Introduction

A doctor will usually ask a patient about lifestyle, job and exercise to understand the factors that may affect the patient’s health. Although often helpful, new research suggests that such questions may be outdated by decades. Indeed, our current lifestyle does affect our health and well-being, but risk factors during early development can exert a much more profound effect on disease risks and organ functions.

Text Box 1. Examples of stressors that can impact on early development.

Stressors that may adversely affect early development:
- Nutritional imbalance
- Environmental chemicals
- Tobacco smoke, alcohol, drug abuse
- Pharmaceuticals
- Psychological stress

For many years human development was thought to follow a hard-wired genetic programme that was not much affected by outside influences. It is now understood that development is plastic, which allows the developing foetus and the small child to respond to the surrounding environment (1). This plasticity is essential for normal development, but may also result in dysfunctions or set the scene for enhanced risk of disease later in life. The best documentation exists for maternal alcohol use, tobacco smoke, nutritional imbalances and certain pharmaceuticals and other industrial chemicals (see Text Box 1). For example, prenatal exposure to methylmercury from contaminated seafood can result in delayed cognitive development with effects that can persist into adulthood (2).

Implications

The new insight suggests that preventative measures that improve maternal health in the short term will have important long-term effects in the child by significantly reducing disease incidence (Figure 1) (3). Thus, early interventions have a much higher rate of return than interventions put into place at a later time.

One additional aspect of recent research is important. A major mechanism for the developmental programming involves chemical modification of the DNA, for example, via methylation. Such epigenetic changes can be induced by a variety of environmental stressors and it is now clear that they can be transmitted transgenerationally, thereby affecting future generations (4).

Human studies have shown that environmental toxins, poor nutrition and compromised maternal metabolic status in early intrauterine life increase the risk of metabolic disorders and cardiovascular disease in adulthood. Interventions during pregnancy, if properly timed, can therefore have a large impact on the developing child and significantly affect the risks of noncommunicable diseases (NCDs) throughout their lifetime. Figure 1 shows that a timely intervention in early life can generate substantial reductions in a person’s risk for chronic disease and is markedly more effective than adult intervention.

Early intervention is key

With this new evidence in mind, we need to adjust our current prevention focus in order to effectively impact disease risk much earlier and create a significantly positive effect on the next generation’s lifelong health. There needs to be a much greater emphasis on implementing preventative measures early in life, when they can do the most good, rather than waiting to remedy the symptoms once a disease has manifested in adulthood.

A key focus of these prevention programmes must be education and public awareness, as illustrated, for example, by the successful reduction of the foetal alcohol syndrome incidence. In a wider sense, maternal perception of risk from environmental hazards is one of the most important factors to safeguard an unborn child (5). Thus, existing maternal-child health platforms that could be used to educate women include those in place at a physician’s office and obstetric wards where education is already given during routine prenatal and postnatal visits. Further, new biomarkers of stressor exposures (such as the hair-mercury concentration) are available for application to identify pregnancies at particular risk, where additional prevention efforts may be warranted.

Still, access to healthy food items and exposures to industrial chemicals constitute stress factors that may be difficult for individual families to control. Thus, strengthened public efforts are needed, where emphasis should be on protecting the most vulnerable life-stages, i.e., pregnant women and small children. Many countries have enacted regulations that protect pregnant women against occupational hazards. These efforts need to be extended to cover other environmental risks as well, starting as soon as pregnancy has been recorded, if not before.

A redirected preventative focus will require a significant reallocation of resources and policy needs to recognize that NCD development is not solely a matter of individual responsibility, as some risk factors require societal or governmental intervention (1). Putting new and effective health measures in place will be a challenge. However, the rewards are substantial.

NCDs constitute a major cause of death worldwide and contribute to almost two-thirds of all global deaths (6). As with many other diseases, the poorest and most vulnerable populations in each country are affected the most. NCDs such as diabetes and cardiovascular disease are widespread and often assumed to have a purely genetic or lifestyle-related cause. The recent advances in the field of epigenetics and developmental origins of disease have opened a new understanding into the effects of environmental stimuli during pregnancy and foetal development. This new paradigm therefore offers hope that current rates of disease will not continue to increase and that revised prevention strategies will help restrain future health costs.

In addition, research findings by economists have concluded that the monetary
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Chronic disease risk

Life course

Adult-age intervention

Risk of NCD without intervention

intervention in early life

0-3 preschool

4-5 school

post-school

0 Rate of return to investment in human capital

Job training

Schooling

Pre-school programmes

Programmes targeted towards the earliest years

Protection of early brain development?

Rate of return to economic and social benefit with interventions at different stages of the life-course (7).

Figure 1. A life-course approach for disease prevention and effect on disease prevalence (3).

Figure 2. Rate of return of economic and social benefit with interventions at different stages of the life-course (7).

rewards are much greater with earlier intervention (Figure 2) (7). These findings are supported by calculations that focus on the protection of brain development against endocrine disruption chemicals, such as certain pesticides, during prenatal development (8). Researchers calculated that the accumulated costs to society from IQ losses due to toxic substances may reach a very large amount in terms of billions of euros per year.

Conclusion

Health policy and medical practice have long operated under the assumption that NCDs are caused by a combination of genetic and lifestyle factors and should be remedied in adulthood as symptoms appear. However, recent research has shown that the risks for many diseases can be significantly reduced by early interventions. To be most effective, some efforts may need to start during prenatal development. As global health costs are steadily rising due to the ever-increasing pandemic of NCDs, intervention against early-life risk factors will constitute a significant complement to current preventative programmes. While significant policy changes may be necessary to meet this need and improve overall health, calculations of the benefits involved suggest that such early-life strategies will result in substantial returns.

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References


Key messages

1. Maternal exposure to environmental toxins can have a significant effect on the developing child, even if the mother is relatively unaffected.
2. The risk of NCDs can be significantly reduced by prevention efforts during development and early childhood.
3. Prenatal exposure to environmental stressors can also cause dysfunctions, such as cognitive deficits and physical developmental problems that persist into adulthood.
4. Changes in health practice and policy are needed to address risk factors during early development and improve health overall.