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Editorial

Strengthening Global Programs and Policies for Youth Based on the Emerging Science

The focus of the Wingspread consultation was to explore the implications of recent research in the fields of epigenetics, adolescent neurodevelopment, and neurobiology on adolescent health. Specifically, its goal was to explore policies, programs, and future research directed to critical health concerns affecting youth that have implications for a range of noncommunicable conditions with lifelong consequences. The focus was on low- and middle-income countries.

In response to the growing attention that is being given to noncommunicable conditions, a focus on adolescents is important because many of the behaviors that give rise to these conditions start during the adolescence. Most health problems have important behavioral components. Many of the recommendations from the Wingspread meeting are therefore likely to be as applicable to communicable diseases (e.g., HIV and sexually transmitted infections), and to a range of health problems associated with adolescents' sexual and reproductive health and the prevention of noncommunicable diseases.

A clear understanding of the processes that give rise to health promoting and damaging behaviors during adolescence will enable the development of relevant and effective policies and programs. Additionally, it is essential to delineate the ways in which adolescents are different from young children and adults in terms of how they think, what influences them, and how they act.

Of course, not all adolescents are the same. It is now well recognized that although the sequencing of the changes that take place during this phase of development is universal, the timing varies between individuals. Even within the same individual adolescent, the physical and psychosocial changes are often not synchronous. However, while needing to recognize this heterogeneity, it is equally clear that there are common phases of development, common processes taking place in terms of brain development, and common biological pathways being activated in response to a range of external stimuli.

The Individual, the Environment, and the Life Course

The new epigenetic and neurodevelopmental science tells us a great deal about individual adolescents and has important implications for action. This science also challenges us to place

the individual within the context of both his/her environment, and within a life course perspective.

Concerning individual factors, the new research makes it clear that the adolescent brain is still developing, and that this evolving brain is not the same as that of either a child or a fully mature adult [1]. Our expectations, policies, and programs need to reflect this understanding. There is now strong evidence that the adolescent brain is much more plastic than previously believed, which challenges the notion that by the teen years, behaviors and responses are relatively fixed. The new science says that there is ample opportunity during adolescence for effective policies and programs directed to adolescent behaviors to have lifelong impact [2].

Another important finding is that adolescents are more sensitive to rewards and less sensitive to punishments than either children or adults, the reason for which is that regions of the brain important for processing rewards are especially active during adolescence, whereas the processing of aversive stimuli is often attenuated. Thus, under some conditions, adolescent decision making appears to be influenced more by reward than by punishment or by consideration of the long-term consequences of their actions than are the decisions reached by adults [3]. Adolescents are especially prone to reaching risky decisions under exciting or emotionally charged situations that override the inhibitory control provided by still developing cognitive control regions.

Research has also shown that the neuromaturational processes of brain development during the second decade of life make adolescents more prone to sensation seeking and thus increase the initiation of risk behaviors [1]. We see the manifestations of this risk taking in substance use and unprotected sex [3]. However, from an evolutionary biology perspective, risk taking may be important at this time when adolescents of many species leave the protection of the family to seek new partnerships and new ways of interacting with their environments.

In terms of the importance of seeing individual adolescents within the context of their environments, it is increasingly clear that genetics alone explains a relatively small amount of variance for health problems—for example, genetics explain only a small fraction of the intergenerational nature of obesity. Epigenetic mechanisms provide an understanding of the gene-environmental influences at critical time windows on a range of health

Table 1
Implications of the new science on programs and policy

Current understanding	New insights from the new research	Implications for policies and programs
1. Confirms: the new research strengthens current understanding.		
Adolescents' health outcomes and behaviors are often linked together in terms of cause and effect	Pathways are identifiable that map how one factor or behavior affects the others, leading to a negative cascade	Programming needs to identify the pathways and develop intervention strategies that address the common determinants that give rise to multiple risk behaviors
Individual capacities are still developing during adolescence	The adolescent brain is still somewhat malleable, and with appropriate interventions, some rewiring is possible	Interventions need to develop the executive function capacities of adolescents and other life skills while concurrently restricting access and exposure to harm
Peers have an important influence on adolescents' behaviors	Environments play a key role in determining behaviors, and from an evolutionary biology perspective, being accepted by peers is central to group dynamics	Interventions need to be inclusive of an understanding of the importance of peers in view of their protective potential in reducing high-risk behaviors
The environments in which young people live have an impact on their health and development	Environmental factors interact with both genome and epigenome that controls gene expression affecting morbidity and mortality in adolescence and beyond	Because environments alter biology, attention needs to be paid to neighborhood influences, and prevention strategies need to use family, neighborhood, or community as a unit of programming, which needs to start early and be sustained through adolescence
It is important to place adolescent interventions in a broader life course context	Epigenetics emphasize the periods from conception to early childhood are critical time windows in terms of sensitivity to environmental influences, developmental programming and plasticity, with impact on adolescent and adult health	Our understanding of epigenetic influences creates new opportunities for long-range multigenerational health promotion strategies. The next generation of health promotion strategies needs to be grounded in a life course framework
All adolescents are vulnerable, but some are more vulnerable than others	Individual variations in vulnerability to environmental adversity and health risk stem from the complex interplay of environment, genetics, and epigenetics	Continue to develop targeted prevention strategies for vulnerable individuals and groups, and pilot individualized prevention strategies that address vulnerabilities. Biomedical research and technology offers the promise of molecular biomarkers to identify most vulnerable individuals before clinical disease occurs
2. Corrects: the new research modifies current understanding.		
Adolescents should be discouraged from indulging in high-risk behaviors	Sensation seeking and risk taking are heightened in adolescence. This is seen in a variety of species	Adolescents need structured opportunities to take risks, and there is a need for more effort in the area of harm reduction (e.g., Outward Bound). Graduated risk taking acknowledges developmental processes (e.g., graduated drivers licenses)
Interventions need to emphasize the consequences of behaviors	There is a blunted response to punishment and a heightened response to rewards	Enhancing reward opportunities likely to be more effective than punishing interventions (e.g., Scared Straight, <i>Drug Abuse Resistance Education [DARE]</i>)
Adolescents should be held responsible for their own decisions	In the heat of emotional arousal (hot cognition), adolescent reasoning is inherently different from adults	Opportunities to cool down (e.g., the Interrupters approach of Cease Fire) hold promise. Interventions are needed to help adolescents manage reactivity and impulsivity
Obesity prevention interventions should focus on reducing caloric intake and increasing exercise	Hyper-palatable calorie-dense foods activate reward pathways similar to other addictions	Environmental constraints on high-calorie/low-nutrient foods are a matter for public policy (e.g., taxation, media advertising), communities (e.g., location of fast-food restaurants near schools, menu labeling), schools (e.g., food and exercise standards), and families
3. Challenges: the new research stimulates new ways of understanding.		
Young people are best dealt with at a rational level	Young people are more likely to have their decision making derailed under emotional, exciting, or stressful circumstances	Interventions are needed that can encourage maintenance of cognitive control even in emotional situations
Young people are motivated by punishment	Young people are more likely to be motivated by reward than by punishment	Interventions should move away from punishment-based approaches toward developing more reward-based incentives
We now know what needs to be done to contribute to adolescent health and development. Further research is not needed	We are learning new things all the time that are not being reflected in policies and programs	Recent sleep research should challenge conventional policy that has high school students starting school before their younger siblings

outcomes, and in combination with evolutionary biology help to delineate some of the pathways of the biology of behavior [2].

In addition to the need to see adolescents within the context of their environments, there has been a growing recognition of the many interconnections between different periods of the life course that have an impact on public health. The new science forces us to consider intergenerational strategies for prevention and treatment that help policy makers and programmers understand how a focus on other periods of the life cycle improves the health and development of adolescents, and how a focus on adolescents can improve public health more generally.

Influencing the Next Generation of Policies, programs, and Research

The importance of linking policies and programs to currently available science was emphasized throughout the consultation, and the participants identified three main ways in which the new science should influence policies, programs, and research directed toward noncommunicable conditions and the behaviors that shape health outcomes. The research findings:

1. *Confirm* current understanding and ongoing approaches, for example, the existence of common determinants (e.g., pathways in the brain) and the inter-relationships between the determinants of risk behaviors and the behaviors themselves, such that one impacts the other. For example, growing up in persistently violent environments impacts brain development, which in turn affects cognition, emotional reactivity, mental health, and drug use, which in turn affects violence and sexual behaviors;
2. *Correct* and question current orthodoxy. For example, it may be necessary to rethink some of the concepts of *mature minors*

and informed consent by adolescents in the light of the evolving understanding of brain maturation;

3. *Challenge* and raise new options/opportunities for confronting existing and new problems. For example, if we have the capacity to better understand biological, social, environmental, and familial risks that a young person brings with him or her into adolescence, then one can envision individualized prevention, akin to personalized medicine, rather than the current generic strategies directed to all young people.

The ways in which the new science confirms, corrects, and challenges current thinking are summarized in [Table 1](#).

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