative effectiveness logic that assesses the relative utility of different intervention strategies. This approach can be addressed empirically and in the end has little to do with the nature of the underlying developmental processes per se. Policy is dependent on perceptions of capacity, and great care should be exercised when such capacity is challenged on principle. A more useful approach would be to assess such concerns empirically and recognize that during a period of unprecedented growth in clinical and public health efficacy, the policy-based opportunities for effective intervention are likely to be highly dynamic.

**Constructing a Policy Response**

The recognition that the risks associated with early exposures can be complex, highly interactive and potentially amenable to intervention provides a useful foundation for constructing an effective policy response to the undernutrition and growing rates of obesity. For the purposes of this discussion, the components of such a policy response can be considered in relation to three highly interactive components of policy: knowledge base, social strategy, and political will [10].

**Enhancing the Knowledge Base**

While early exposures have been shown to influence later outcomes, there is an urgent need to expand applied research into policies sufficiently comprehensive to address both undernutrition and obesity. Continued investigation of the basic mechanisms involved in early influences on later health remains crucial. Of special concern is the exploration of the complex interactions that persist and reshape life course influences and particularly how efficacious interventions can complement each other at different ages and developmental stages [11]. However, these should be matched by efforts to craft new, innovative strategies to address what is already known to be highly detrimental rates of early undernutrition and elevated child mortality. These broad approaches could include research into larger societal policies, such as those affecting food security or patterns of consumption, as well as more direct, community-based nutrition and health interventions should receive enhanced attention from the research community.
Crafting Social Strategies

Knowledge alone is insufficient for successful policy. Social strategies that attend to prevailing ideologies and the machinery of policy implementation are also essential. In addition, these strategic considerations must respond to programmatic histories, extant funding mechanisms, and systems of provision and accountability. In this manner, policies addressing the continuum of undernutrition and obesity will need to be attentive to the mechanisms of social welfare and planned societal change, mechanisms that may be intensely local and at times, highly flexible, as the parameters of social strategies can change rapidly in unstable political settings.

Given this policy context, the science of malnutrition as well as an examination of prevailing social strategies together underscore the importance of optimizing the health and well-being of women. A traditionally confined focus on the prenatal period does not respond to the longstanding determinants of a healthy pregnancy nor the programmatic requirements of embedding prenatal care within a comprehensive system of women’s health care [3]. Although there are a variety of strategies that hold promise in addressing the nutritional needs of both high- and low-income societies, the importance of healthy childbearing, optimal child nutrition and the shaping of the developmental precursors of lifelong healthy behaviors are in many respects, best addressed by a strong commitment to the health, education, and civic engagement of women. The growing adoption of conditional cash transfer programs in many mid- and low-income countries could also be used more effectively as a basis for improving nutrition. Social strategies that attempt to shift social norms through education, controls on advertising harmful foods, and enhancing healthy behaviors through social and popular media have also been implemented to address other public health challenges, such as tobacco use, and therefore could prove useful in improving general levels of nutrition. It is always important to relate the requirements of optimal growth and development to policies directed at eliminating poverty and enhancing societal equity.

Building Political Will

At some level, all policies must enjoy sufficient political support to ensure their implementation and maintenance. This will often require not only public awareness of the issue but also a political framing that generates sufficient consensus to permit enactment and the appropriation of adequate resources. Particularly in settings of profound social inequity as well as in areas of inadequate or unstable governance, political considerations will prove critically important to effective policy. In this regard, integrated approaches that incorporate developmental science into broader discussions of public health, food economics and policy
should be welcomed [12–14]. However, in calling attention to early influences on later health, great care should be taken not to overextend the claims of early developmental processes and devalue exposures and interventions occurring later in childhood and beyond. Elevating early influence by suggesting that later health outcomes and capacities are merely the product of ‘trajectories’ determined in early life can create unhelpful political dynamics that fragment constituencies and their advocacy. Particularly because the science of life course malnutrition and the relevant social strategies may suggest policies that do not focus exclusively on pregnancy and young childhood (e.g. women’s health), an integrated, comprehensive framework will not only respect the complementarity of interventions and policies over the life course but will also create the coherent, unified political voice that will best ensure the implementation of effective public policy.

References